An Ergonomic Operative Technique for the Pubovaginal sling

11/08/2017

By

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The last twenty years of continence surgery has seen the marketing of numerous midurethral slings which can be placed via a transvaginal, retropubic, transobturator, or mini-sling, minimally invasive approach. The efficacy for the original tension-free vaginal tape at 10 years' follow-up is above 80% - a great leap in success compared to suture bases, vaginal wall slings, or vaginal plication for prolapse. However, the midurethral sling is not a cure-all, as failure may require follow-up surgery, and complications with the Prolene mesh. I learned the pubovaginal sling procedure from attending workshops with Drs. Jerry Blaivas and Edward McGuire and have since gained faith in its long-term results. With a mean 12 years' follow up, I have attained a 73.4% cure rate. Cure rate is defined as no increase in pad weight following a 1-hour provocative pad test with an average cough leak point pressure less than 60 cm H_2O, and at least 250 mls in the bladder. Patients are also asked to cough 10 times in the standing position so we can monitor on a lit blue pad that no leakage is recorded. We achieved a same-day voiding rate of 83 percent. Achieving this standard may seem difficult, but it can be attained if the physician takes care with material selection, permanent suture, paravaginal dissection, and retropubic Space of Retzius dissection. Below, we describe our step-by-step technique.

Pubovaginal Sling Operative Technique

We start our procedure with the marking of our 2 centimeter by 12 centimeter Repliform cadaveric dermal fascia [Repliform, Boston Scientific, Natick, MA]. Hydrate the fascia for 20-30 minutes in normal saline with a hemostat placed on top to keep it submerged. After 20 minutes, it should be very malleable. However, recently I have found that the dermal fascia can be cut dry before hydration without any adverse circumstances. Most of this manufacturer's human dermal fascia described as 2 by 12 centimeters are actually 3-3.5 by 15 centimeters which is too wide and long. Last year I ventured to cut it dry before hydration and it was very facile. It is much easier to cut while it is dry so try to refrain from this practice of cutting after hydration I assure you it poses no risk to the patient's outcome at one-year follow-up with some 87 patients last year. Take and place the fascia on the reverse side of a kidney basin and use a metal ruler to mark a vertical 2-centimeter line, one centimeter from each of the two ends. The Repliform pieces are all of different lengths, so if it is 12, 14, or 15 centimeters, make the middle at 6, cut the extraneous material length after 12 centimeters, and measure the height, which is often 3 centimeters. Mark the height with a 2 centimeter horizontal line and cut by pressing a metal ruler over the line and applying pressure. Then, take a number 11 blade and slowly cut the extraneous length, followed by the height. This is important because 3 centimeters is too tall and will lead to too much bladder neck support and difficulty voiding. The length doesn't need to be more than 12 centimeters. Getting too long a sling can be seen in your suprapubic incision, and scarring may lead to voiding difficulties like urinary retention. This center line is never imbricated but used only to mark the midline of the fascia in preparation for placement.

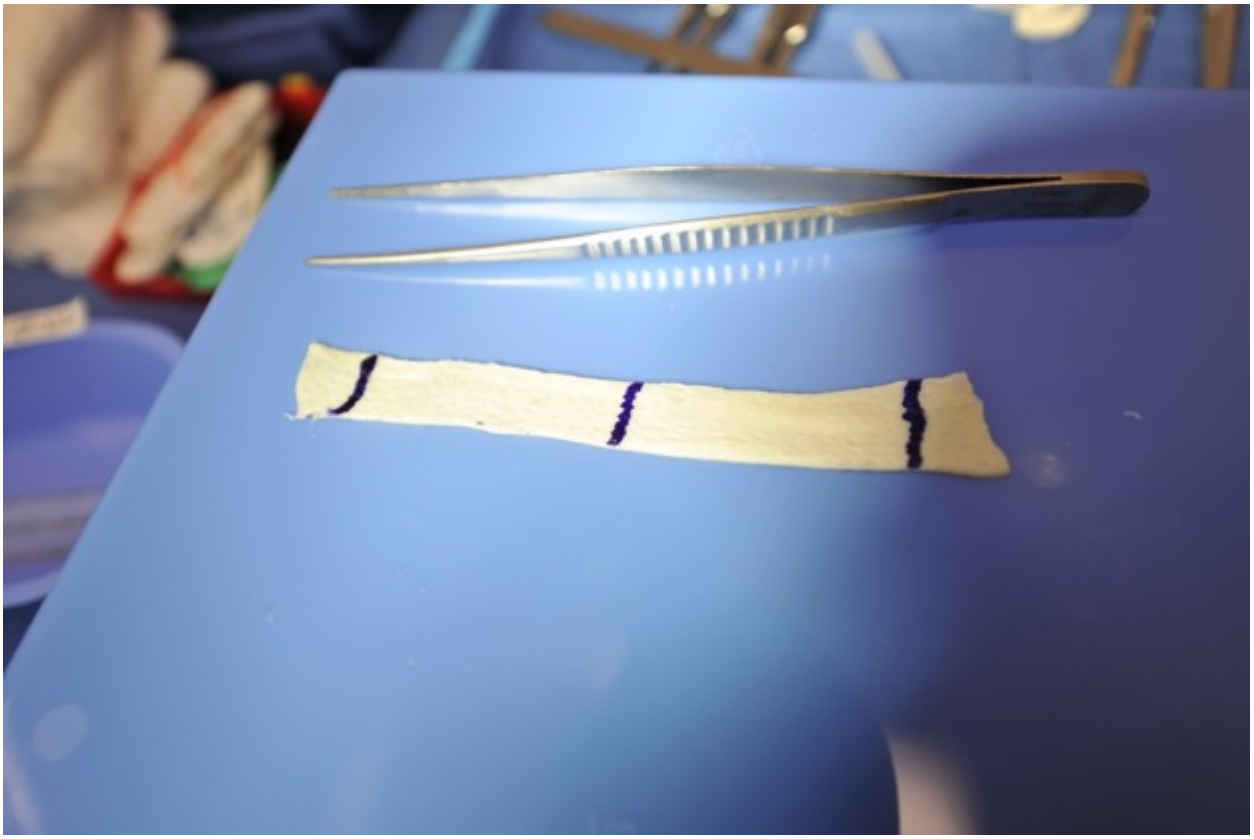

Figure 1a

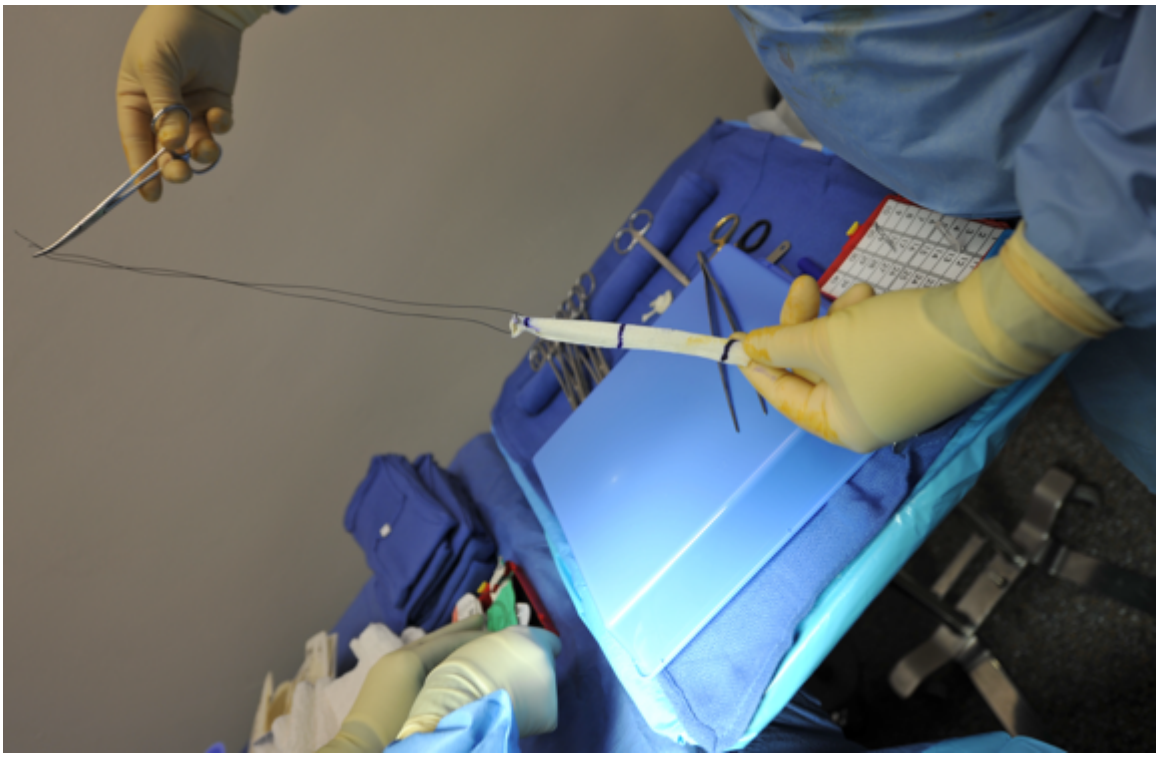

Figure 1b

Figure 1a & 1b. One end of the human dermal cadaveric allograph has had one side imbricated with number 2 nylon. One centimeter from both ends and the middle of the 2 x 12 centimeter fascia have been marked to define the sling center and delineate the area for suture imbrication.

Place the midline line on the front and back of the fascia so that, regardless of how it will lie on the periurethral tissue, you know where the middle of the fascia sling is as it is placed underneath the urethra. Then on each 1 centimeter end line from top to bottom, imbricate with number 2 nylon with a Heaney needle driver and a hemostat at the end of the nylon to control its memory. Number 2 nylon (not 2-0 nylon) suture has a lot of memory and is very difficult to control. By placing a hemostat at its end, you improve the maneuverability of the fascia. Try to apply the suture on this dermal fascial line from top to bottom, starting from underneath the fascia, then through the fascia, bringing the CT-1 needle entirely through the fascia. The second pass is from the

top and through the fascia 5-7 mm below. The third and last pass is from beneath the fascia, up and through it. Take your needle with a long Adson Brown (just medial to the 2 centimeter line) to gain more purchase as you take the suture through the fascia. Repeat the same process on the opposite side. The most ergonomic manner for time and reduction of blood loss is to start with the imbrication of the fascia, then make your 4-5 centimeter suprapubic incision, and finally your vaginal paravaginal dissection incision.

