

Trunk And Perineal Reconstruction

Male-to-Female Gender-Confirming Surgery

Shane D Morrison, MD, MS, Stelios C Wilson, MD, Marcelina G Perez, Medical Student, Thomas Satterwhite, MD

Gender affirmation is recognized as one of the optimal treatments for gender dysphoric individuals, who experience marked distress from the discrepancy between their gender identity and assigned sex.^{1,2} The care of transgender patients requires a coordinated multidisciplinary approach to support changes to primary and secondary sex characteristics through hormone therapy and surgery.^{3,4}

The World Professional Association of Transgender Health (WPATH) establishes the standards of care (SOC) and criteria for initiation of surgical treatments followed by most medical professionals caring for transgender patients [*see Table 1*].⁵ Prior to surgical treatment of male-to-female transgender individuals, the diagnosis of persistent gender dysphoria should be established and a referral from a mental health professional should be obtained for chest surgery, whereas two referrals are recommended for genital surgery. Additionally, the patient should be of legal age, have capacity to consent, and have significant medical or mental health diagnoses well controlled. A real-life experience, during which the patient lives as the gender congruent with the patient's true gender identity while taking feminizing hormones, is recommended for a minimum of 12 months before surgery. This period allows for social adjustment and maximizes breast growth to optimize aesthetic results.

Table 1 WPATH Criteria for Initiation of Surgical Treatment in MtF Patients ⁵	
Breast Augmentation	Vaginoplasty
One referral from mental health professional	Two referrals from mental health professionals
Persistent, well-documented gender dysphoria	Persistent, well-documented gender dysphoria
Capacity to consent	Capacity to consent
Legal age	Legal age
Well-controlled medical or mental health conditions	Well-controlled medical or mental health conditions
	12 continuous mo of hormone therapy
	12 continuous mo of living in gender role congruent with gender identity

MtF = male-to-female; WPATH = World Professional Association of Transgender Health.

For transgender women, hormone therapy typically involves a combination of estrogen and antiandrogen medications, such as spironolactone, to reduce endogenous testosterone production and minimize the required estrogen dosage. The goals of feminizing hormone therapy include breast development, body fat redistribution, and reduced male-pattern hair growth [see Table 2].^{3,5} Unfortunately, increased risk of venous thrombosis is observed with short-term cross-sex hormone therapy, and an increased prevalence of type 2 diabetes, osteoporosis, myocardial infarction, and cerebrovascular disease has been observed relative to non-transgender control populations with long-term therapy. However, rates of hormone-related oncologic events are not increased [see Table 3].⁵⁻⁹ Following hormonal transition, surgical options available to the male-to-female transgender patient include augmentation mammoplasty, genital reconstruction,

and non-genital procedures, including facial feminization, thyroid cartilage reduction, vocal cord surgery, and body feminization procedures, such as fat transfer to hips and buttocks. In this review, male-to-female chest and genital reconstructive surgery is discussed.

Table 2 Effects of FHT and Expected Time of Onset ⁵		
<i>Effect</i>	<i>Expected Onset (mo)</i>	<i>Time to Achieve Maximum Effect (yr)</i>
Body fat redistribution	3–6	2–5
Softening of skin/decreased oiliness	3–6	Unknown
Breast growth	3–6	2–3
Thinning/decreased male-pattern hair growth	6–12	> 3

FHT = feminizing hormone therapy.

Table 3 Risks Associated with FHT ⁵	
Risk Level	Risk
Likely increased risk	Venous thromboembolic disease; hypertriglyceridemia; gallstones; elevated liver enzymes; weight gain; cardiovascular disease (with presence of additional risk factors)
Possible increased risk	Hypertension; hyperprolactinemia or prolactinoma; type 2 diabetes (with presence of additional risk factors)
No increased risk or inconclusive data	Breast cancer

FHT = feminizing hormone therapy.

Augmentation Mammoplasty

The acquisition of adequate female secondary characteristics is imperative for success in the transition from male to female. One of the most obvious characteristics is a feminine-appearing chest.¹⁰ Exogenous hormone therapy has been shown to produce a wide range of responses in male mammary tissue that are not strictly dose related.¹¹ In addition, male breast tissue responds to estrogen and develops in an analogous way to female breast tissue during puberty and, thus, takes nearly 2 years of therapy to realize maximum growth potential.¹² Taken together, hormone therapy alone is generally unable to induce sufficient breast growth when transitioning from male to female. In fact, nearly 60% of patients ultimately request an augmentation mammoplasty.¹³ Given that augmentation mammoplasty is a major operative procedure with all associated risks, candidates must feel strongly that this procedure will help improve their quality of life. Historically, augmentation mammoplasty has been found to significantly improve transgender patients’ satisfaction with their breasts and to positively impact both psychosocial and sexual well-being in as early as 4 months following surgery.¹⁴

PREOPERATIVE CARE

Although seemingly analogous to traditional augmentation mammoplasty in non-transgender female patients, when presented with a transgender patient seeking augmentation mammoplasty, it is required that plastic surgeons obtain proper evaluation and documentation from a mental health professional [see *Table 4*]. It is important to note that although the WPATH SOC recommends obtaining two referral letters prior to genital surgery, the association recommends only one referral letter prior to chest/breast surgery.¹⁵ Some argue that the requirement to obtain evaluation from a mental health professional places undue strain on transgender patients and should not be universally obligatory.¹⁶ Others argue that equal treatment does not mean that all patients receive the same care but, instead, that all patients be treated in a way that most optimally addresses each individual's unique needs and goals.¹⁷ Although recommendations may change in the future, it is critical to adhere to the current WPATH SOC guidelines and request appropriate documentation to establish and meet the SOC for patients and to be protected medicolegally.¹⁸

Table 4 WPATH Recommendations for Mental Health Referral Letter⁵

1. Client’s general identifying characteristics
2. Results of client’s psychosocial assessment, including diagnoses
3. Duration of mental health professional’s relationship with client, including type of evaluation and therapy or counseling to date
4. Explanation that criteria for surgery have been met and brief description of clinical rationale for supporting patient’s request for surgery
5. Statement that informed consent has been obtained for patient
6. Statement that mental health professional is available for coordination of care and welcomes phone call to establish this

WPATH = World Professional Association of Transgender Health.

If deemed ready for consultation, the patient meets initially with the surgeon to discuss all aspects of the surgery. Specifically, this discussion is to better understand the patient’s preferences and expectations while providing details of the preoperative, perioperative, and postoperative course. In addition, the patient is educated on the irreversible nature of this procedure. By this point, the patients should have completed at least 1 year of feminizing hormone therapy and deny any breast tenderness, which is an indicator of ongoing breast development. It is imperative that estrogen-induced breast development has fully plateaued prior to proceeding with augmentation mammoplasty. A detailed history and physical examination are conducted, with careful attention to any history of diabetes, smoking, heart or lung disease, immunosuppression, previous chest operations, or radiation. It is important to elicit any significant family history of breast cancer. Any medications that may contribute to bleeding, such as nonsteroidal anti-inflammatory drugs, should be stopped 1 week prior to the operation. Patients are to abstain from all nicotine products 1 month before and 1 month after the operation. All patients above the age of 40 or patients below the age of

40 with a significant family history of breast cancer are instructed to obtain a preoperative mammogram. Examination of the breasts and axillary and cervical lymph nodes is conducted. Standard breast measurements are performed, including nipple to inframammary fold (IMF) distance, base diameter, and upper pole pinch test. Any asymmetries of the chest (breast volume, nipple/areola size and position, location of IMF) should be pointed out to the patient and documented. Risks of the procedure include general surgical risks and risks associated with augmentation mammoplasty, which include, but are not limited to, postoperative pain, bleeding, infection, scarring, capsular contracture, implant rupture, loss of nipple sensation, loss of nipple, wound-healing problems, and asymmetry. The patients are also educated on the fact that the procedure may not necessarily resolve gender dysphoria. Surgical consent is signed at this time.

OPERATIVE CONSIDERATIONS

Implant Preference and Selection

Although many different types of implants have been described, our team preferentially uses silicone gel–shaped anatomic implants. They are used in a manner similar to what has previously been described in the literature, although special considerations must be taken given the unique anatomy of male-to-female transgender patients.¹⁹ Transgender women tend to have more widely spaced nipples and areolas, minimal breast development, a short IMF, and tight submuscular pockets. Given these challenges, silicone gel–shaped implants generally offer a more natural-appearing feminine chest. Round implants are reserved for individuals who desire ample upper pole fullness. Based on recommendations from the US Food and Drug Administration, saline implants are used if a patient is under the age of 22.²⁰ The vast majority of our team's experience has been with silicone gel–shaped implants in this patient population for primary breast augmentation. Overall, it is imperative to assess preferences and expectations for size, shape, and projection in the preoperative consultation. It is not unusual to have a base width greater than 15 cm with an associated nipple-to-IMF distance greater than 21 cm. Due to the tight soft tissue pockets of transgender women, as well as their relatively wide base diameters, low- or moderate-profile implants with a relatively high height are preferable. For the majority of male-to-female transgender patients, the base width will be the most pertinent factor in determining the ultimate implant size.

Submuscular versus Subglandular

In one of the largest series, Kanhai and colleagues documented a preference for the subglandular approach to better “fill” the breast as opposed to a submuscular or dual-plane approach.¹³ In contrast, our group defaults to implant placement in the submuscular plane. Using the pinch test, we routinely assess whether the patient has sufficient tissue for subglandular implant placement. A sufficient amount of tissue has been previously described as greater than 2 cm in the upper pole of the breast.¹⁹ Despite hormone therapy, we rarely experience adequate tissue to comfortably perform subglandular augmentation. Of note, the aforementioned study reported a trend toward larger implants with an average prosthesis volume of 165 mL in 1979 and 287 mL in 1996.¹³ In our group’s experience, this trend toward larger implants continues to persist, which again favors a submuscular rather than a subglandular approach.

Measurements

In the preoperative holding area, the chest midline, chest meridian, and native IMF are marked [see *Figure 1*]. The base diameter is also measured as it will serve as the initial benchmark for implant selection because the measurement is generally fixed.¹⁹ A 3 cm zone between the base markings is not violated during the dissection to prevent medial implant migration or symmastia. Next, attention is paid to the IMF. In general, this patient population has an exceedingly short nipple-to-IMF distance. To prevent a high-riding prosthesis, the IMF must be lowered based on the volume or base width of the implant. Briefly, as the base diameter increases from 11.5 to 14 cm, the nipple-to-IMF distance should increase from 7.5 to 10.0 cm.¹⁹

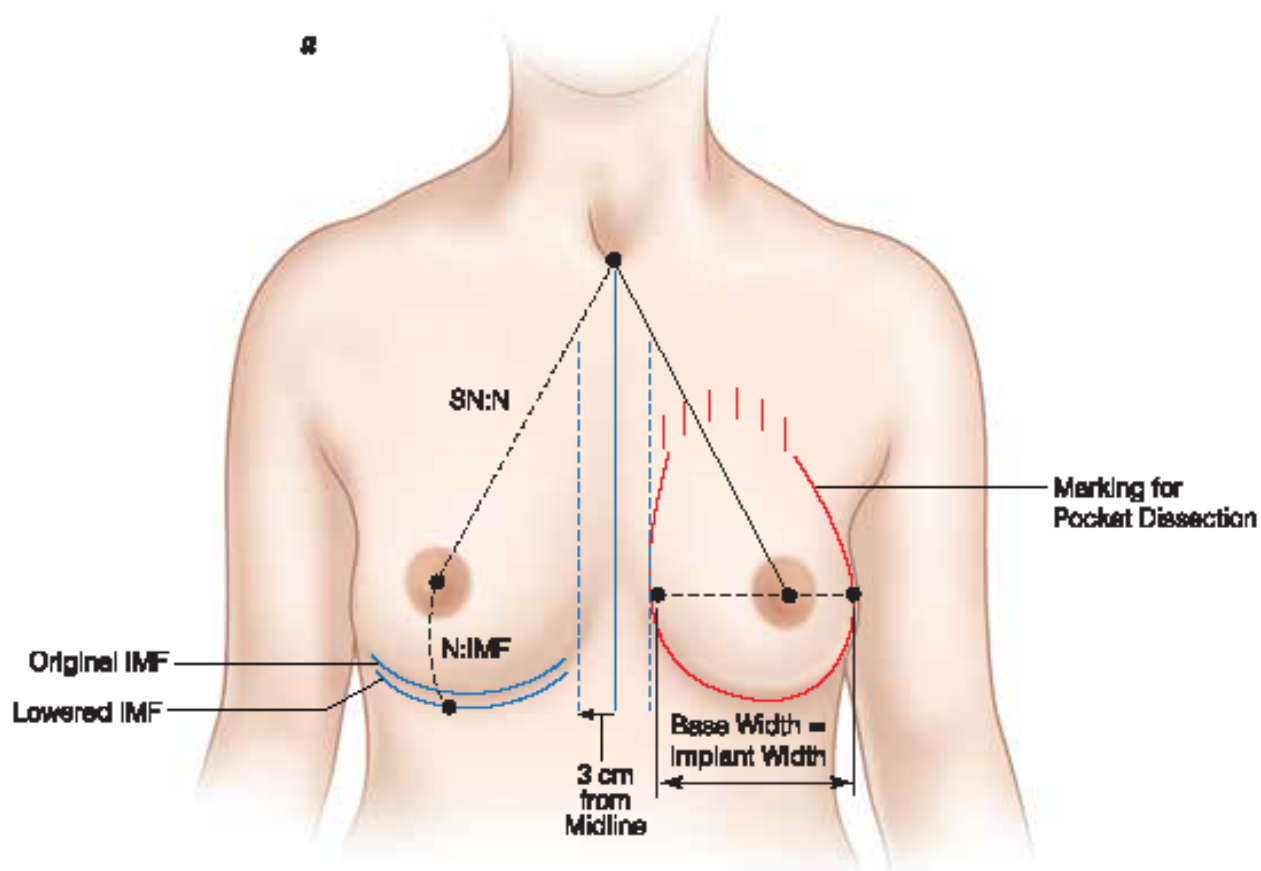


Figure 1a

Preoperative markings for augmentation mammoplasty. (a) Preoperative measurements and markers for precise implant placement. Male-to-female patient population has short nipple (SN) to inframammary fold (IMF) distances and generally requires lowering of IMF.