Next, palpate the pubic symphysis. Two finger breadths above the symphysis, draw a 5 centimeter horizontal line. If there is a prior horizontal incision, that too can be utilized instead of making two separate incisions. The skin is incised with a #15 blade, and the subcutaneous tissues are incised in the horizontal midline with cut and electro cautery at 20 watts down but not through the rectus fascia.

Figure 2. Ergonomic approach to minimize blood loss and operating room time starts with the dermal fascia hydration once the patient is in the room. Imbricate both ends with number 2 nylon. Then, starting 2 finger breadths above the pubic symphysis, create a 4 centimeter horizontal incision down but not through the rectus fascia.

Use a sponge stick to clear off a good view of the rectus fascia. The right and left corners of the rectus fascia are incised with electro cautery. Then, long Metzenbaum scissors are utilized to pierce through the Bovie rectus fascia incision to the rectus muscle to the pubic symphysis. Both of these incisions need to be the width of your index finger so you can later easily pass your finger through the incision, leaving the fingertip just below the superior border of the pubic symphysis. This technique is important. Empty the Foley catheter to decompress the bladder. Place the Metzenbaum scissors in your dominant hand into the right and, later, left corner of your incision, with a perfect vertical line being 0^0. Angle the tip of your Metzenbaum scissors 30-40^0 to the ipsilateral ischial tuberosity.

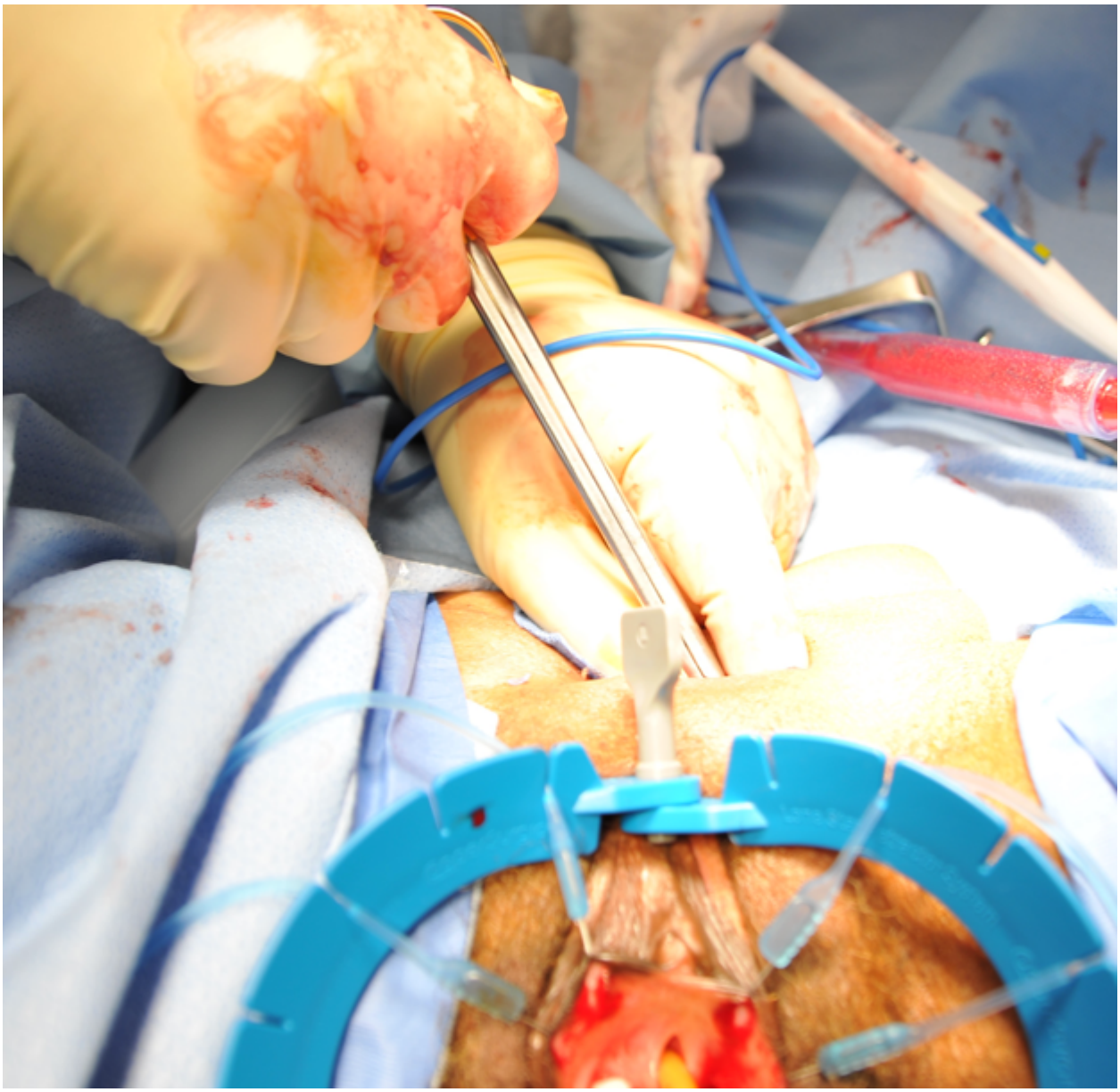

Figure 3. At the right and left incisional corners, the rectus fascia is incised with Bovie 1 centimeter in length. Metzenbaum scissors are used 300 off the vertical plane to perforate the rectus muscle and transversalis fascia to make direct contact with pubic symphysis bone and Space of Retzius.

The non-dominant hand is placed in the area of the Metzenbaum scissors' screw and held firmly to prevent anything more than a 1

centimeter piercing of the rectus muscle to the pubic symphysis. Then with your fingertip resting on the pubic symphysis, slowly open the Metzenbaum scissors in a horizontal plane. Turn the scissors 90^0 and again open them 2 centimeters in breadth. Close the scissors and retract them 1 centimeter. Again dilate with your Metzenbaum scissors in the horizontal and vertical planes and again retract in 1 centimeter increments until you are out. At this point, you should be able to easily place your dominant hand index finger onto the retropubic space. The 30^0 angulation prevents a bladder perforation. Repeat the same process on the surgeon's left side (patient's right). You must be able to place your index finger through the right and left rectus fascia incision to behind the pubic symphysis to ensure access is straight and wide open so the fascial sling will not get caught or suspended by extraneous connective tissue.

Vaginal Incision

We place a 16 F Foley catheter with 10 mls in the Foley balloon. Drain the bladder and place a heavy clamp on its end. Use a disposable Lone - Star Square retractor with blue hooks for labial retraction. Take care to place and remove these blue hooks with a hemostat. They retract easily when being engaged or disengaged from the Lone star and can slice through your gloved hand and finger. Apply blue hooks at the 1 and 7 o'clock positions first, so the Lone star is self-retaining in its position. Then, apply 11 and 5 o'clock, followed by 3 and 9 o'clock. The Foley balloon is palpated while traction is applied to the Foley's shaft. Determine where the anterior surface of the Foley balloon is and draw on the anterior vaginal wall a 3 centimeter horizontal line, followed by an additional vertical line in the middle of the horizontal line overlying the urethra approximately 2 centimeters. Why do we do this? Because our sling's dimensions are 2 centimeters high by 12 centimeters in length. Too much height or length can lead to voiding complications with dermal fascial redundancy. Pubovaginal slings are designed to provide two centimeters of bladder neck support versus midurethral

slings which apply one centimeter of support. This inverted outline is hydro-distended with 15-20 mls of injectable normal saline through a 20 gauge 5-inch-long spinal needle while bending the distal 2 centimeters in an L shaped configuration.

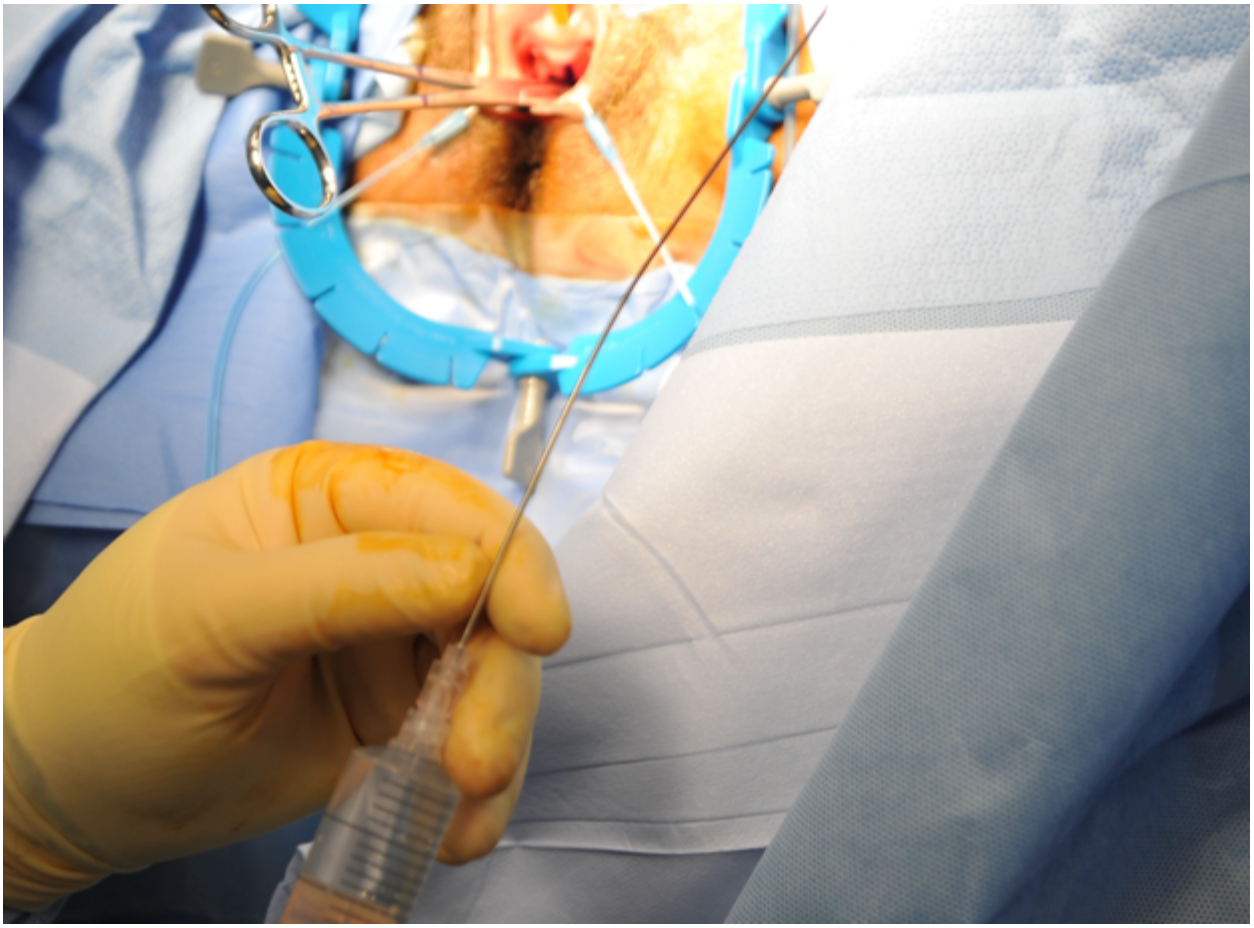

Figure 4. For vaginal hydrodissection, 20 milliliters of injectable normal saline are used. Marcaine or lidocaine with epinephrine is unnecessary. Also used is a 20 French 5-inch spinal needle, with the distal 2 inches of the needle curved to improved hydrodissection delivery.