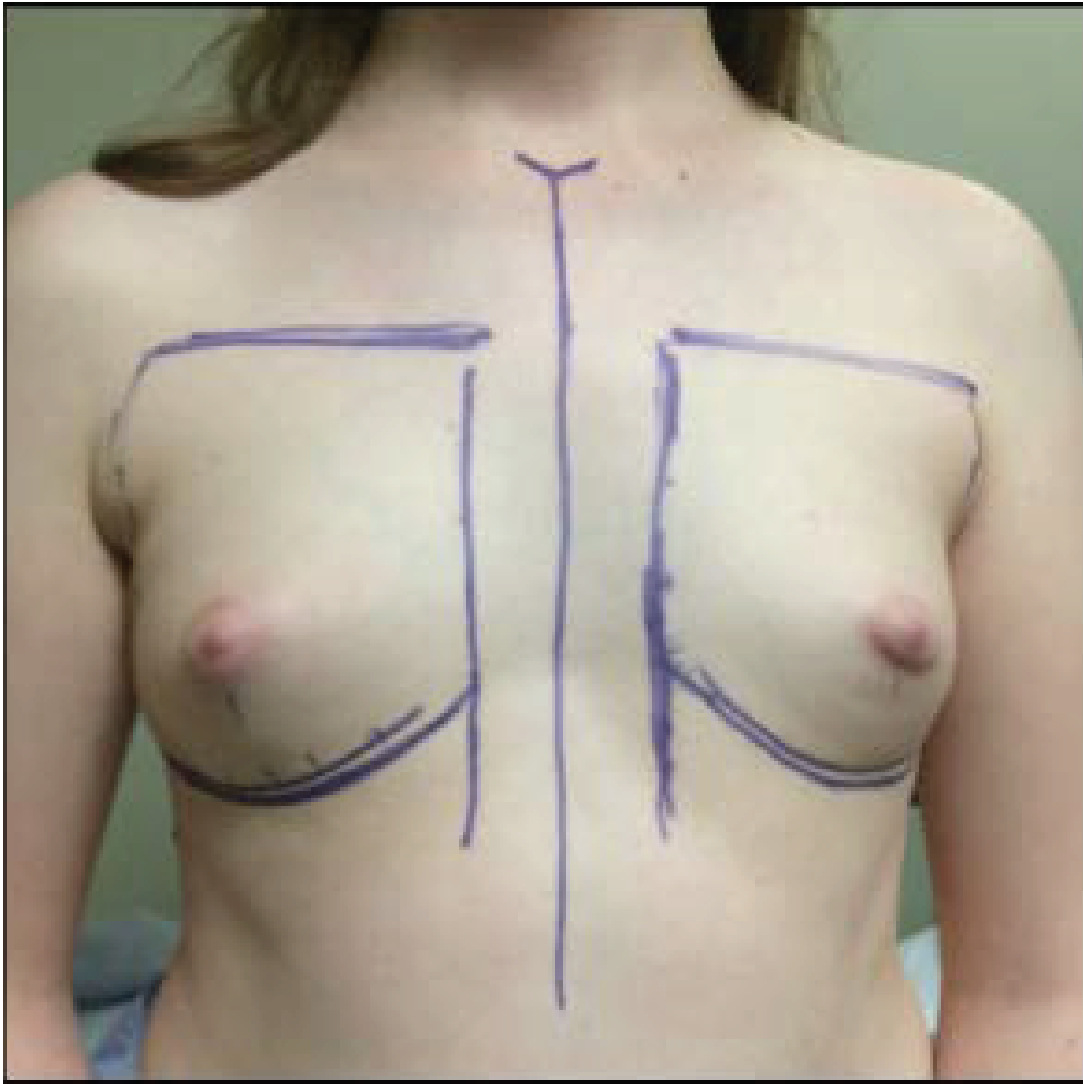


Figure 1b Preoperative markings for augmentation mammoplasty. (b) Preoperative markings on patient. N = nipple.

Special Considerations

The male chest has anatomic differences compared with the female chest. Male chests are generally wider and have a greater distance between the left and right nipple-areola complexes (NACs). During male-to-female augmentation mammoplasty, the implant must be placed directly behind the nipple. Taken together, this may lead to widely spaced breasts without highly defined cleavage. Given the unavoidable nature of this problem, patients must be made aware preoperatively

that they may have widely spaced breasts with limited options for secondary correction. If a patient is unhappy with the spacing between the breasts, fat grafting can be performed to the bilateral medial breasts to improve the overall appearance of the chest.

In addition, there are differences in the shape and size of male and female areolas.^{21,22} Previous reports have shown that 91% of men have areolas that are oval and only 7% are found to be round. In contrast, most female areolas are round and are typically larger than male areolas because the size of the NAC is directly related to the size of the breast.²³ In our experience, we have found that male-appearing NACs tend to become rounder and more feminine after implant placement [*see Figure 2*]. If a patient is not satisfied with the size or shape of the NAC, tattooing can be performed secondarily.

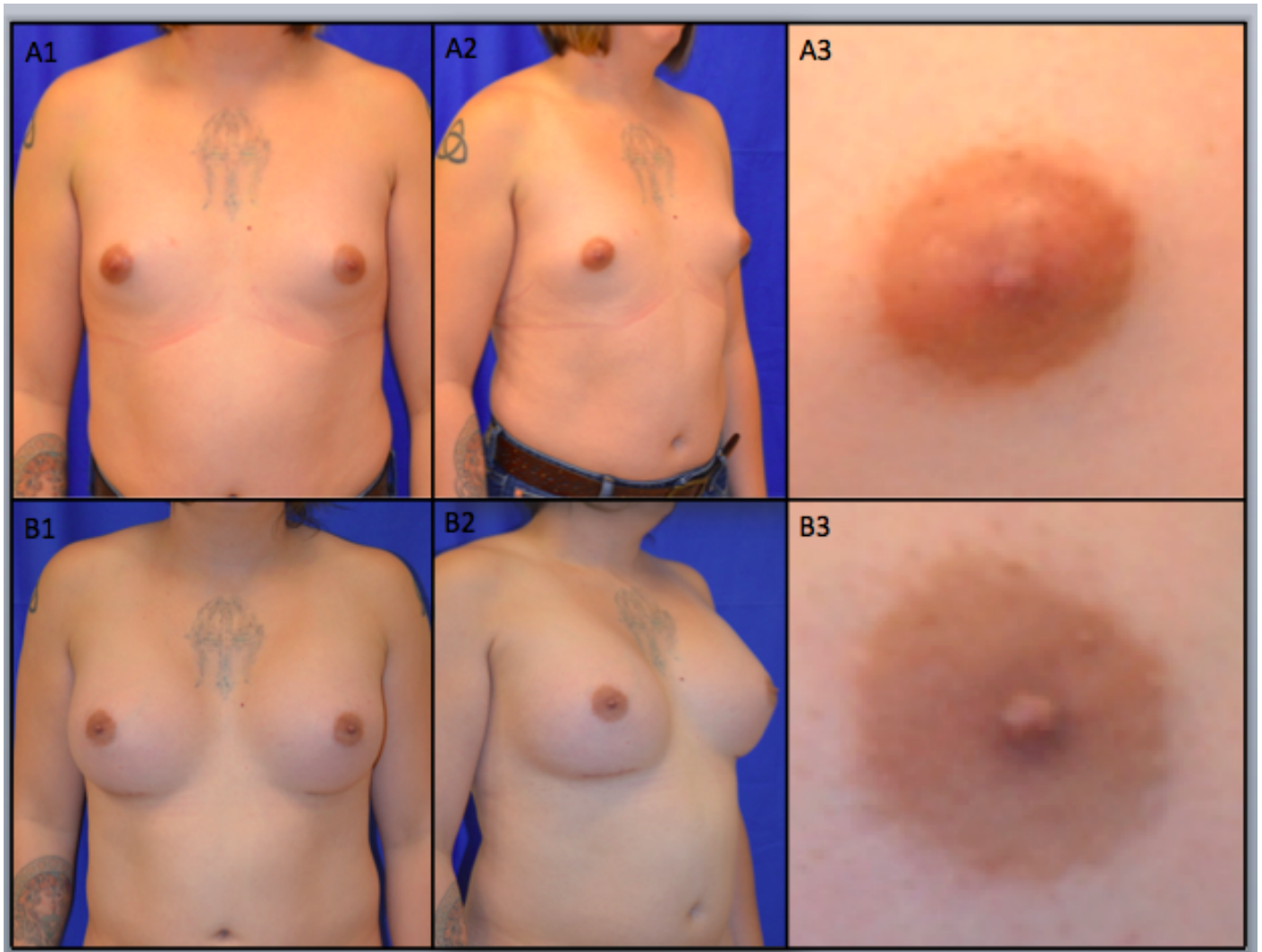


Figure 2

Outcomes of augmentation mammoplasty. (a) Before (A1, A2) and (b) after (B1, B2) male-to-female augmentation mammoplasty. After placement of implant, male-appearing areolas stretch to be rounder and more feminine appearing (A3 vs B3).

Medications Prior to Surgery

There is some evidence to suggest a 20-fold increase in the risk of deep vein thrombosis (DVT) in male-to-female transgender patients taking certain types of exogenous estrogens.⁸ Thus, we advise our patients to stop taking estrogen (and any estrogen-containing supplements) 2 weeks prior to surgery. In addition, our group asks patients to avoid aspirin, aspirin-containing products, antiinflammatory medications, and herbal supplements if not medically contraindicated. Other medications that are continued or discontinued on a case-by-case basis include anticoagulants, corticosteroids, antihypertensives, and others. In general, all preoperative medications are discussed during each preoperative visit.

SURGICAL APPROACH

Many well-known techniques have been described for primary breast augmentation and breast reconstruction. However, very little literature has focused specifically on the operative techniques used during chest reconstruction of male-to-female transgender patients. Here we discuss our team's most frequently employed approach.

Prior to the procedure, cefazolin is dosed in a weight-based manner. Should a second dose be indicated for prolonged operative time or excess blood loss, an additional dose is administered per guidelines.²⁴ When this procedure is performed alone, this is seldom necessary.

The patient is brought to the operating room and positioned in a supine fashion with arms abducted at 90°. The arms are secured to the arm boards with a Kerlix bandage. The bed is tested to ensure that the patient is situated in such a way to be able to safely sit up during the procedure. The patient is then secured and grounded, and the indicated DVT prophylaxis, including sequential compression devices, is provided per Caprini's risk assessment guidelines.²⁵ Although this procedure can be performed under local anesthesia with sedation, the majority of these procedures are performed under general anesthesia.