The key with hydrodissection is to penetrate only 2mm deep at the end of the inverted T outline, with the bevel of the needle facing you.

Advance the needle halfway down the 2 centimeter vertical line and infiltrate the injectable saline slowly. If you are in the correct plane, you should meet resistance. If it flows too easily, you have either perforated the vaginal epithelium or you are in the urethra or bladder lumen. If you begin to get backflush around the needle, advance it another 5 mm towards the original horizontal line. If it gets harder and harder to infiltrate, you are in the correct plane and should see substantial blanching of the anterior vaginal wall surrounding your inverted T incision. You can now incise the vertical 2 centimeter incision about 4 mm deep and create right and left vaginal flaps.

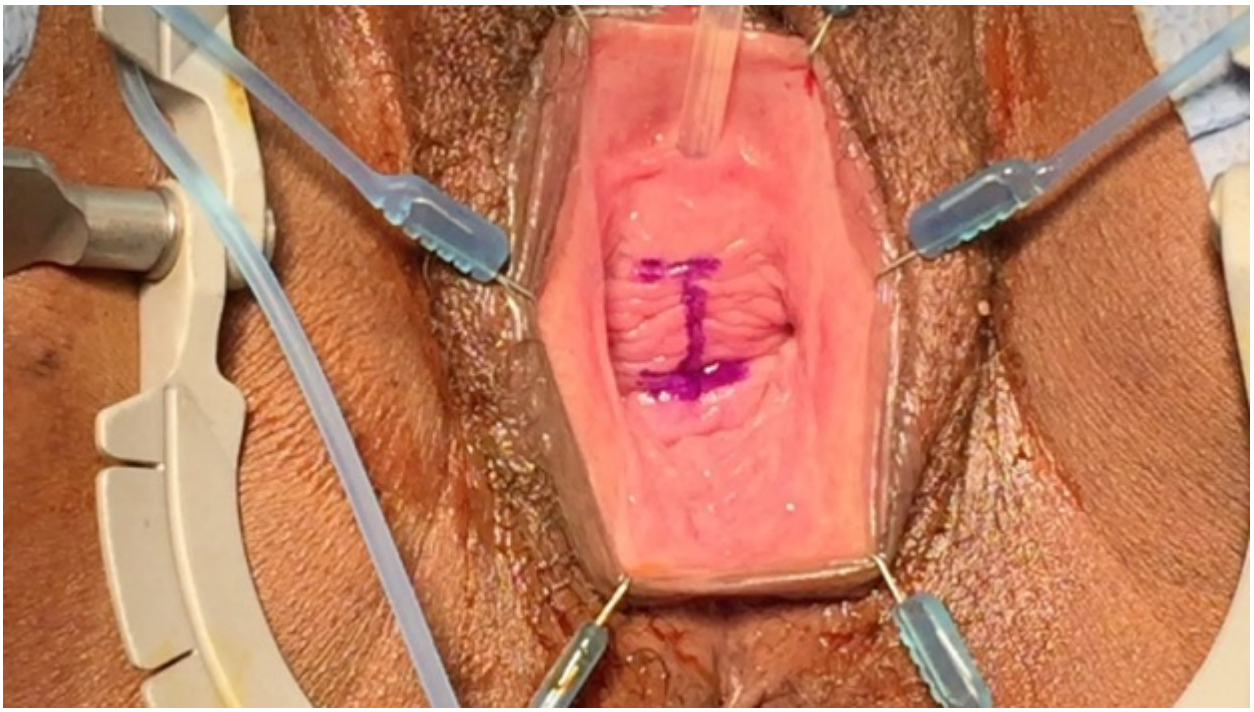

Figure 5a

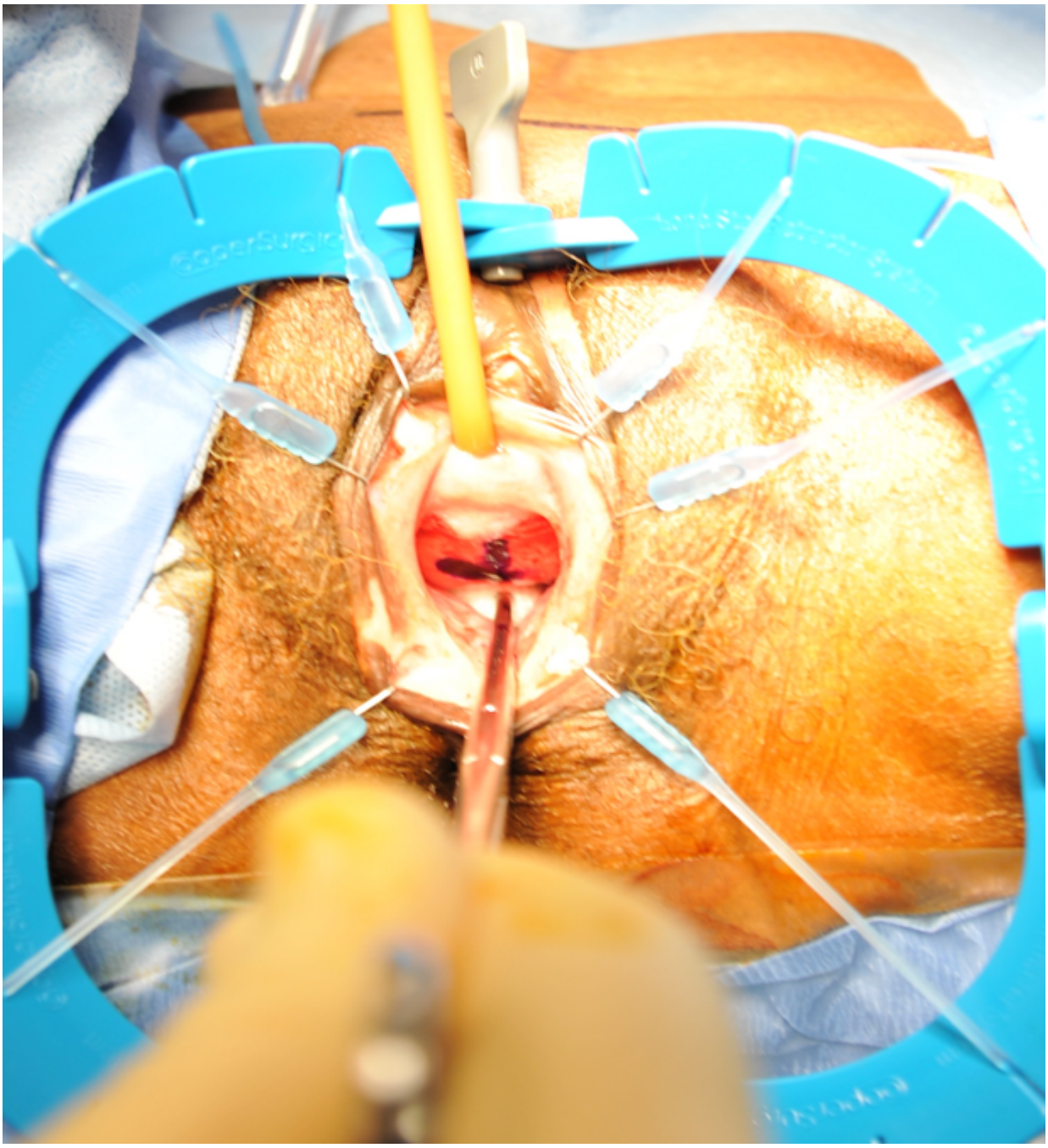

Figure 5b

Figure 5a &5b. A horizontal line is drawn on the anterior vaginal wall at the level of the anterior curve of the palpable Foley catheter. This is followed by a vertical line, 2 centimeters in length in the midline towards the urethral meatus. A #15 blade on a long handle is used for better maneuverability.

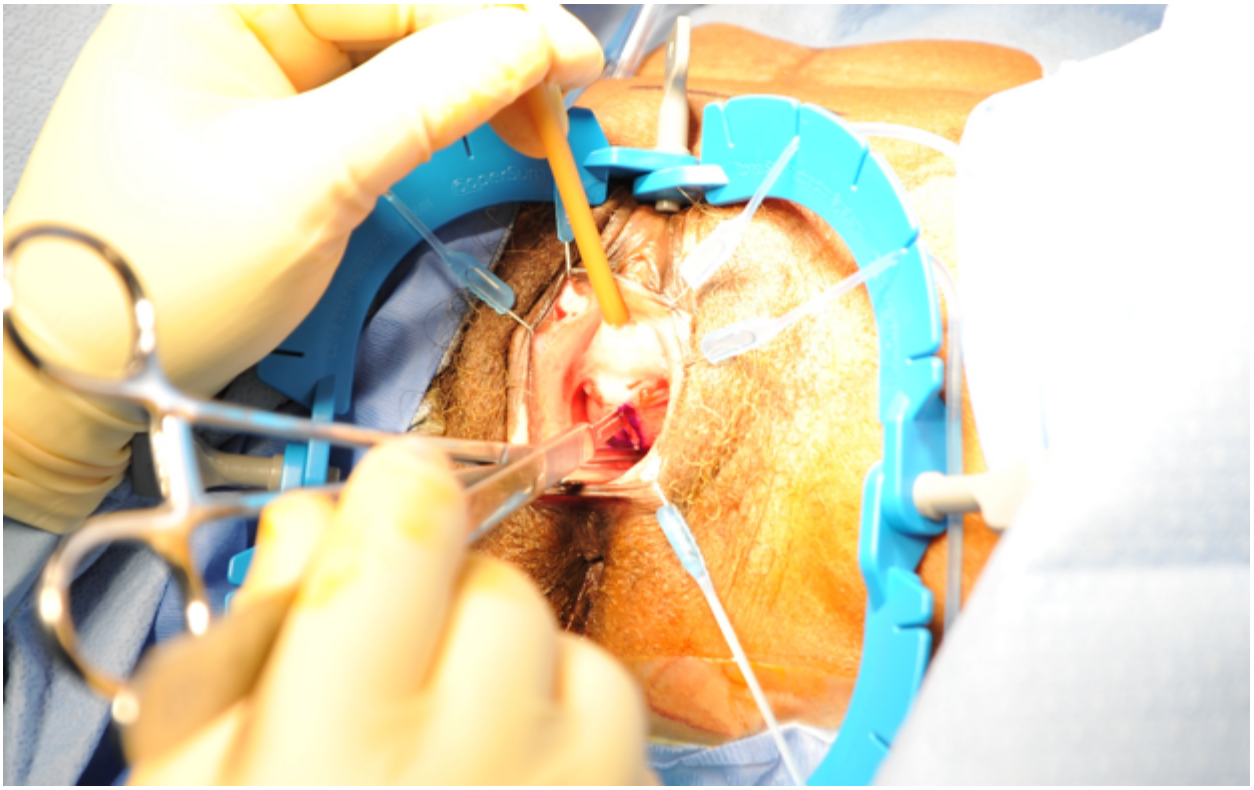

Figure 6. The #15 blade after making the 2 centimeter incision, 4-5 mm deep.

Place blue hooks on the flaps at the 1, 4 ,7 and 11 o'clock positions. Take the #15 blade on a long scalpel handle and place it at a 45^0 angle of the midline, aiming the tip of the blade towards the outside point of the ipsilateral shoulder. Slowly advance the entire length of the blade's length approximately 2 inches in a slow, meticulous manner, keeping the scalpel handle horizontal at 180^0 and perfectly vertical at 90^0.

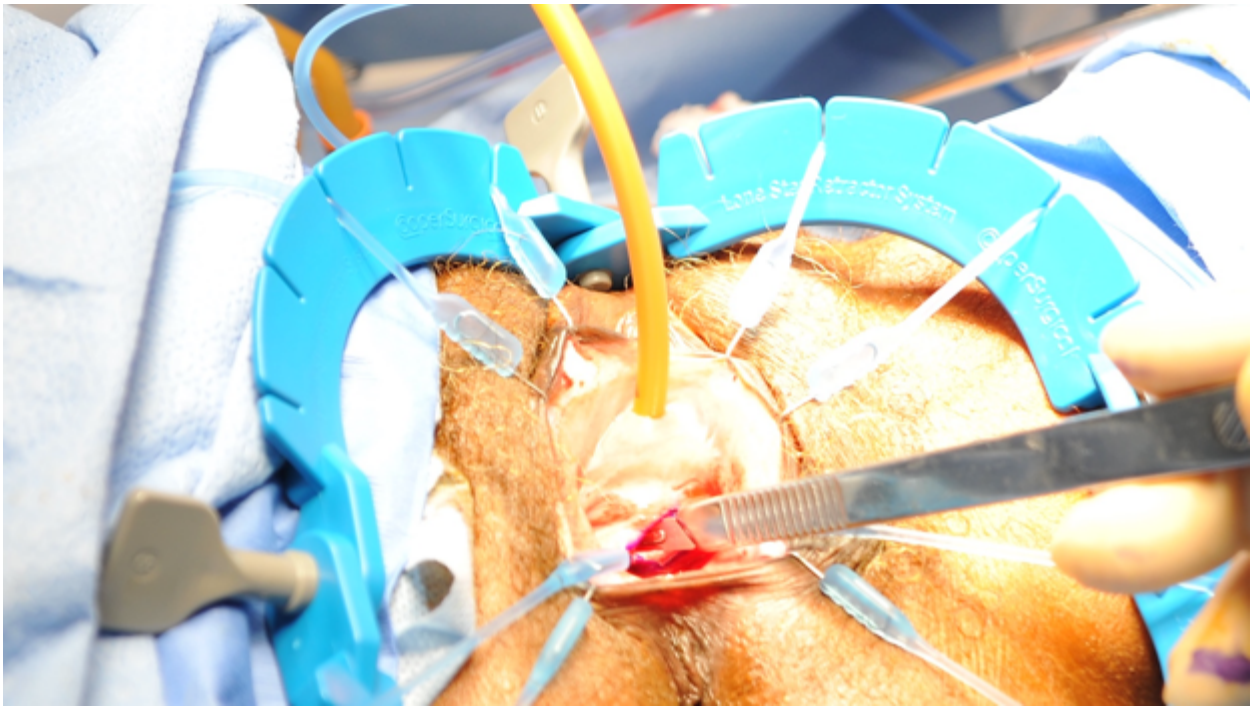

Figure 7. The paravaginal space is approached in the direction of the outside shoulder for the entire length of the #15 blade to create a tract that will later be dilated with the long Metzenbaum scissors.

Once you are at the end of the length of your needle, slowly and carefully remove the long needle blade from the incision. Take the long Metzenbaum scissors and find the tract, slowly advancing through the previous blade tract to its end. By the time you reach the long Metzenbaum scissor's screw, you are close to perforating the endopelvic fascia or have done so. Once perforated, you are free to

advance the Metzenbaum scissors. Continue to apply steady, slow pressure until you pierce through. Open the Metzenbaum scissors, keeping them horizontal and perfectly vertical. Any variation can lead to a cystotomy. Open the Metzenbaum scissors 2 centimeters, then slowly close them and retract back in one centimeter increments. Remember while retracting to completely close your Metzenbaum scissors. Retract another centimeter and perform the same process. By the 4th centimeter retraction, you are at opening of the vaginal incision. At this last dilation, see that your Metzenbaum scissors are spread apart enough to allow your dominant hand's index finger to easily enter the paravaginal space and up to the Space of Retzius.

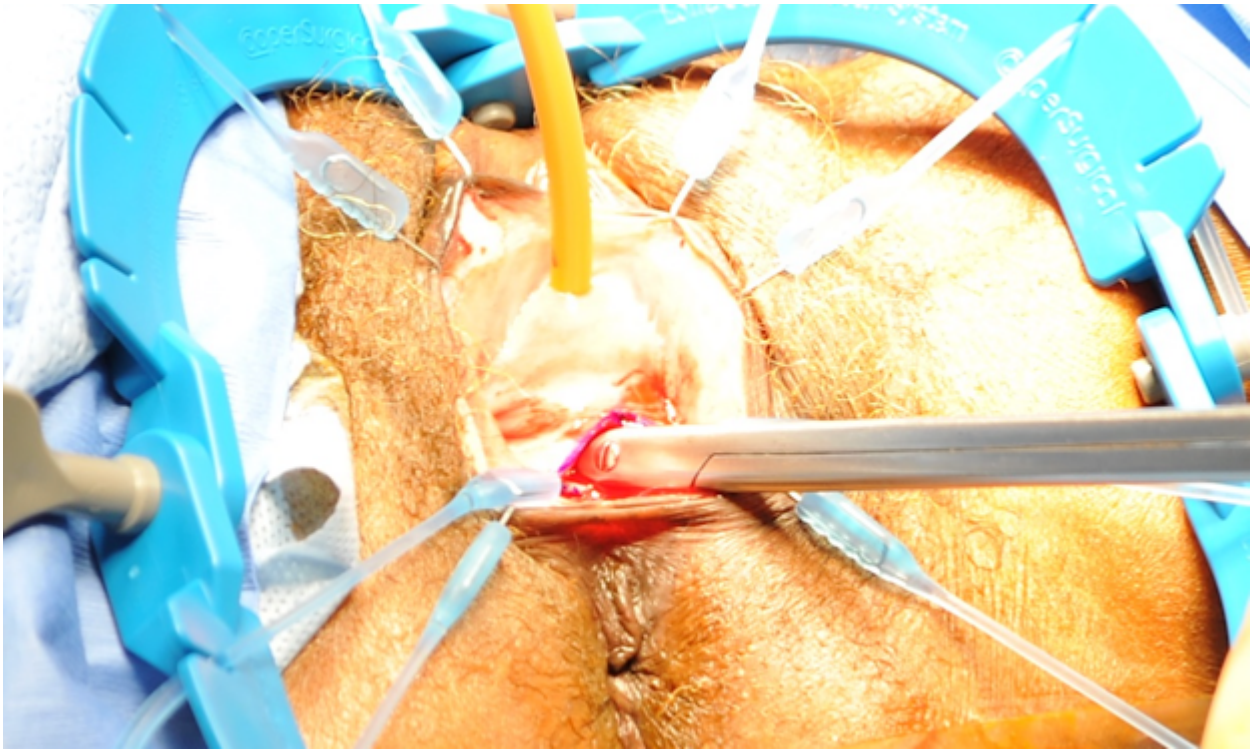

Figure 8. The paravaginal endopelvic fascia perforation plane is dilated with a closed long Metzenbaum scissors with slow, steady, advancing pressure. Once you reach the scissor's screw, slowly open the tip of Metzenbaum scissor at least 2 centimeters in a vertical plane. Only then

close the tips, retract your Metzenbaum tip one centimeter outward, and open the Metzenbaum scissors another 2 centimeters. Continue this process until you are at the beginning of your incision. Dilate the last area enough so you can place your dominant hand's index finger.