After the airway is secured, the patient is prepared with alcohol-based preparation from the umbilicus to the base of the neck. Local anesthesia is infiltrated. Specifically, 10 mL of 0.25% bupivacaine with 1:200,000 epinephrine is used as a field block for the incision on each side for a total of 20 mL. The patient is then draped in the standard sterile fashion. A Tegaderm dressing is placed over the areolas to prevent the potential risk of bacterial contamination from the underlying ducts.

To initiate the operation, a no. 15 blade is used to make a 5 cm incision at the level of the new IMF located beneath the native IMF [see *Figure 1*]. In general, the IMF should not be lowered, nor should the Scarpa fascia be violated, below this incision to prevent bottoming of the implant and creation of a high-riding scar.¹⁹ Bovie electrocautery is used to continue the dissection through the subcutaneous tissue to the level of the pectoralis fascia. The dissection is then carried under the pectoralis muscle. A lighted retractor is used for better visualization. A combination of blunt dissection and bovie electrocautery is used to dissect out the pocket to the exact dimensions of the proposed implant. Care is taken not to violate the pectoralis minor. After the pocket is defined, hemostasis is achieved.

Careful preoperative planning will determine the size of the implants to be used. If there is some degree of uncertainty, or particularly if the patient has asymmetrical breast volumes, then saline sizers can be used to determine the optimal implant size. When using sizers, care must be taken to avoid widening the dimensions of the pocket. The patient can be sat up for more optimal observation. The saline sizer is removed, and the pocket is irrigated with triple antibiotic solution (cefazolin 1g, bacitracin 50,000 U, gentamicin 80 mg). The appropriate implant is selected as previously described.

In many cases, large-volume implants are needed, so a Keller funnel is typically used for easier insertion. The wound is then closed in a layered fashion: 3-0 poliglecaprone 25 (Monocryl) is used for the deep Scarpa layer and the deep dermal layer, and 4-0 Monocryl is used for the subcuticular closure. The wound is then covered with liquid adhesive (Mastisol) and wound closure strips (Steri-Strips). The chest is then covered circumferentially with light ACE wrap compression.

The procedure is performed in an outpatient setting. The incisions and chest binder are kept dry and in place until the postoperative follow-up, which generally occurs in 5 days. At the follow-up appointment, patients are fitted for a sports bra, which they must wear for 4 weeks. Strenuous activity must be avoided for 6 weeks. In general, we discourage patients from bending, reaching, and lifting for several weeks after surgery to prevent the pectoralis from placing force on the prosthetic and ultimately causing it to migrate. The patients are instructed to resume estrogen and estrogen-containing supplements 1 week after surgery. Once the wound closure strips have fallen off (typically at 2 weeks), patients are instructed to massage the incisions three times daily and to use a silicone-based cream to minimize scarring.

OUTCOMES AND CONSIDERATIONS

Complications

Complications are difficult to quantify for this patient population given the current body of literature. In general, we discuss risks with our patients based on the most common complications that occur in female patients undergoing augmentation mammoplasty. These include, but are not limited to, significant capsular contracture (5 to 10%), rupture (1%), infection (1%), scarring, sensation changes, hematoma, seroma, and the reported but exceedingly low risk of anaplastic large cell lymphoma.²⁶⁻²⁹ A greater amount of research is needed to better stratify risk for our patient population moving forward.

Postoperative Considerations

To date, no significant association has been found between hormone therapy and increased risk of cancer or mortality in transgender individuals.³⁰ Still, in male-to-female transgender patients receiving exogenous estrogens, lactotroph adenomas, breast cancer, and prostate cancer have been reported.⁹ Thus, we recommend to our patients that they undergo breast cancer screening as dictated by the American Cancer Society at age-appropriate milestones similar to nontransgender female counterparts.³¹ Specifically, we recommend that our patients perform monthly breast examinations, have a yearly examination by their primary care provider, and have yearly mammograms starting at age 40 or younger if there is a family history of breast cancer.

In addition, the majority of our patients undergo implant-based augmentation with silicone implants. For these patients, we recommend regular MRIs, with the first occurring 3 years after augmentation, followed by repeat imaging every 2 years to detect implant rupture.³²

Additional Approaches

In addition to the direct-to-implant approach that we have described, it may be beneficial to undergo a two-stage reconstruction with initial insertion of tissue expanders. This is especially true for those patients in whom defining an adequate subpectoral pocket is difficult. Based on patient preference for a single-stage procedure, our group has yet to perform this technique. Still, with proper patient selection, this could be a valuable strategy. Also, autologous fat grafting offers promise as a primary method for breast augmentation. Given the limited amount of subcutaneous tissue, most of the grafting would need to occur within the pectoralis muscle. As with all fat grafting, unpredictable resorption rates and overall limitations in total volume continue to be associated with this procedure.³³

Vaginoplasty

PREOPERATIVE CARE

Prior to undertaking any surgical preparation or planning, all patients are seen in a preoperative surgical consultation. The WPATH guidelines are reviewed with the patient [*see Table 1*].⁵ To be considered appropriate for consultation, the individual should have endorsement letters from two licensed therapists or physicians (one must have a doctoral degree and work with gender dysphoric patients) stating that the patient is appropriate for gender-confirming surgery [*see Table 2*]. The letters should have a professional letterhead, discuss the therapist's/physician's background and education, and state their experience with gender dysphoric patients. The letter should also discuss the emotional stability of the patient, any abusive behaviors, the patient's real-life test (living as true gender 24 hours a day, 7 days a week for 1 year), any procedural ambiguity, and the potential for postsurgical remorse. Evaluation by a primary care provider should assess the patient's current state of health and discuss any chronic medical conditions that may prevent gender confirmation surgery (e.g., uncontrolled diabetes, congestive heart failure, chronic obstructive pulmonary disease, angina pectoris, previous myocardial infarction, inflammatory bowel disease, peripheral vascular disease).^{5,34} A body mass index of 35 or below is required prior to surgical intervention.

If deemed ready for consultation, the patient meets initially with the surgeon to discuss aspects of the surgery, including the irreversible nature of the penectomy and orchiectomy along with the resulting infertility. Risks of the procedures are discussed, including general surgical risks and those specific to vaginoplasty (urethrovaginal and rectovaginal fistula, urethral stricture, vaginal stenosis,

neovaginal prolapse, and injury to pelvic organs/rectum/bladder). The use of dilators postoperatively, cessation of smoking 1 month prior to and 2 months following the operation, and activity restrictions, including abstinence from penetrative sexual intercourse for 3 months postoperatively, are disclosed to the patient.

The goals of vaginoplasty, including creation of a moist, elastic, and hairless vaginal canal with a minimal depth of 10 cm and a width of 3 to 4 cm without introital stenosis, along with the ability to micturate in the seated position and engage in receptive sexual intercourse, should be discussed with the patient. The various options for vaginoplasty should be mentioned so that a collaborative informed decision-making process can be undertaken. Risks and benefits of the main approaches to vaginoplasty (penoscrotal inversion and pedicled intestinal flaps) should be disclosed. For the penoscrotal inversion flap, it is important to discuss reliance on dilation postoperatively, possible hair growth within the neovagina, increased risk of protrusion or prolapse, need for lubrication during receptive intercourse, malodor, and limitation of vault length depending on the extent of penoscrotal skin. For the pedicled intestinal flap, it is important to discuss the necessity for an abdominal operation, potential diversion colitis, mucorrhea, dyspareunia, and necessity for colon cancer screening. The potential for secondary revisional procedures should also be mentioned.³⁴⁻⁴¹ Verbal and written consent is obtained at this time.

A full physical examination should be completed, including rectal and testicular examinations, extent of hair-bearing nature of the penile shaft/scrotum/perineum, and stretched penile skin shaft length. These examinations will assist in determination of the creation of the neovagina and necessity for additional graft length to achieve optimal neovaginal depth. If additional full-thickness skin graft is used, it is typically harvested from the groin. Preoperative lab tests, including a complete blood count and basic metabolic panel, should be obtained, along with a baseline ECG and chest radiograph in patients over the age of 50 or with a history of cardiac or pulmonary disease.

Once determined to be ready for surgery, the patient can undergo electrolysis or laser hair removal of the proximal penile shaft, scrotum, and perineum [see *Figure 3*]. Depending on the amount and density of hair, 3 to 6 months may be needed to adequately remove all hair. Patients must stop taking estrogen- and progesterone-based hormones 2 weeks prior to surgery to prevent the risk of a DVT. Patients may continue to take androgen blockers. Aspirin, antiplatelet agents, and antiinflammatory agents should be stopped 1 week prior to surgery. Herbal medications should be reviewed with the patient because many can increase bleeding risk. At noon prior to the day of surgery, the patient should begin a clear liquid diet with no oral intake after midnight. Magnesium citrate and bisacodyl are taken on the day before surgery with the addition of a mineral oil enema

the night before and morning of surgery for a bowel preparation.

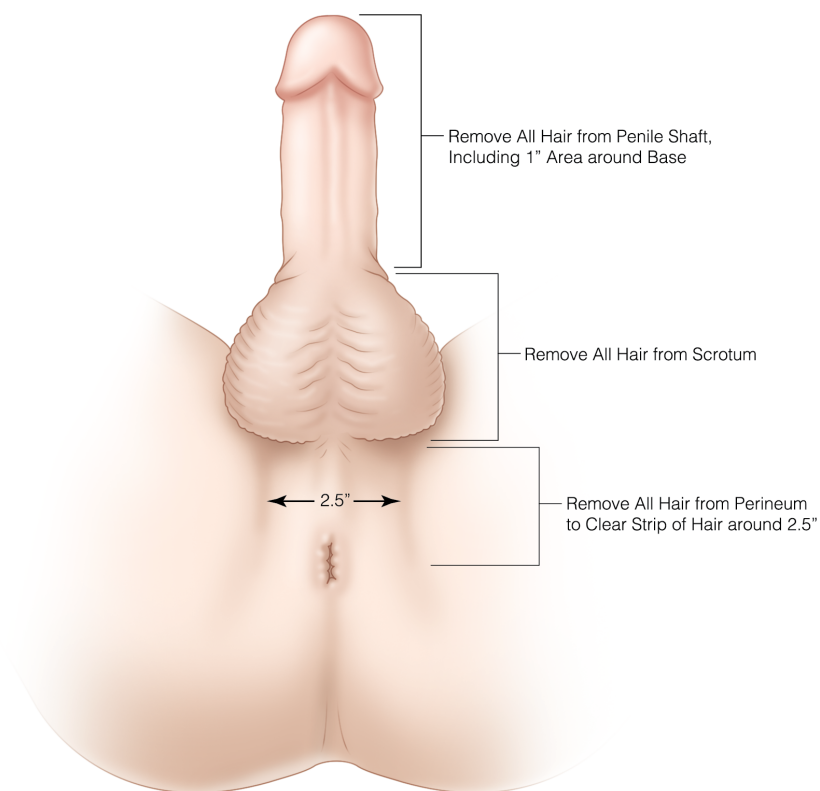


Figure 3

Sites for hair removal prior to vaginoplasty. Penile shaft, scrotum, and perineum are included.

SURGICAL APPROACH

There have been a variety of surgical approaches to gender-confirming vaginoplasty in the male-to-female patient.³⁵ Here we discuss the two most common types of vaginoplasty: penoscrotal inversion and pedicled intestinal flaps.

Penoscrotal Inversion Flap

In most centers, this is the first-line option offered for vaginoplasty in male-to-female transgender patients.⁴⁰⁻⁴⁴ The majority of these procedures are done under general anesthesia, but some providers do them under spinal anesthesia.³⁴ Prior to incision, antibiotics consisting of cefazolin and metronidazole are given with repeat dosing throughout the case as necessary. Active warming, bilateral sequential compression devices, a Foley catheter, and glucose control are continued throughout the case.

Patients are placed into lithotomy position with appropriate padding to prevent neuropraxia [see *Figure 4*]. Residual hair-bearing areas not cleared by electrolysis are clipped after positioning. Bilateral pudendal block with 0.25% bupivacaine along with a field block of the perineum with the same plus 1:200,000 epinephrine is completed. A kite-shaped design incorporating the perineum and scrotal skin is designed [see *Figure 5*]. Once elevated, the skin flaps are defatted to allow for ease of placement of the graft as the lining of the neovagina.



Figure 4

Preoperative positioning in lithotomy prior to vaginoplasty.



Figure 5

Design of skin flaps in “kite” orientation to create vaginoplasty cavity.

The exposed testicles are then placed under traction to allow for blunt and sharp dissection of the spermatic cord to the level of the inguinal canal [see *Figure 6*]. High-ligation orchiectomy is performed with silk ties followed by bovie electrocautery transection. Meticulous hemostasis is obtained, and the residual stumps are infiltrated with 0.25% bupivacaine with 1:200,000 epinephrine.

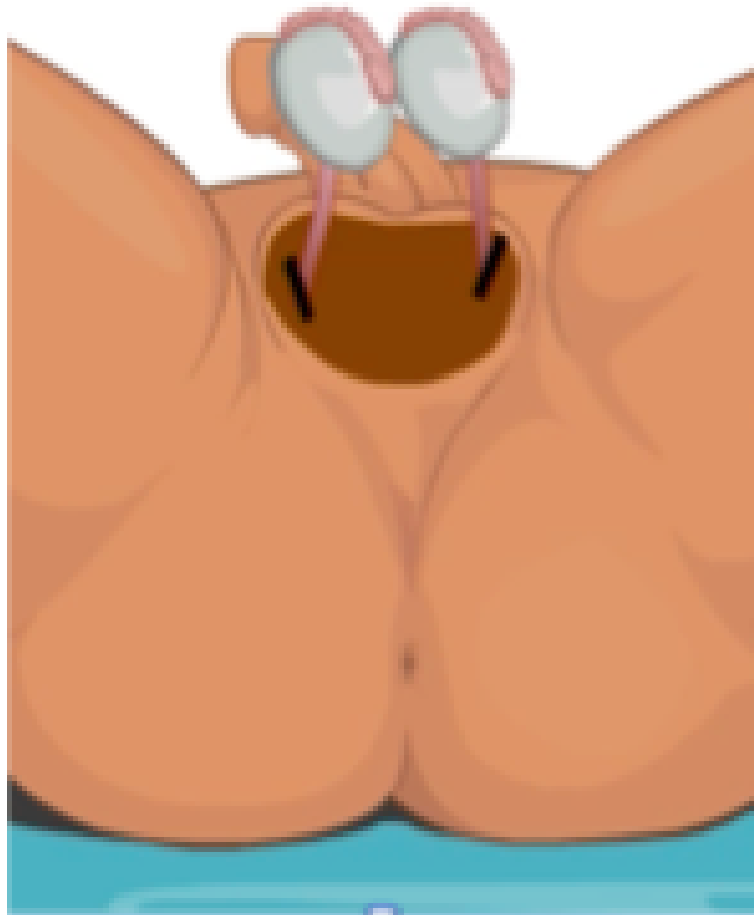


Figure 6

Removal of scrotal skin followed by high-ligation orchiectomy.

The base of the penis is dissected with removal of the bulbospongiosus muscle from the underlying urethra to decrease the bulk of the future introitus. Dissection of the vaginal canal begins with sharp division of the central tendon followed by blunt, sharp, and electrocautery dissection in the prerectal space between the urethra and rectum. A lighted retractor and a weighted speculum are used to assist in the process. A rectal dilator and Foley catheter are used as landmarks for dissection planes [see *Figure 7* and *Figure 8*]. A depth of more than 10 cm is desired for this plane.

For any large hemorrhoidal veins that are encountered, suture ligation is performed. Once hemostasis is obtained, a double-gloved finger is passed into the rectum to check for bleeding. If any blood is noted, the rectum is repaired primarily without the need for bowel diversion. The cavity is then packed with an epinephrine-soaked sponge for further hemostasis.

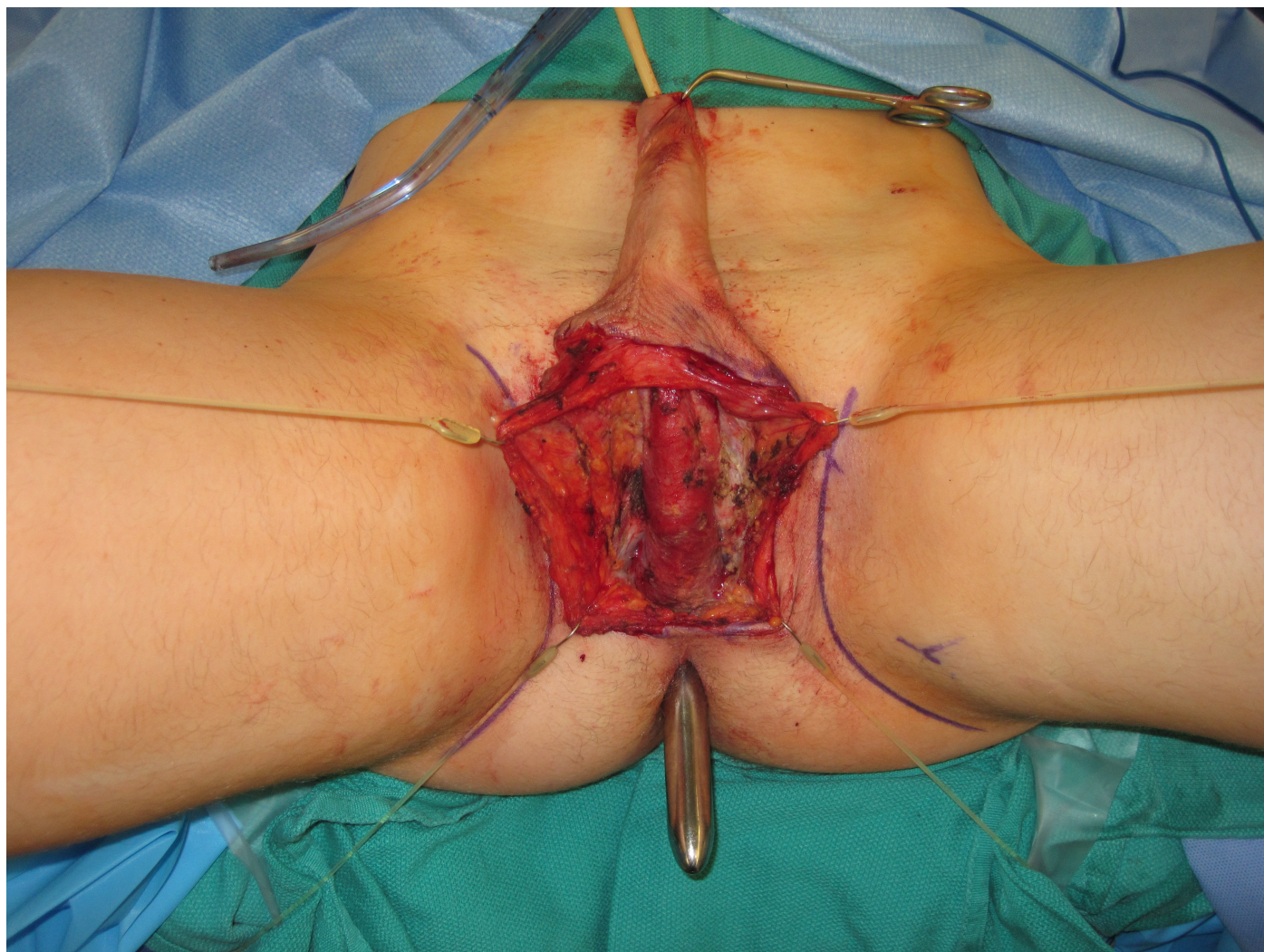


Figure 7

Exposure of the prerectal space for dissection of vaginoplasty cavity. "Kite" skin flaps are elevated with rectal dilator and Foley catheter in place to guide dissection.

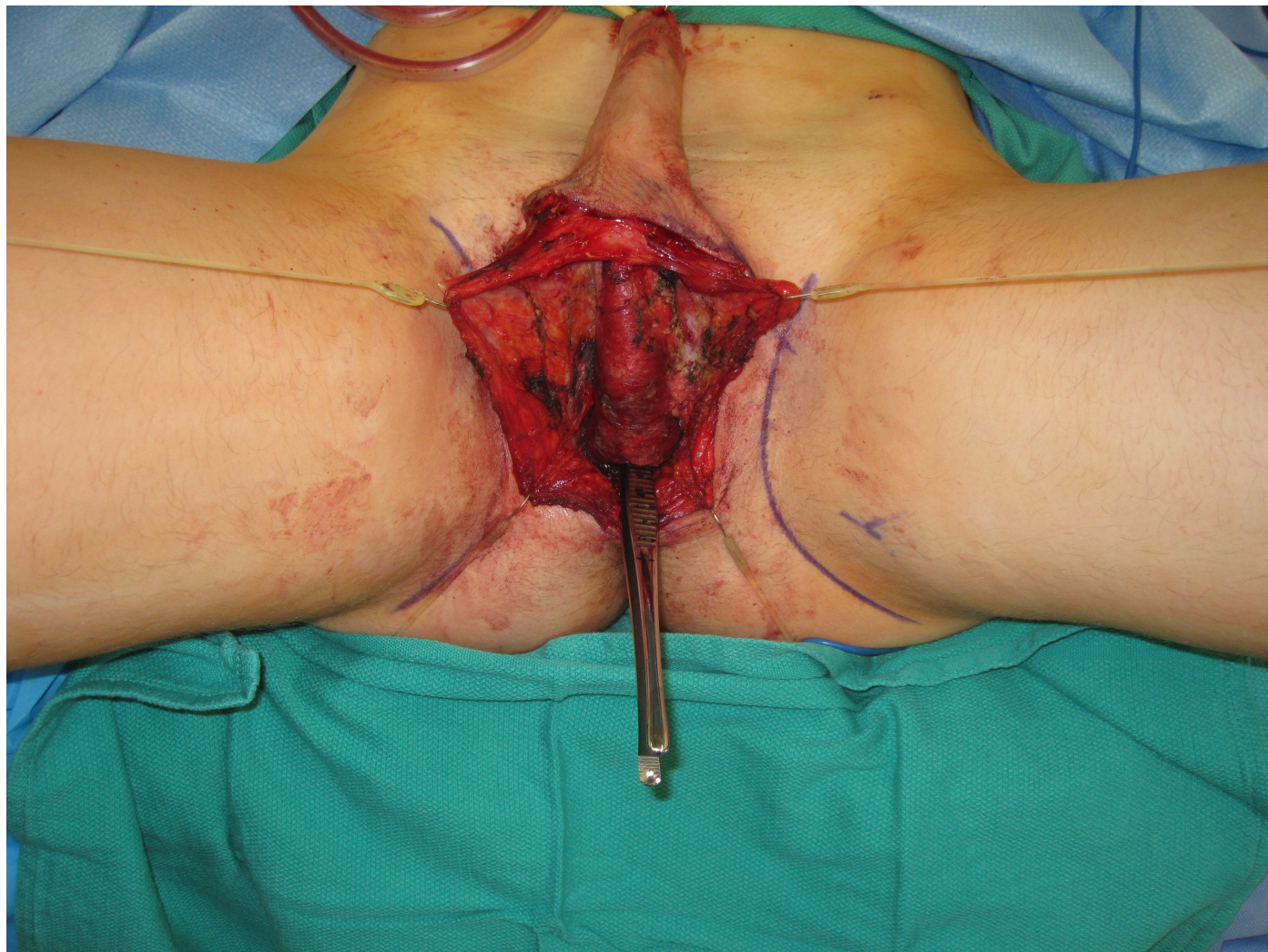


Figure 8

Dissected prerectal space above rectum and below prostatic urethra with pair of pick-ups showing depth of cavity.

Obtaining a long vascularized pedicle for the penoscrotal inversion flap is necessary, so an incision 2 cm proximal to the base of the penis is used to dissect the penile skin away from the underlying musculature [see *Figure 9*]. The dissection plane is maintained above the tunica albuginea with avoidance of the neurovascular bundle within the Buck fascia [see *Figure 10*]. The urethra is transected at approximately midshaft, and the proximal portion, still containing the Foley catheter, is separated free from the overlying corpora cavernosa, carrying the dissection to the crus of the

corpora.