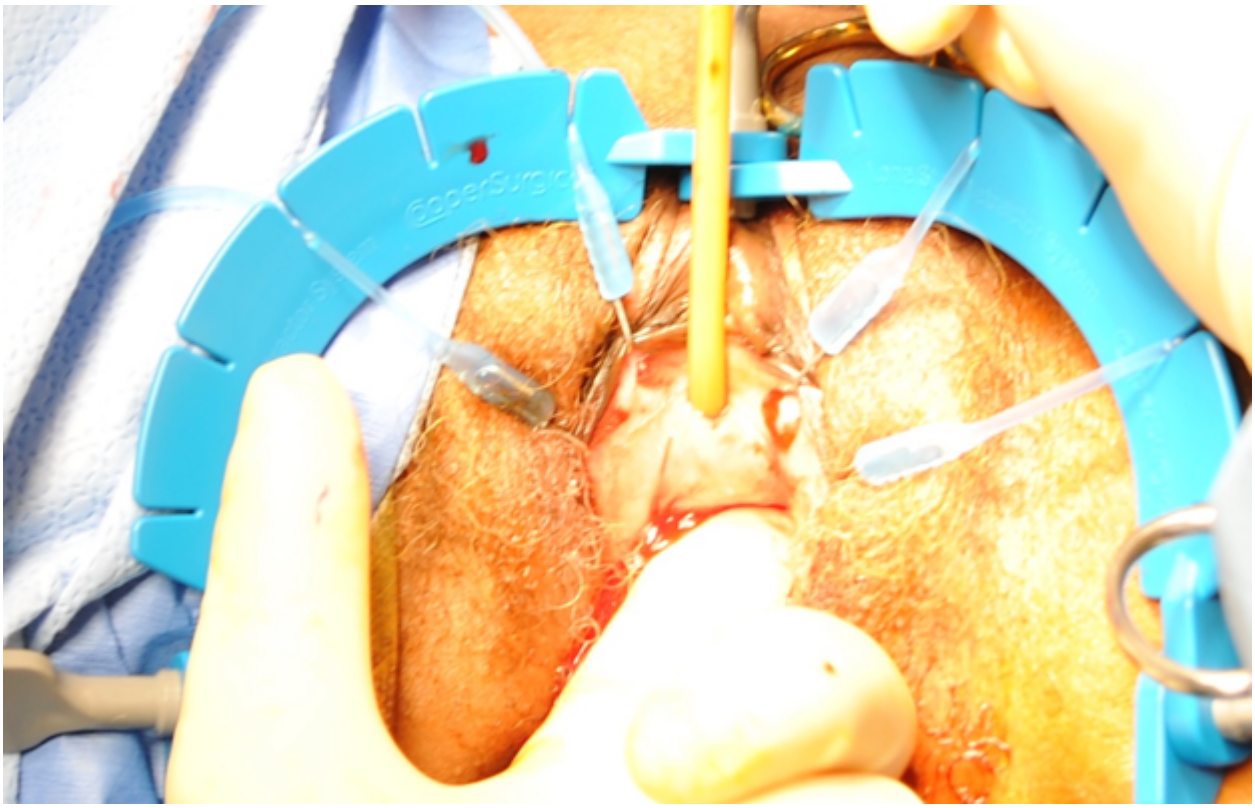

Figure 9. Place your nondominant index finger through the paravaginal tract and direct it to the cephalad suprapubic incision and toward your dominant hand's index finger in the suprapubic incision. Make sure they meet with ease.

Take your dominant hand suprapubically and place it through the finger-wide rectus incision. On the same side of the vaginal dilation, place your non-dominant index finger. You should easily be able to touch the index fingers of both hands behind the pubic symphysis. Next, take your dominant hand and grasp the 30^0 Stamey needle and place it through the suprapubic rectus fascial incision. Slowly and safely find your non-dominant hand's index finger behind the ipsilateral paravaginal side. Do not advance the Stamey needle until you can feel it on top of your non-dominant hand's index finger. Then guide the needle through the paravaginal pathway and out through the vaginal incision.

Figure 10. The 30^0 Stamey needle is advanced retropubically by your dominant hand and your non-dominant index finger in the ipsilateral paravaginal incision. Advance only until direct digital control of the tip of the 30^0 Stamey needle.

Never lose track of the Stamey needle. If you do, remove it and start again. Repeat the exact technique on the contralateral side with the same precautions. Soon you will have both your Stamey needles exiting paravaginally.

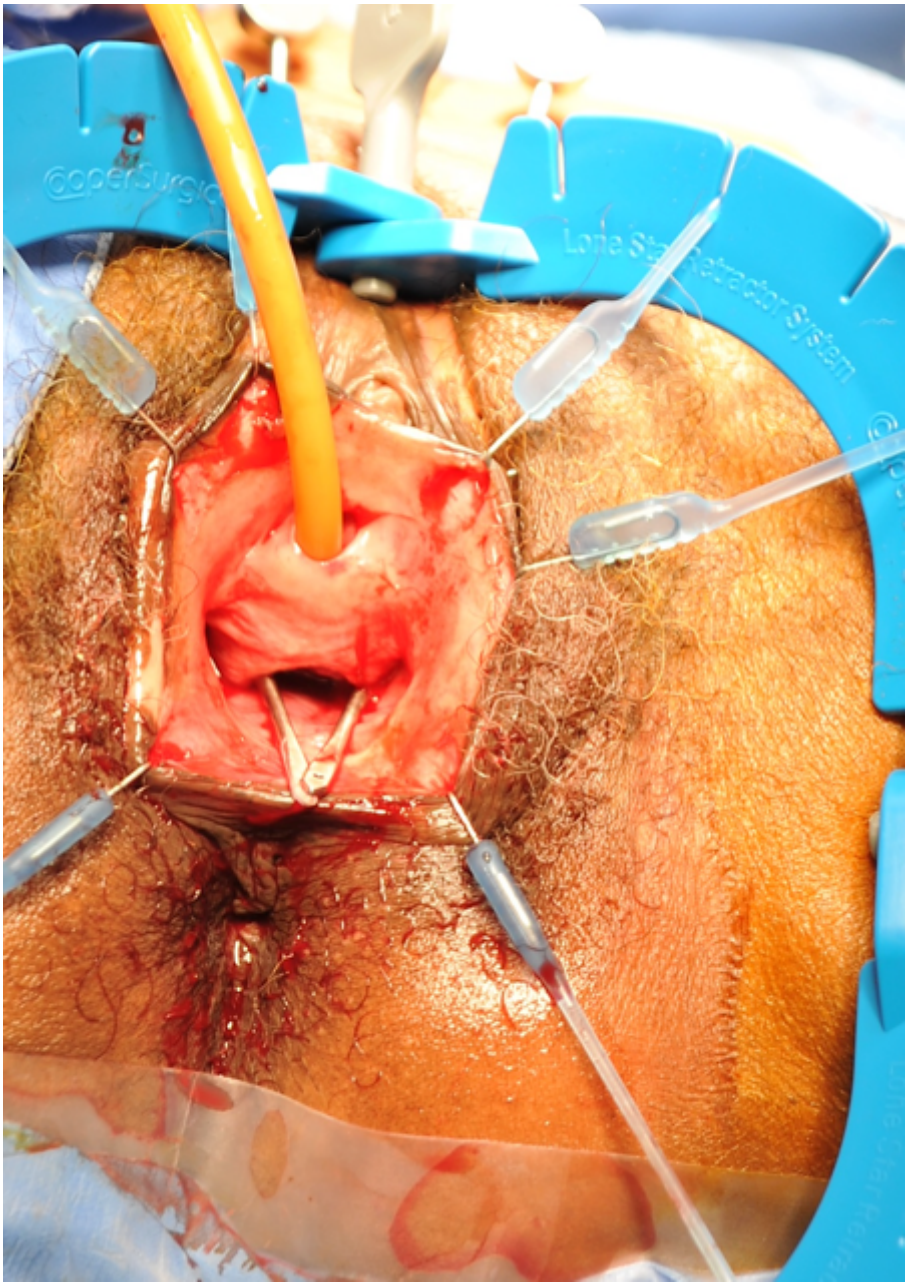

Figure 11. Both Stamey needles have been successfully advanced paravaginally. A colposcopy is performed to ensure no other anterior vaginal wall enterotomy has occurred.

Cystoscopy

Your cystoscopic technique is important. With both Stamey needles in place, carefully look at the urethra and bladder neck. If you feel an obstruction on either side, it is the Stamey needle having caught the bladder neck. Carefully remove and reposition the needle on the affected side, so the obstruction is no longer felt.

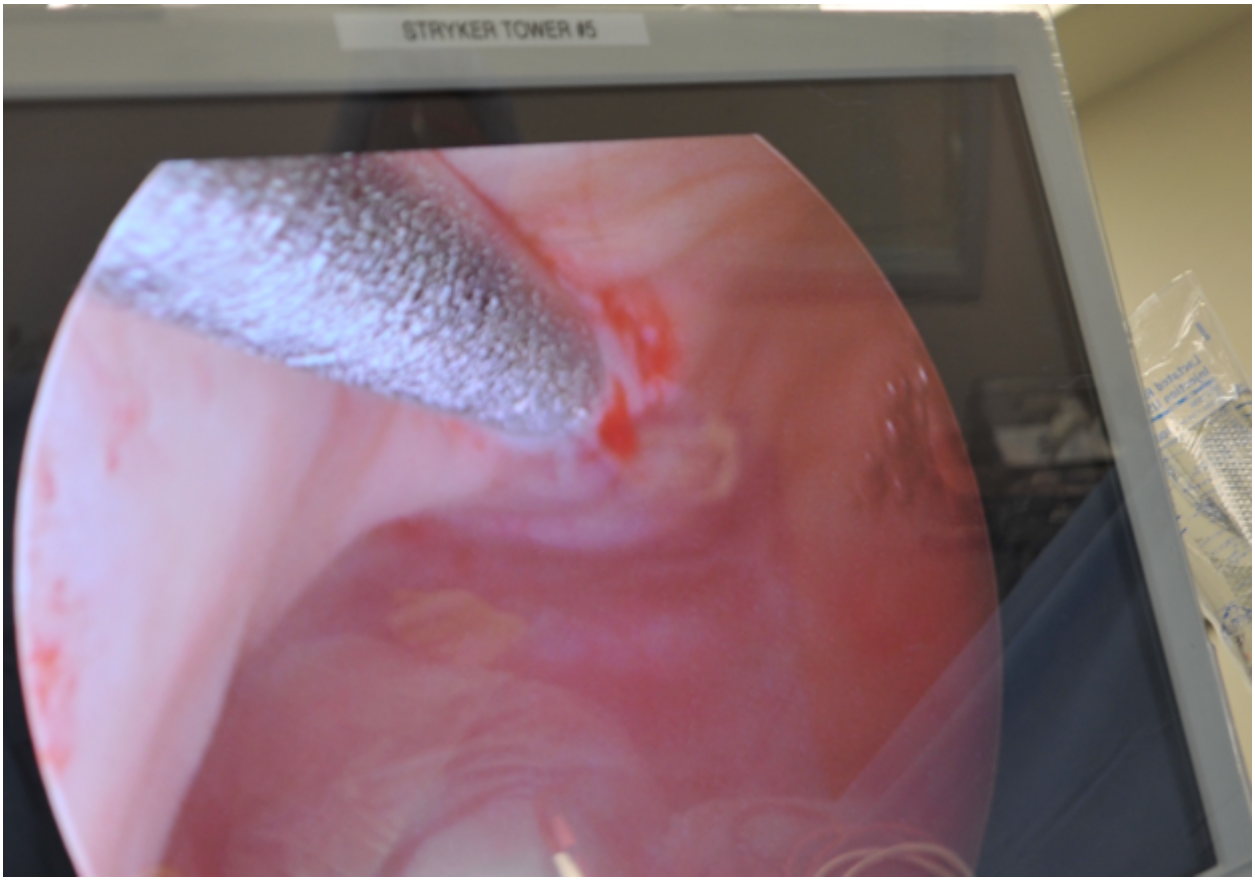

Figure 12. Demonstrated here is the result of advancing the Stamey needle without complete digital contact of the Stamey needle's tip.