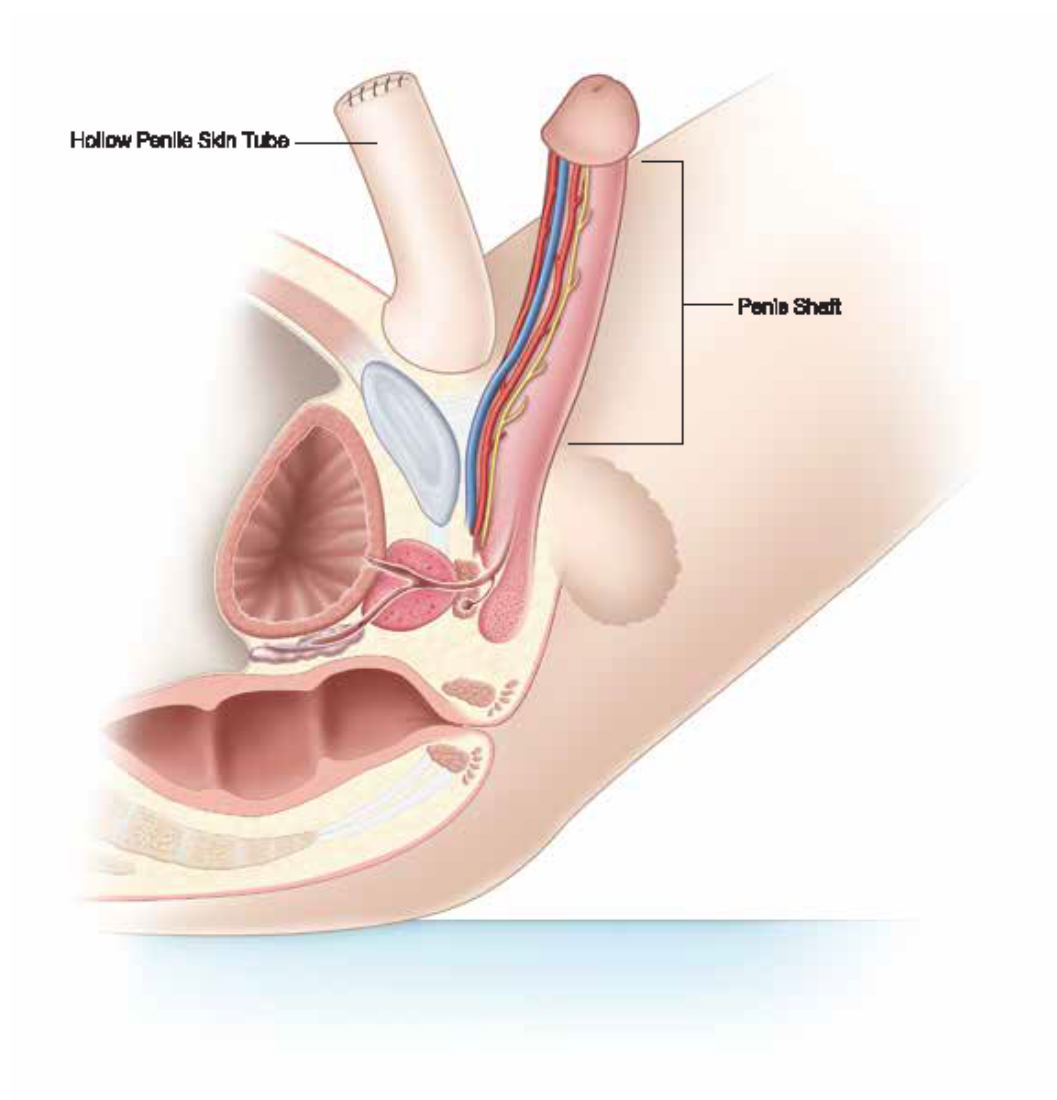


Figure 9

Removal of penile skin from shaft.

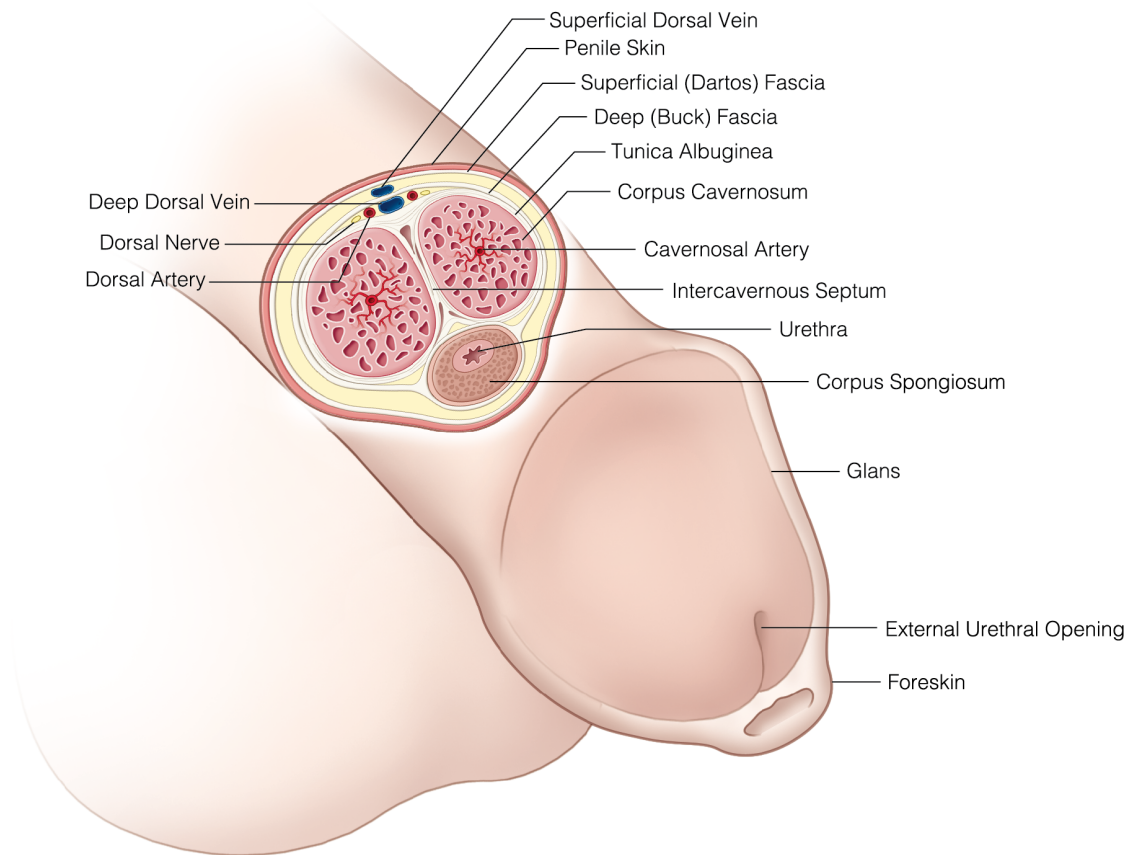


Figure 10

Anatomy of penis showing fascial layers, muscles, urethra, and neurovascular structures.

A Satinsky clamp is placed at the base of the remaining penis. A longitudinal incision is made within the tunica albuginea at the 3 o'clock and 9 o'clock positions. Sharp dissection is used to excise the erectile tissue away from the remaining dorsal penis, which is continuous with the glans, supplied by the dorsal neurovascular bundle [see *Figure 11* and *Figure 12*]. The ventral portion of the penis is then transected at the level of the Satinsky clamp and discarded. Purse-string closure of the corpora cavernosa stumps is performed using 0 silk to ligate the deep arteries. Careful hemostasis of

this area is crucial to prevent postoperative hematoma. The penile skin, proximal urethra, and glans with associated neurovascular bundle are now separated [see Figure 13].

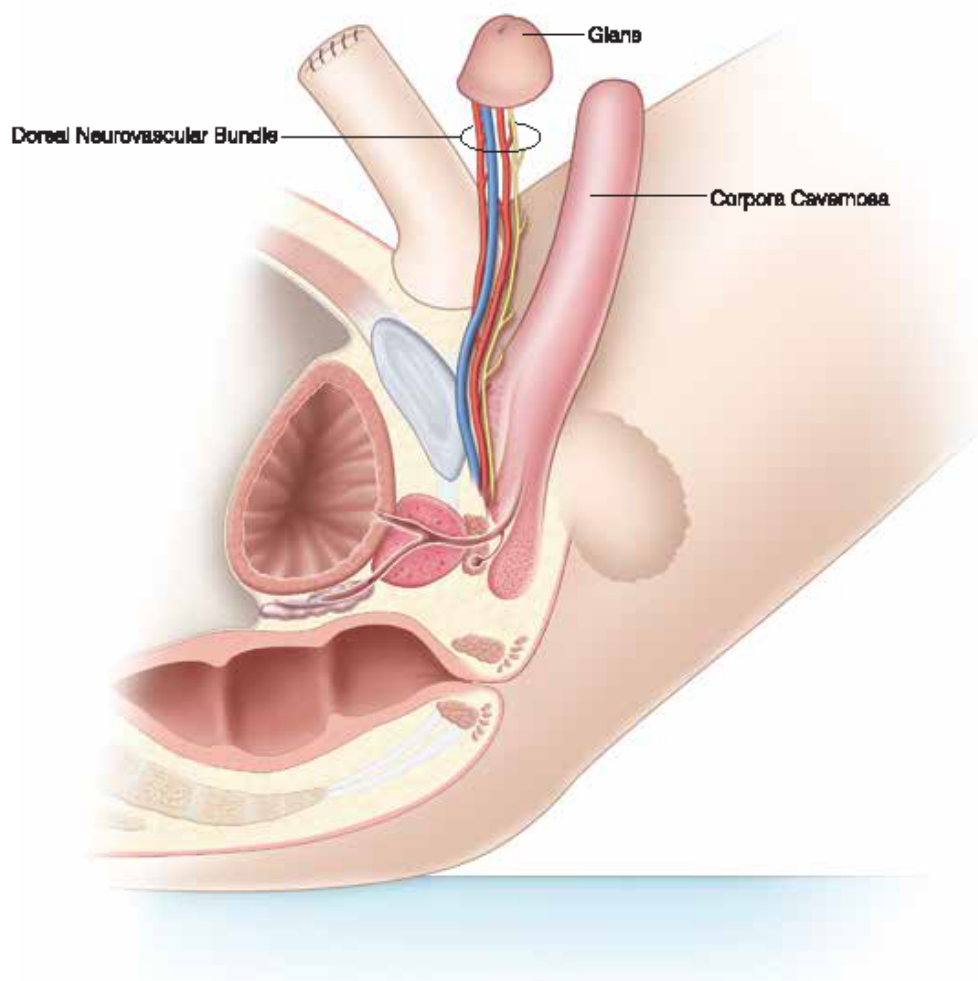


Figure 11

Dissection of glans from corpora cavernosa with preservation of dorsal neurovascular bundle.

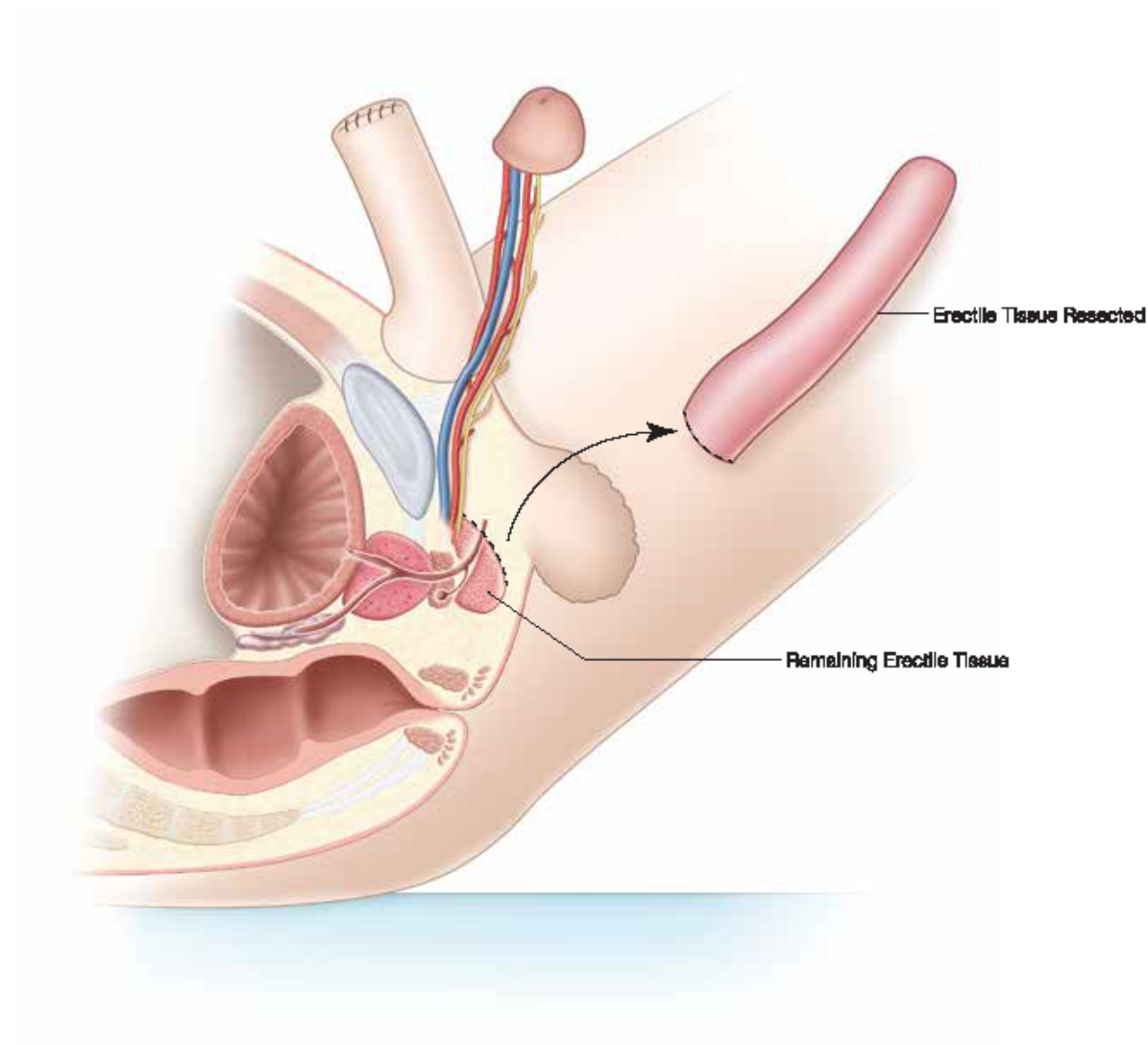


Figure 12

Resection of erectile tissue at base of penis and translocation of urethra to more inferior portion in pelvis.



Figure 13

Dissection of distinct layers of penis: penile skin, proximal urethra, and glans with neurovascular bundle.

Formation of the neoclitoris proceeds with designing of a zigzag pattern or M -shaped pattern with removal of the excess glans tissue [see Figure 14]. The glans is shaped into a coned neoclitoris with interrupted Monocryl suture [see Figure 15]. The neoclitoris is sutured in place to the corpora cavernosa stump with Monocryl suture. The neoclitoris is typically located on the same transverse plane as the adductor tendon, below the pubic symphysis. The tunica albuginea and associated

neurovascular bundle are folded and sutured onto the mons in a suspended fashion [see *Figure 16*].



Figure 14

Design of neoclitoris from glans. M-shaped pattern is drawn to allow for design.

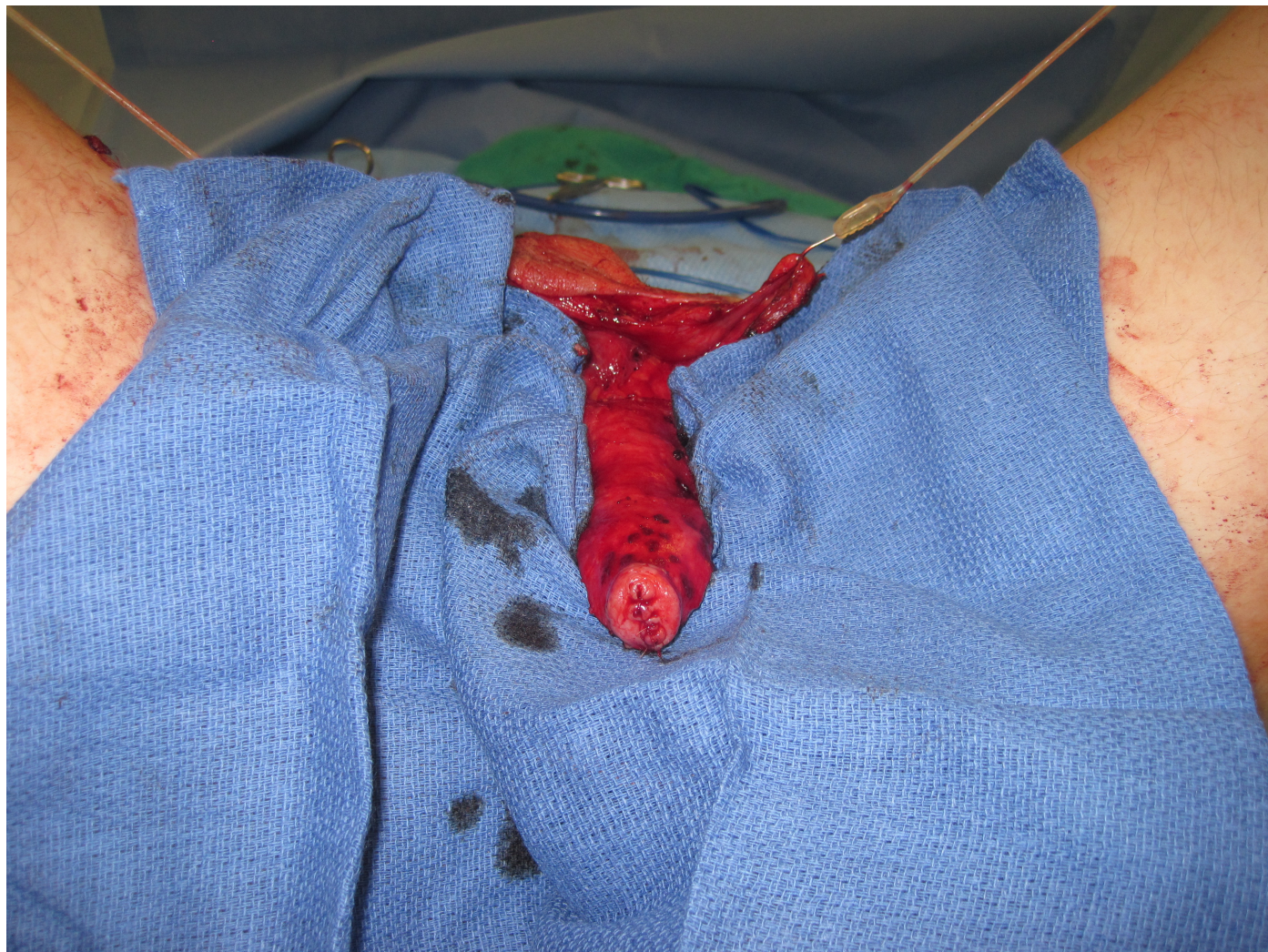


Figure 15

Neoclitoris formed on glans after dissection of flap.

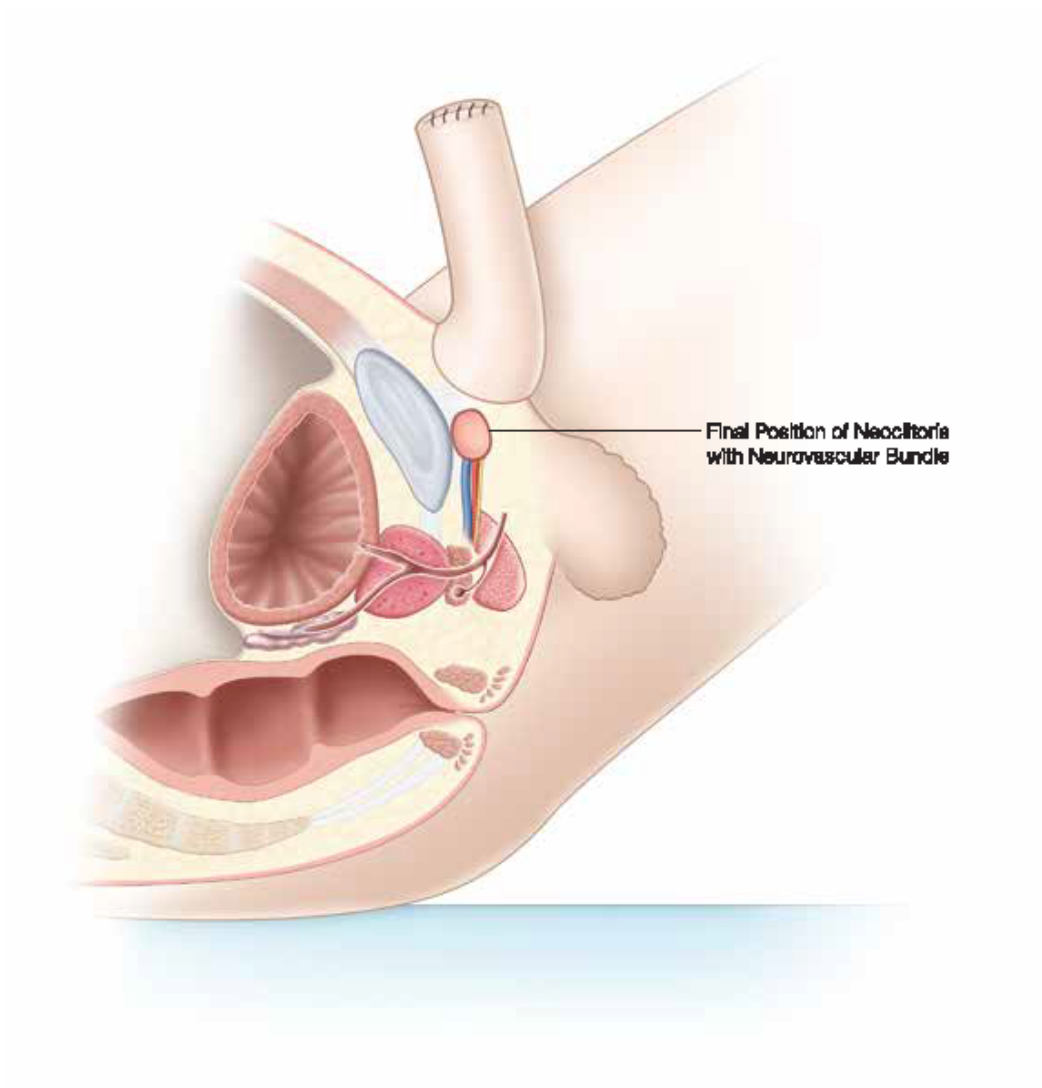


Figure 16a

Inset of neoclitoris with associated neurovascular bundle. (a) Digital representation

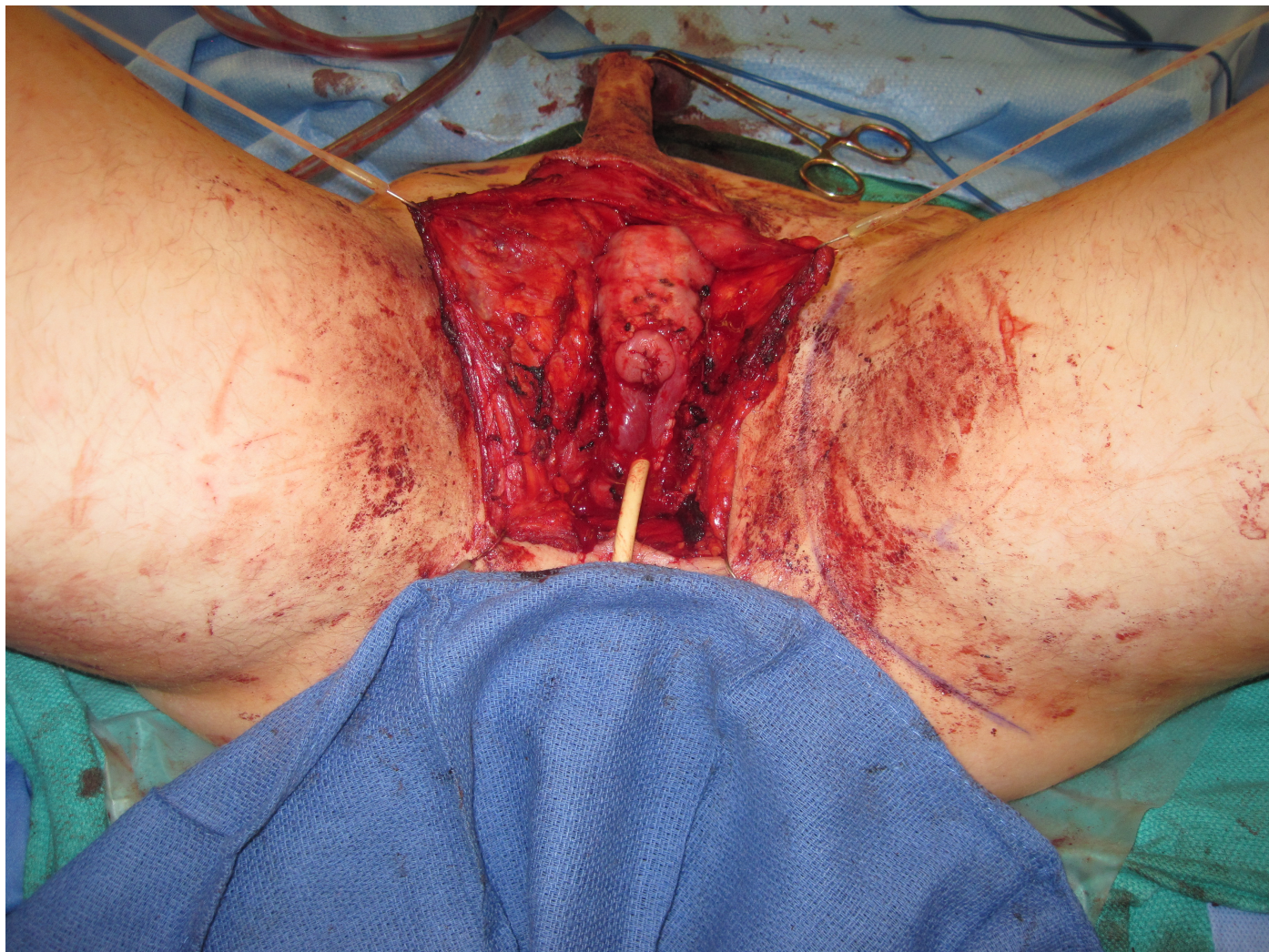


Figure 16b

Inset of neoclitoris with associated neurovascular bundle. (b) patient photo.