When placing the cystoscope, if you immediately feel an impediment on the right side of the bladder neck. The right sided Stamey must be removed and repositioned.

Once in the bladder, check for a good efflux of urine from each ureter. Then look to the dome and assure that no stainless steel is penetrating or outlining the mucosa. If demonstrated, remove the suspected Stamey needle under direct vision. Then empty the bladder and place the Stamey needle as described before. If there is no bladder or urethral obstruction or bladder perforation, it is safe to proceed to the sling placement on both Stamey needles. It is important to look for bleeding, as this usually indicates a perforation or cystotomy. The Stamey needle perforation does not require the prophylactic placement of a Foley. In 17 years of rare cystotomies (and not leaving a Foley), I have not incurred surgical complications.

I recently changed dermal fascial right and left imbricating stitches from 0-Prolene to Number 2 Nylon because, if the patient has continued stress incontinence with 200 mls in the bladder after 6 weeks, revisional surgery can easily be performed. The problem with 0-Prolene surgical knots is that tightening can lead to disintegration of the stitch, requiring a repeat of the entire operation. Number 2 Nylon knots can easily be undone with a fine tip clamp, Keith needle held with a small needle driver, or a free Mayo needle on a needle driver. The Nylon has not been torn or compromised, and tightening can be performed with minimal effort.

The human dermal fascial sling is grasped with the right and left hemostats placed at the end of each Nylon suture. The Stamey needle has an eye near the tip. Both right and left-sided ends (2 inches) of each suture are placed through the surgeon's right and left Stamey needle,

advancing them separately cephalad until the Nylon suture is retrieved. The hemostat clamp is then placed at the end of both sutures.

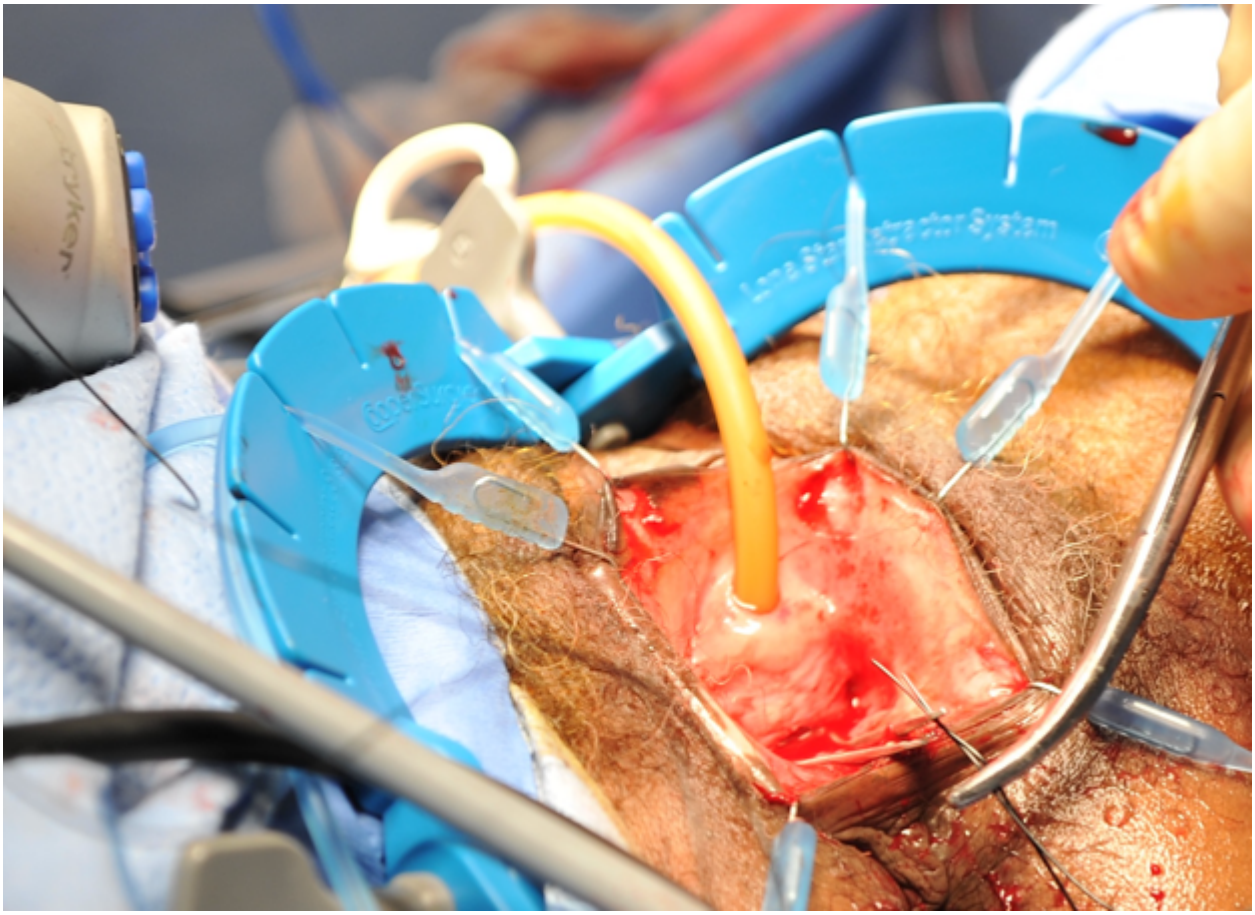

Figure 13. The one-sided suture ends are placed through the eye of each Stamey needle. Advance just 2 inches of the suture through the eye of the needle.

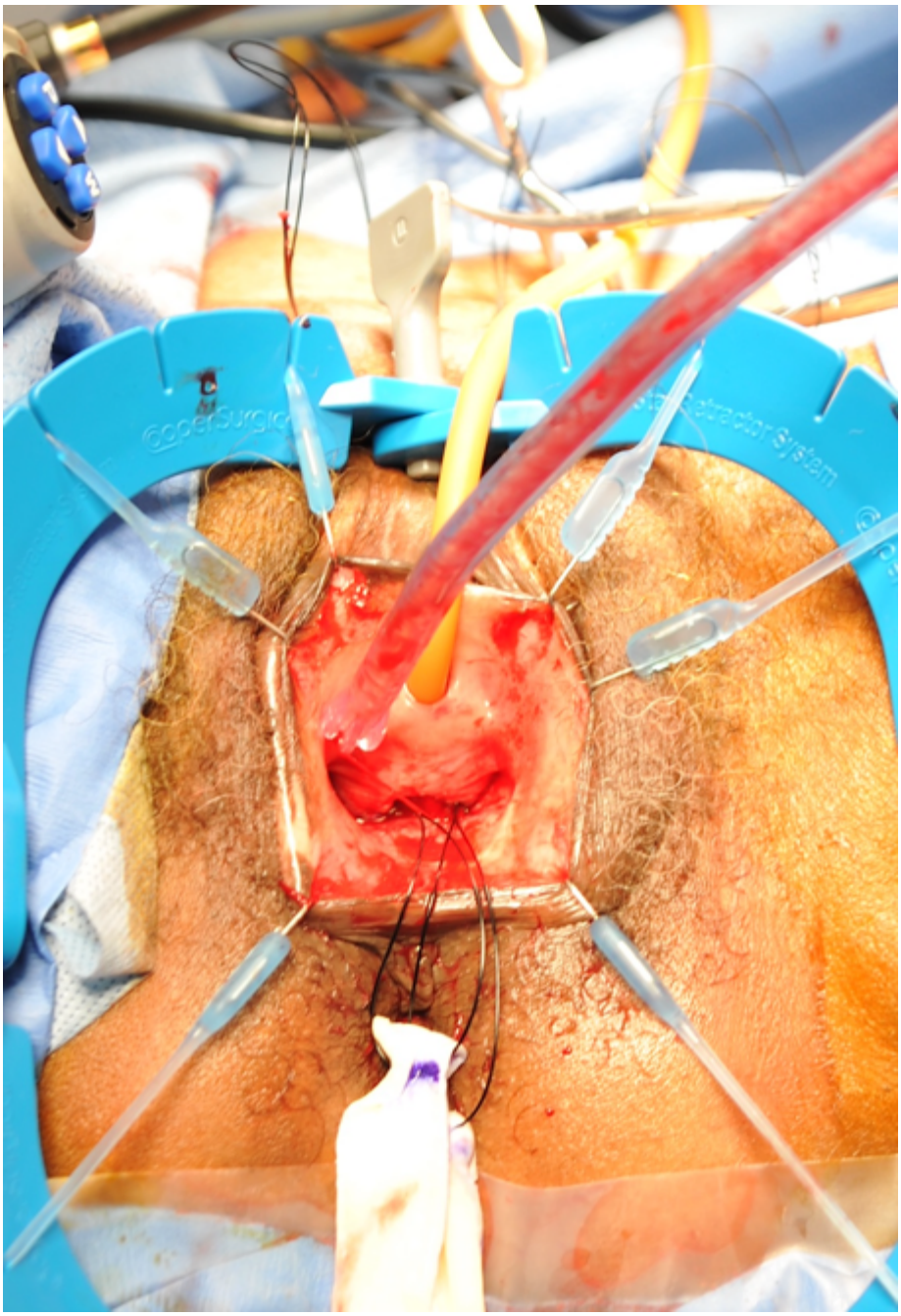

Figure 14. Both sutures have been run through the Stamey needle and advanced retropubically. The sling lies well centered.

Next, since the paravaginal incision and retropubic dissection are very wide, the sling should swing right to left, until its full length traverses end-to-end freely without obstruction. Obstruction means the affected side needs to be dilated with the Metzenbaum scissors so it will move without obstruction. To do this, take the sling off the affected side and remove the corresponding Stamey needle. Re-dilate first suprapubically down to the pubic symphysis, then paravaginally. The dominant hand index finger placed suprapubically and non-dominant hand placed paravaginally need to meet easily without obstruction. Slow, methodical dissection will achieve this result. Take the middle mark of your sling and secure the superior top to the midline of the midline paravaginal tissue, so the sling is easily and evenly placed. You do not want the right and left sling arms to be uneven because this can compromise compression of the bladder neck lumen. Evenly dispersed coaptation is the objective, although this is my opinion and is unproven in the literature. The suture used to separate and position your sling evenly is a 2-0 PDS to provide a longer-term directional support. The vaginal wall is then closed with 3-0 Monocryl with a running, locking fashion.

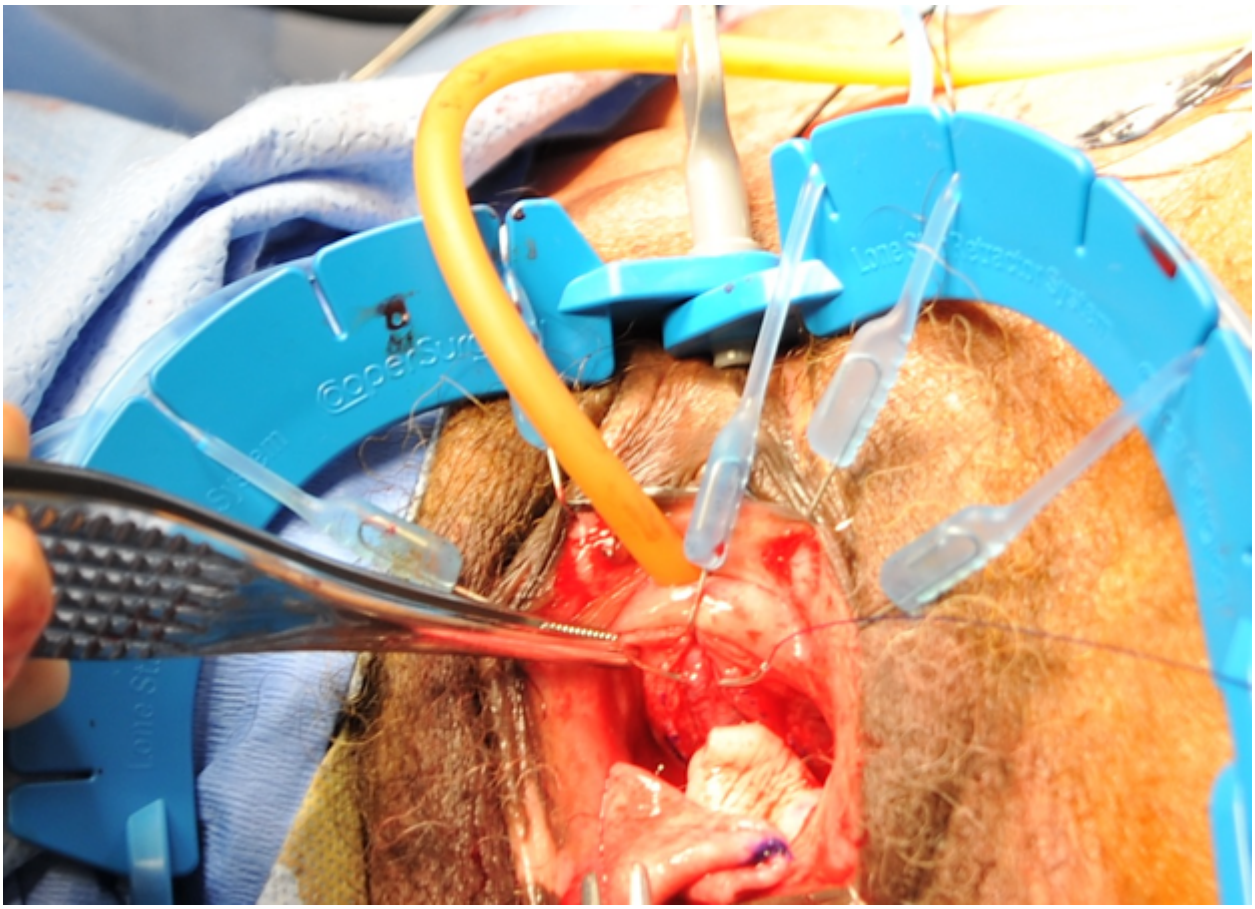

Figure 15. The midline of the sling is secured to the undersurface of the urethra with a 2-0 PDS stitch. The Foley is drained, filled to 240 mls with normal saline, and then removed.

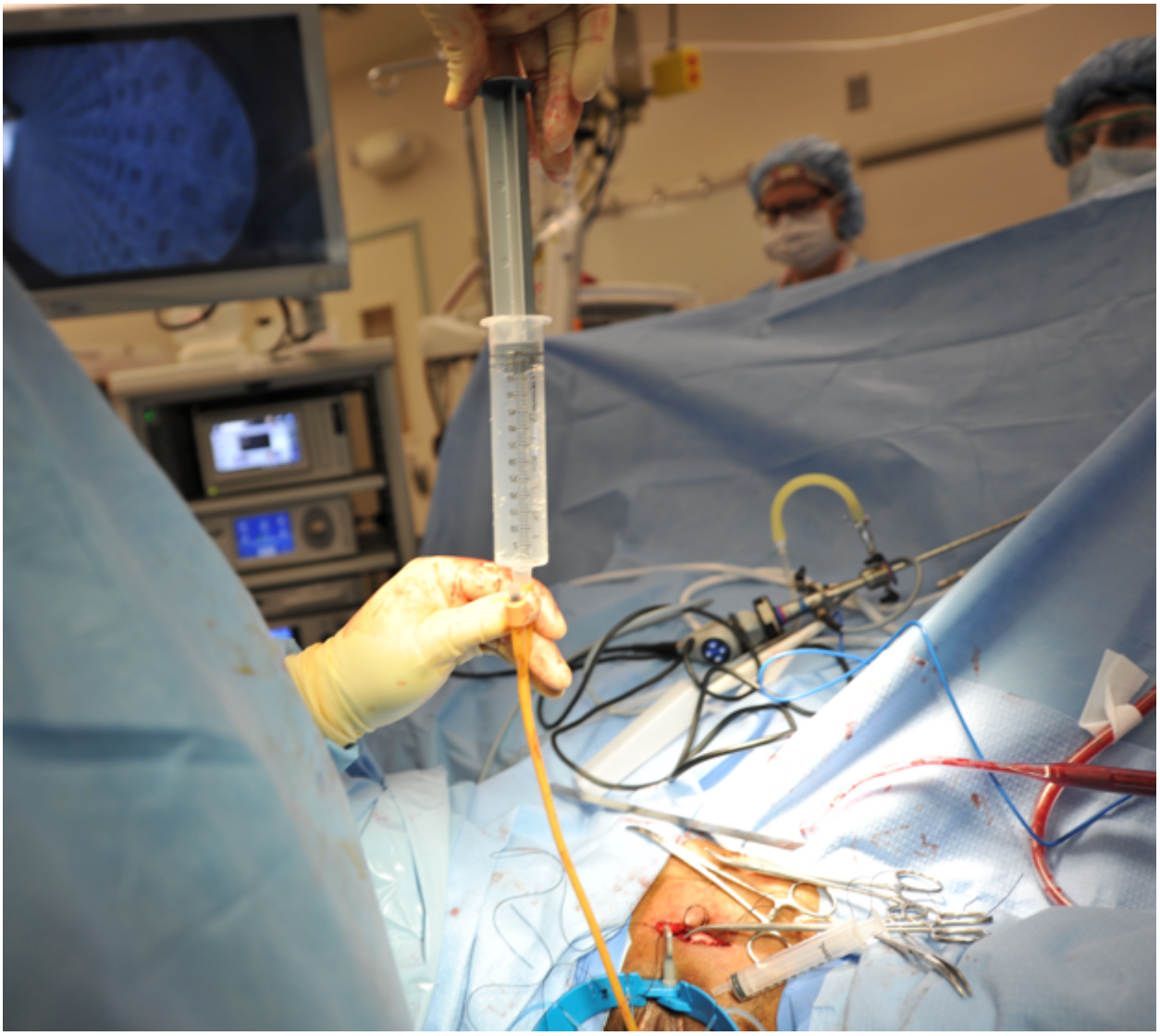

Figure 16. The bladder is drained so there is no residual urine. Then the bladder is filled with 240 milliliters of normal saline slowly to decrease the chances of stimulating a bladder contracture.