The remaining proximal urethra is incised on the ventral aspect to splay it open to prepare for the creation of the new urethra and inner aspects of the labia minora. A running locking suture with 4-0 Monocryl around the edge of the urethra is performed for hemostasis. A midline dorsal incision approximately 1.5 cm in size is made to prepare for the inset of the neoclitoris. The neoclitoris is introduced through this dorsal urethral slit and inset with Monocryl sutures. There will be an additional 1 to 2 cm of excess urethra beyond the superior aspect of the neoclitoris, which will contribute to the creation of the clitoral hood.

The vaginal cavity is inspected to ensure hemostasis. The epinephrine packing is removed. Hemostatic agents (such as Arista or FloSeal) and suture ligation of bleeding vessels can assist with this procedure. The remaining erectile tissue (bulbospongiosus) at the base of the penis is plicated with a series of 3-0 polyglactin 910 (Vicryl) figure-of-eight sutures to prevent engorgement with arousal and any blockage of the introitus.

The scrotal skin is inspected for remaining hair follicles that can be cauterized on the dermal side to prevent hair growth within the neovagina. A silicone dilator is placed within the degloved penile skin to act as a stent. The defatted and depilated scrotal skin graft is sutured to the distal aspect of the inverted penile skin to add vault length [*see Figure 17*]. The stented penile and scrotal skin graft is then inserted into the vaginal canal, and a bolster consisting of a Kerlix bandage roll covered in clindamycin cream and 1% lidocaine gel is placed within the neovagina [*see Figure 18*].



Figure 17

Penile and scrotal skin assembled over dilator prior to insertion into vaginoplasty canal.

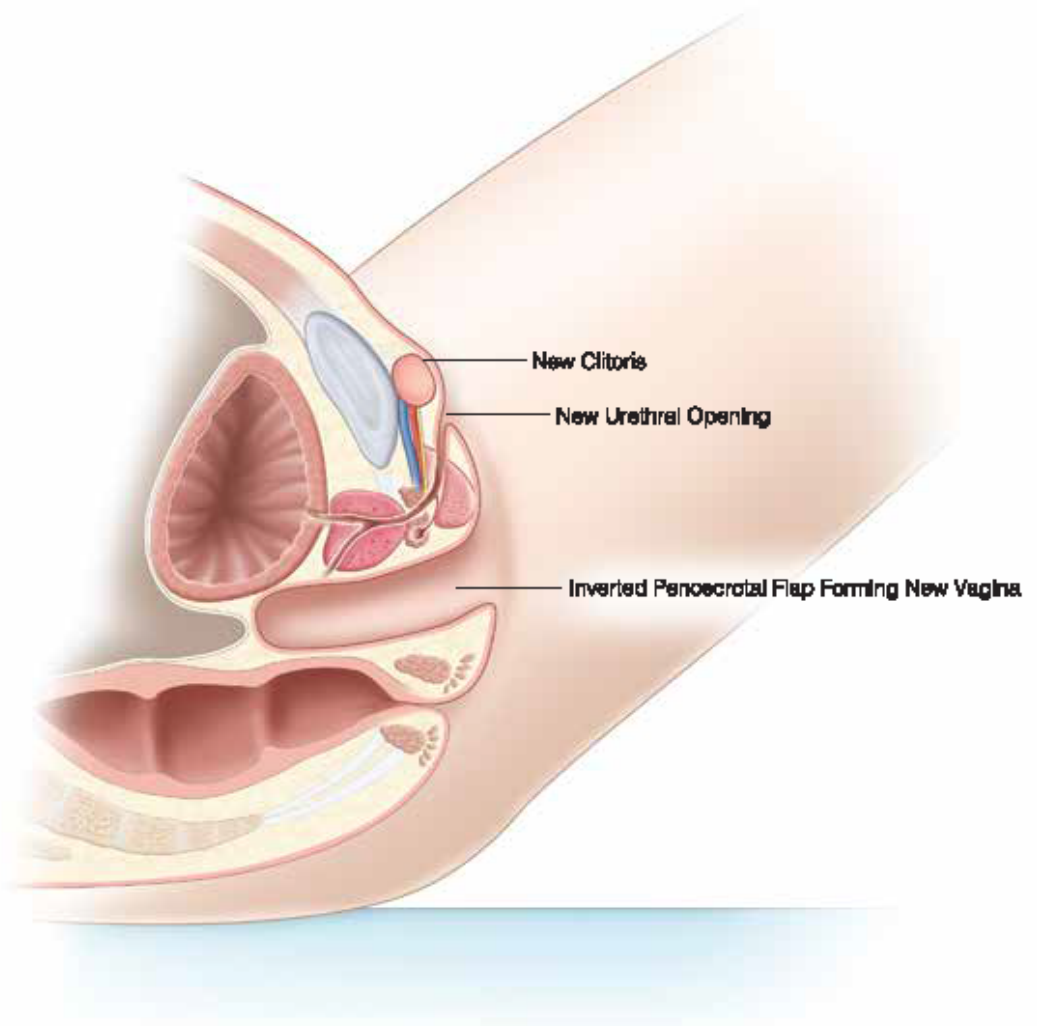


Figure 18

Inset of inverted penoscrotal flap into pelvis lining cavity between urethra and rectum.

A 3 cm vertical slit is made on the base of the inverted penile skin to allow for inset of the neoclitoris, neourethra, and labia minora with Monocryl sutures. The urethra above the neoclitoris is inset 1 cm beyond, and beneath, the superior aspect of the vertical penile shaft skin incision for recreation of the clitoral hood [see *Figure 19*]. The labia minora are then imbricated with 3-0 polydioxanone suture to allow for anterior projection [see *Figure 20*]. Excess scrotal fat can be

excised or plicated to control for any unsightly bulging. A single half-inch Penrose drain is placed. The labia majora incisions are then closed with deep sutures and running 4-0 Monocryl. After inseting all of these aspects, 0.25% bupivacaine with epinephrine is used for a pudendal nerve block again.



Figure 19

Inset of inverted penoscrotal flap for vaginoplasty with approximation of labia majora.



Figure 20

Formation of labia minora.

A large bolster is sutured into place over the surgical site with bacitracin and petrolatum gauze, and the Foley catheter is left in place. Additional superficial dressings are placed, with the patient being extubated once out of the lithotomy position. The patient is initially monitored in the postanesthesia care unit until ready appropriate for floor care. Final surgical outcome is seen at 1 year postsurgery [see *Figure 21*].



Figure 21

Long-term (1-year) outcome of penile inversion vaginoplasty.

Pedicled Intestinal Flap

Some authors prefer to offer this type of vaginoplasty as a first-line treatment, yet generally it is relegated to secondary approaches or for those with a previous penectomy and orchiectomy.³⁵⁻⁴⁶ Positioning and much of the dissection procedure are similar to the penoscrotal inversion flap, so they are not discussed here. This section focuses on the harvesting and inset of the pedicled intestinal flap.

Two teams generally work simultaneously when the patient is in the modified lithotomy position. While the plastic surgery team is dissecting the vaginal cavity, the general surgery team harvests the rectosigmoid colon. A low transverse abdominal incision is used to gain access to the peritoneal contents. Mobilization of the rectosigmoid colon is achieved in standard fashion and isolated on the superior hemorrhoidal artery. A 15 cm segment is isolated with the distal end closed. Continuity of the bowel is established in an end-to-end fashion with an end-to-end stapler [see *Figure 22*].

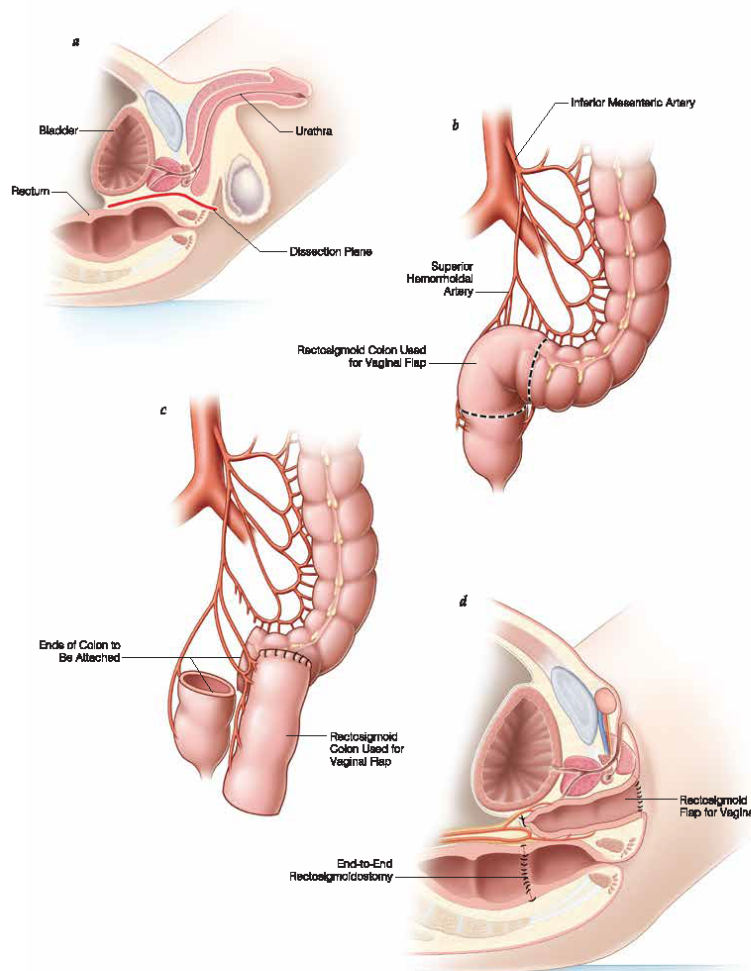


Figure 22

Pedicled intestinal flap for vaginoplasty. (a) Normal anatomy of nontransgender male. (b) Design of rectosigmoid pedicled flap based on superior hemorrhoidal pedicle. (c) Isolation of pedicled rectosigmoid flap with bowel continuity established. (d) Final anatomy after pedicled rectosigmoid flap.

If possible, introital and perineal skin flaps are elevated to allow for construction of the labia minora and majora as above in the penoscrotal inversion flap section. The rectosigmoid flap is inset into the inverted skin flaps in a circular fashion with Z-plasties, darts, or bias cuts to minimize introital stenosis. The final external outcome is similar to penoscrotal inversion flaps [see Figure 23].



Figure 23a

Long-term outcomes of pedicled rectosigmoid vaginoplasty.



Figure 23b

Long-term outcomes of pedicled rectosigmoid vaginoplasty.

VAGINOPLASTY POSTOPERATIVE CARE

After the procedure, the patient will stay in the hospital for the acute recovery phase, typically 3 days. The patient will remain on bed rest the day of surgery and will begin to ambulate on postoperative day 1. Sequential compression devices are used in lieu of chemical DVT prophylaxis given the high risk of bleeding. Postoperative antibiotics, typically amoxicillin/clavulanate, are continued until the Foley catheter and vaginal packing are removed to prevent the theoretical risk of toxic-shock syndrome. After discharge, normal restrictions apply, including no lifting more than 20 lb, no strenuous physical activity, and no smoking or alcohol consumption for 1 month. The patient must refrain from taking baths and water submersion for 2 months and abstain from sexual intercourse for 3 months following surgery.