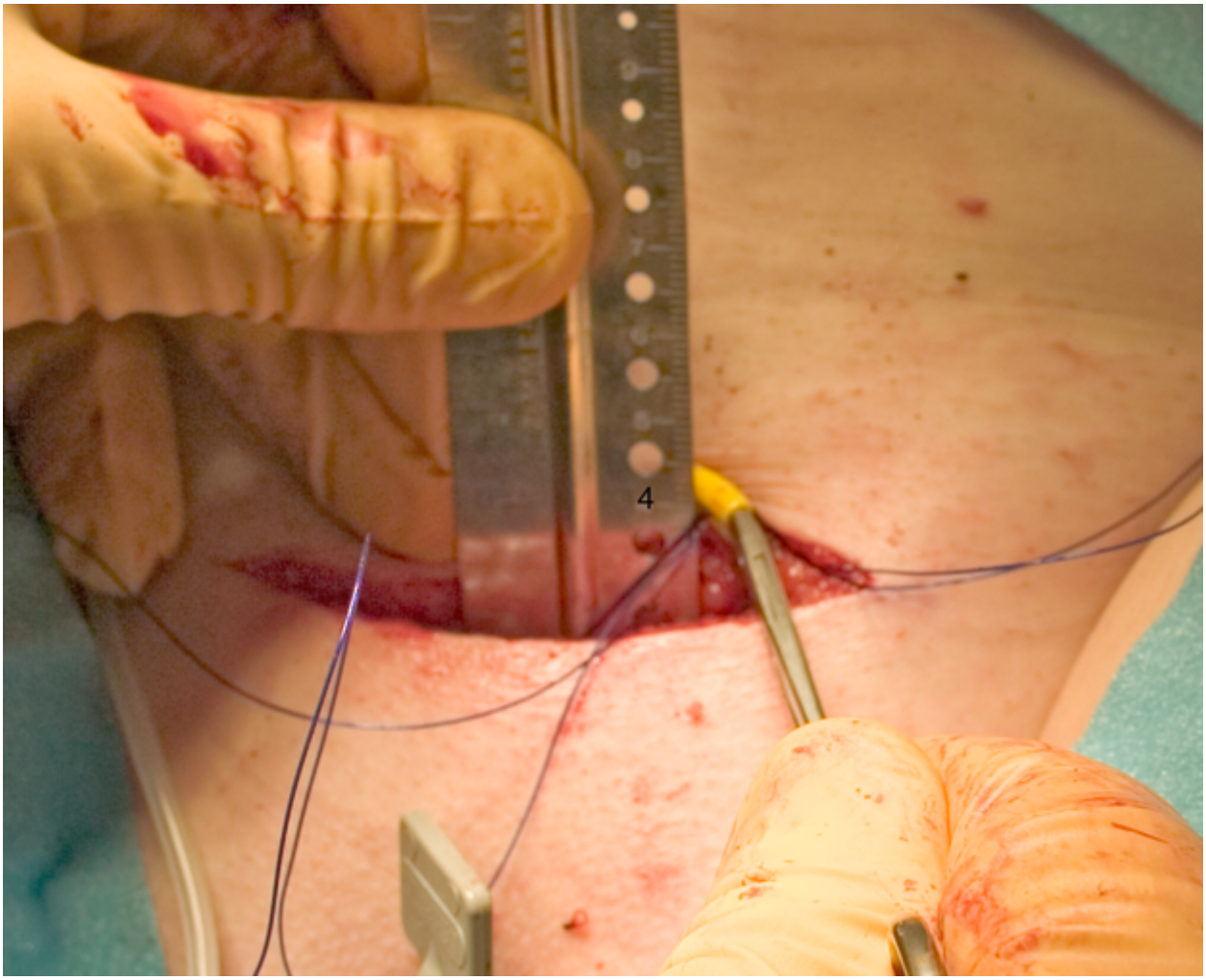

Figure 17. Sling length is started at 6 centimeters with a Beckman clamp tightly pressing to the operating room ceiling to avoid redundancy in sling length calculation. Here, the patient had failed a 6 and 5 centimeter sling length. Finally, with a 4 centimeter length, she did not leak with 10 consecutive coughs.

If this exceeds the bladder capacity, let the extra volume run out effortlessly and proceed as follows. The suprapubic ends of the Number 2 Nylon stitches are then tied in the midline with one surgeon's knot. The height of this knot is 6 centimeters above the pubic symphysis as determined by our metal ruler and using a Beckman

clamped to the surgeon's knot. You must tent this clamp to the operating room ceiling as tightly as reasonable possible. This is the only easily performed, reliable manner for setting sling length. We start with the bladder neck sling length at 6 centimeters, but in the figure above, the patient required a 4 centimeter sling length. You should also see improved bladder neck support on cystoscopy.

Figure 18. The bladder neck was wide open and now, after sling length determination, the bladder neck looks similar to a man's trilobar prostatic hyperplasia.

The anesthesiologist is given a 10-minute warning as the sling is being passed through the Stamey needles. We do not use regional anesthesia because the cough produced is roughly an abdominal pressure of 40-50 cm H_2O while a cough-induced spell under general anesthesia produces an abdominal pressure over 100 centimeters H_2O. The anesthesiologist simply lightens the anesthetic, grasps the endotracheal tube, and administers a gentle cephalad tug until the coughing spell begins. An alternative method is to lighten the anesthetic and place a suction device inside the endotracheal tube to mildly irritate the airway and induce a series of coughs. Place your non-dominant hand on the patient's abdomen during these coughing spells to determine a strong cough from a light cough. Observe the external urethral meatus as 5-10 consecutive strong coughs are administered. If no leakage occurs, it is safe to assume the operation will work. If leakage ensues during the coughs, decrease sling length in one centimeter increments until no leakage occurs with 5 – 10 coughs. With either instance, if there is no leak, Crede the bladder to see if you have a straight stream and no spraying of the stream which can mean the sling is too tight. If it is too tight and spraying is evident on Crede, increase the sling length by one centimeter increments until there is no leakage with 5-10 coughs and no spraying of urine with a Crede. Carefully drain the bladder. There is no need for a Foley catheter except in the instance of unexpected bleeding or other minor operative complication. When a Foley is left in, it is removed early the next day in the office and an ultrasound post-void residual performed some 3-6 hours later.

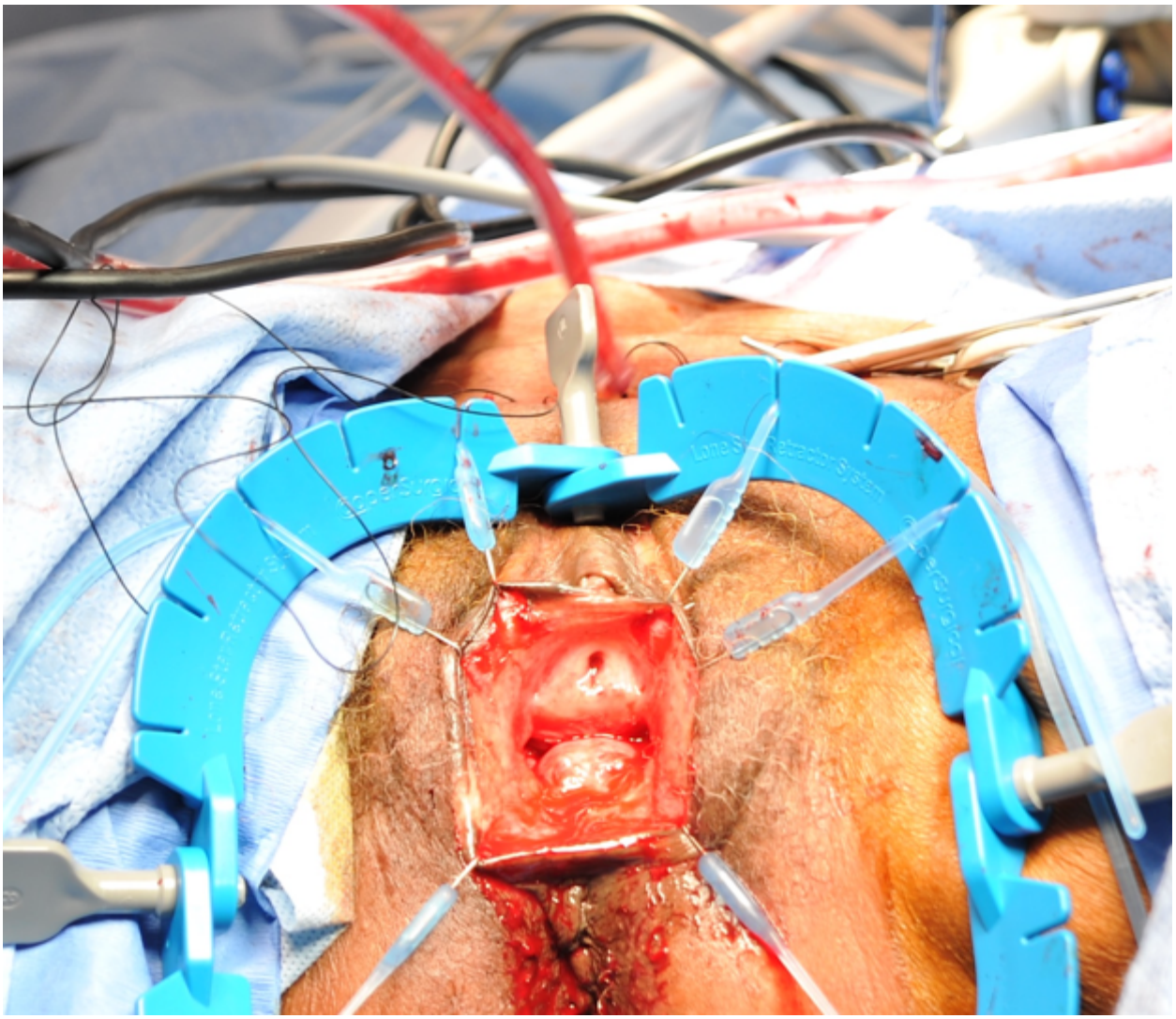

Figure 19. After 5 - 10 consecutively induced coughs and with the head of bed as upright as possible, there should be no leakage of urine.

Close the deep layer of subcutaneous tissue with running 3-0 Chromic and the skin with interrupted, subcuticular 3-0 Chromic followed by a Tegaderm dressing and no Dermabond. Remove the dressing at 72 hours. Post-operatively, the patient is sent home with a 5-day course of antibiotic of choice, narcotic pain medication, and stool softeners. Call the patient at 8 – 9 p.m. to see how well she is voiding. If the patient complains of inability to void after 4 – 6 hours (suspected urinary retention), send her to the hospital emergency room with a

prearrangement for a quick 14 French Foley catheter placement. Remove the catheter the following morning in the office and perform serial ultrasound post void residuals to confirm emptying. Immediate post-op, post-void residual urines of less than 75 mls are considered normal. Currently, with the above described technique in a polyglot patient population, we are seeing an 87% same-day voiding success rate. Our Urethrolysis rate is 2-3%. My success rate with a minimum of 10 years' follow-up is 73.4% with a 1-hour pad test with 200 mls in the bladder and a mean pre-operative cough leak point pressure of less than 60 centimeters of H_2O pressure.

Urethrolysis

A Urethrolysis is necessary if, after 4-6 weeks, voiding with a post-void residual urine of less than 100 milliliters is not consistent. If the decision is made to perform Urethrolysis, we recommend starting by reopening the suprapubic incision and completely untying the Nylon knots. Reopen the vaginal incision after hydrodissection of this plane. Find the sling with a right angle and determine where the blue 2-0 PDS knot is. Cut it with a #15 blade. Place the right angle clamp behind the sling just lateral to the urethra and dissect laterally on the right and left sides. Then slowly and methodically approach the midline of the sling and urethra. Slowly mobilize with your right angle and Metzenbaum scissors until the entire sling is completely free from the left to the right vaginal edges. Place the right angle clamp on your right-sided Nylon suture paravaginally, and tug toward you. It should move with mild force, and the untied suture should come back to the paravaginal space. Perform the same on your left side. Discard the entire sling. It is safe to perform a salvage pubovaginal or midurethral sling after Urethrolysis, but try to discover why the retention episode has

occurred. Usually on one side or the other, the sling was non-dynamic and stuck in the edges of the connective tissue or fascia and was not discovered at the time of the original surgery. That is why a wide open index finger width is necessary paravaginally and suprapubically through the Space of Retzius.

References

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