The first postoperative appointment takes place 5 days after surgery. Estrogen-containing hormones can be restarted at this time. The Foley catheter, bolster, Penrose drain, and vaginal packing inserted during surgery will be removed. For the first month, the patient is seen weekly. Subsequent follow-up visits occur at months 3, 6, 9, and 12. Once the vaginal packing is removed, the genital area should be kept dry. Following urination or bowel movement, the genital and rectal area is gently rinsed by spraying with warm soapy water and then patting dry. Douching with water and vinegar or a non-scented premixed douche will start on day 10 and continue every other day for the first 2 months following surgery and then once or twice weekly thereafter.

Self-dilation is a critical component of the postoperative care, and frequent follow-ups are needed to ensure that the patient is performing it correctly. For the first 3 months, the patient dilates three times daily for 10 minutes each time. From months 3 to 6, the patient dilates once daily. From months 6 to 9, the patient dilates every other day. Beyond 9 months, the patient dilates once or twice weekly. Every 3 months, the patient will increase the size of the dilator she is using [see *Figure 24*]. For the life of the patient, she should dilate or have penetrative intercourse (after the 3-month wait period) a minimum of once or twice a week to maintain the depth and girth of the neovagina following penoscrotal inversion flap. The dilator should be cleaned prior to insertion. A water-based lubricant is applied, and the dilator is inserted at an angle of 45° until under the pubic bone and then straight inward into the full depth of the vagina. If a great amount of resistance or severe pain is experienced, insertion should be stopped and a smaller dilator should be tried. The frequency of dilation should be increased if the vagina begins to feel tight. Without dilator use or subsequent routine penetrative intercourse, the neovagina will close. In cases in which vaginal tightness persists despite the implementation of a more rigorous dilation schedule, intravaginal triamcinolone injections can be performed, particularly if there are any distinct bands. In more

severe cases, scar contracture release will need to be performed in an operating room setting, which is typically deferred until 9 to 12 months postoperatively.



Figure 24

Vaginoplasty dilator kit (Soul Source, North Hollywood, CA).

Vaginal discharge that is brownish yellow is expected in the first 4 to 6 weeks postoperatively. Drainage and some degree of bleeding can persist up to 3 months. To keep the area dry, patients are encouraged to use gauze, sanitary pads, or adult incontinence diapers and to change them frequently. Labial swelling is to be expected and will gradually resolve, with the majority of the swelling gone by 3 months, but in many cases, residual swelling can persist up to 1 year. The use of ibuprofen (which is started at 5 days postoperatively) and applying ice on the perineum for 20 minutes every hour can help relieve swelling. Arnica is also recommended to our patients as it has

been shown to improve inflammation, swelling, and ecchymosis.⁴⁷ It is typically started 2 days prior to the operation and continued for 2 weeks postoperatively.

OUTCOMES

Goals of vaginoplasty include producing an aesthetic vulva, creating a vaginal canal that enables penetrative intercourse, and maintaining clitoral sensation to achieve orgasm. Patients report high satisfaction with cosmetic appearance, vaginal depth, clitoral sensation, and ability to achieve orgasm following either penoscrotal inversion or pedicled intestinal flap.⁴¹⁻⁵⁰ Low rates of dyspareunia are reported after vaginoplasty by either technique. Mucorrhea is reported with the pedicled intestinal flap but resolves with time.^{41,49}

Patients can engage in receptive sexual intercourse at 3 months postsurgery. They are advised to proceed carefully, and if there is significant discomfort or bleeding, then it should be discontinued and reattempted after 2 weeks. The neovagina after penoscrotal inversion does not self-lubricate, so patients are advised to use generous amounts of lubrication. Orgasms are typically achieved by the sixth to ninth postoperative month after neurapraxia of the dorsal nerve has resolved.

COMPLICATIONS

Despite favorable functional and aesthetic outcomes, complications and the need for secondary revision surgeries are common following vaginoplasty [*see Table 5*].²⁻⁵¹

Table 5 Complications and Associated Rates Following PI⁴⁹

<i>Complication</i>	<i>Complication Rate (%)</i>
Neovaginal stricture of introitus	4.2–15
Partial vaginal necrosis	2.7–4.2
Clitoral necrosis	1–3
Rectovaginal fistula	0.8–17
Neovaginal prolapse	1–2
Urethral stenosis	1–6
Local abscess	5
Subcutaneous hematoma	4–6
Surgical bleeding	3.2–10

PI = penoscrotal inversion.

After penoscrotal inversion, potential complications include bleeding, infection, vaginal/labial/clitoral necrosis, vaginal or urethral stenosis, excessive erectile tissue, vaginal prolapse, rectovaginal fistula, inadequate vaginal depth or girth, granulation tissue, sensation changes (loss of sensation, hypersensitivity, excessive pain, or paresthesias), anorgasmia, dyspareunia, painful sex, scarring, and unsatisfactory aesthetic results. Bleeding is the most common complication, with reports of 10% of patients experiencing clinically significant bleeding postoperatively.⁴⁹ The corpus spongiosum surrounding the urethra is the primary source of hemorrhage. Labial hematomas are relatively rare; however, they can occur and require surgical drainage [see *Figure 25*].²⁻⁵⁰ Infections can include cellulitis and urinary tract infections, which can be treated with oral antibiotics. Folliculitis may occur, which is treated with permanent hair removal. Local abscesses were observed in 5% of patients, as reported in the literature. Necrosis of the neovagina ranges from 2.7 to 4.2%, whereas necrosis of the clitoris ranges from 1 to 3%.⁴⁹ In cases of necrosis, sharp serial débridement is performed (typically in the office), as well as frequent gauze dressing changes. In the majority of cases, these areas heal well by secondary intention [see *Figure 26*].



Figure 25

Labial hematoma requiring surgical drainage.



Figure 26a

Necrosis following vaginoplasty and healing by secondary intention. (a) One month postoperatively.



Figure 26b

Necrosis following vaginoplasty and healing by secondary intention. (b) Two months postoperatively.



Figure 26c

Necrosis following vaginoplasty and healing by secondary intention. (c) Five months postoperatively.



Figure 26d

Necrosis following vaginoplasty and healing by secondary intention. (d) One year postoperatively.

Urethral stenosis occurs in an average of 5% of cases and typically presents approximately 2 months postoperatively. Stricture causing reduction in urine flow or urinary retention will often require catheter dilation or revision.²⁻⁵⁰ Introital stricture requiring revision occurs in an average of 12% of cases.⁴⁹ Treatment can involve scar contracture release, Z or W plasties, or a Y-to-V advancement of an inferiorly based perineum flap into the introitus [see *Figure 27*].

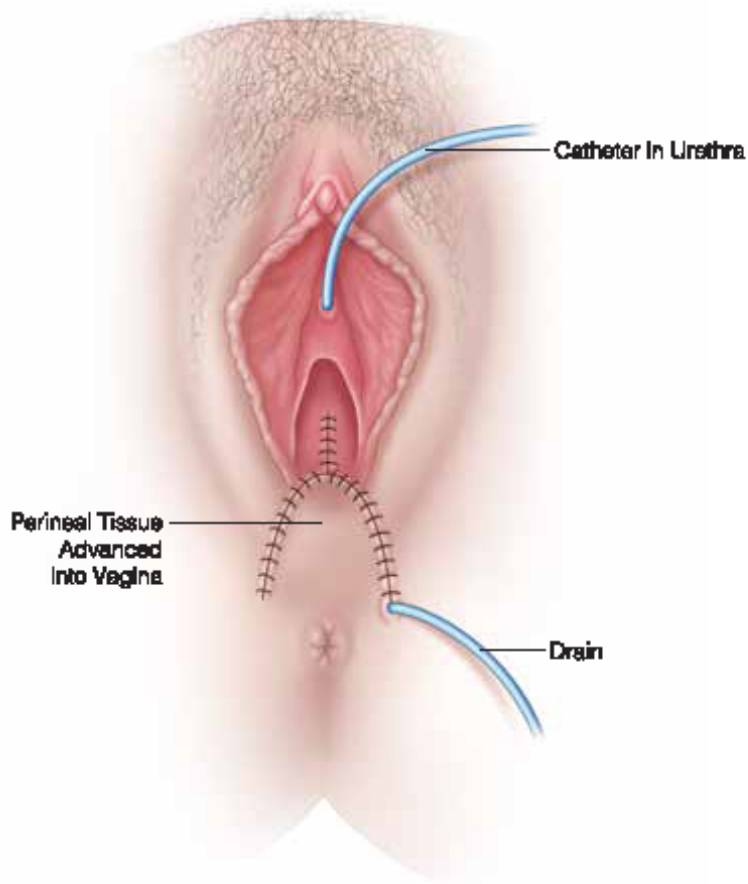


Figure 27

Y-to-V advancement of inferiorly based tissue from perineum into vaginal introitus performed to treat vaginal contractures or stenosis. This adds soft healthy tissue into vagina and increases circumference.

Additional neovaginal complications include prolapse and stenosis. Prolapse occurs rarely, in 1 to 2% of patients, whereas significant stenosis occurs in 2 to 10% of patients. Loss of depth and girth occurs secondary to loss of skin or failure to adhere to the recommended dilation schedule.

Remedies can include dilation under analgesia or anesthesia or secondary deepening procedures using skin grafts or rectosigmoid colon secondary vaginoplasty.²⁻⁵⁰

In general, fistulas are quite rare. These include rectovaginal, urethrovaginal, and vaginocutaneous fistulas. Rectoneovaginal fistulas manifest in approximately 1% of patients. The suspected etiology is breakdown of the anterior wall of the rectum secondary to an unrecognized bowel injury at the time of the operation or a vascular insult.^{2,49} Recognized bowel injury during the operation warrants an immediate intraoperative general surgery consultation if deemed necessary by the surgical team. In most cases, the rectal injury can be repaired primarily, and the operation can be completed.

Sensory changes are a potential postoperative complication. It is not unusual to have temporary numbness throughout the area. Neurapraxia typically resolves by 9 months to 1 year. In cases of hypersensitivity, particularly around the clitoris, topical anesthetic can provide relief. Persistent neuropathic pain throughout the pelvic floor, labia, or neovagina can be treated with physical and behavioral therapy, medications such as gabapentin, or pudendal nerve blocks (using a mixture of bupivacaine and triamcinolone). If patients experience pain and difficulty with penetrative sexual intercourse, excessive erectile tissue (bulbospongiosum) at the base of the urethra may be the culprit. With sexual excitement, this erectile tissue becomes engorged at the level of the introitus, impeding penetration. This requires surgical removal of the erectile tissue in the operating room.

Granulation tissue can develop within the vagina or along the urethra, labia minora, and clitoris. This can result in persistent bleeding, and when it occurs within the vagina, granulation tissue can impede penetration. Topical silver nitrate is the first-line treatment. In recurrent or severe cases, electrocautery ablation or direct excision may be required.

The patient may request aesthetic refinements. These are performed once full healing has occurred, typically at 1 year. Procedures include clitoral hood creation, labiaplasty to create more prominent labia minora, and modifications of the labia majora to either increase volume (fat grafting) or to decrease projection (liposuction or direct lipectomy). Prominent scars along the incision line can be treated with silicone creams, massaging, or triamcinolone injections in severe cases. If follicles were not appropriately removed, hair may grow within the vagina, creating a nuisance. It can affect hygiene and interfere with penetrating sexual intercourse. Treatment requires electrocautery ablation.

Complications of the pedicled intestinal flap include neovaginal stenosis, mucosal prolapse, diversion colitis, adenocarcinoma, junctional neuroma, and intestinal obstruction. Although the frequency of complications varies by surgeon, introital stricture appears to be the most common

complication.⁴¹⁻⁵² Prolapse reportedly occurs in an average of 7.7% of patients. Dreaded complications, including diversion colitis, adenocarcinoma, junctional neuroma, and intestinal obstruction, are rare in the literature.^{41,49}

Conclusion

Advancements in plastic surgery have allowed for innovative approaches to male-to-female gender-confirming surgery. Operative techniques are still evolving, and more research is needed to determine outcomes and standardization of approaches for both top and bottom surgery in male-to-female transgender patients. Continual refinement of the procedures will allow plastic surgeons to restore a patient's sense of psychosocial and sexual completeness that is congruent with the patient's true gender.

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