

Masculinizing Genital Gender Affirming Surgery

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Key Points

- Masculinizing genital gender-affirming surgery includes a wide range of procedures and options, including metoidioplasty, phalloplasty, urethral lengthening, vaginectomy, clitoris transposition, scrotoplasty, glansplasty, and implant of penile and testicle prosthetics
- Key decisions patients must choose from include choice between metoidioplasty versus phalloplasty, urethral lengthening versus perineal urethrostomy, and donor site location
- Patient preparation includes mental health, social, and medical readiness evaluations, informed discussion about all surgical options, and permanent hair removal
- Patients must be nicotine-free, have stable weight with a BMI of approximately 30 or less, and be counseled regarding expectations of surgical results, recovery, and possible complications
- Owing to potential long-term complications with some options, patients should ensure that they are able to return to their surgeon when needed for management of complications
- See Reference 1

1. WPATH Standards of Care Guidelines Requirements for gGAS

Genital surgery is often among the last and most carefully considered step in the treatment process for gender dysphoria. Genital gender-affirming surgery (gGAS) has been shown to be effective and medically necessary in the treatment of gender dysphoria.^{1,2,3,4} Many, but not all, transgender people desire gGAS for the management of their gender dysphoria. It is important for surgeons to consider that not all patients who seek gender-affirming surgery (e.g. facial, voice, chest, gynecologic, genital, and body-contouring surgeries) seek all of these and/or prioritize them in the same way.

World Professional Association for Transgender Health (WPATH) has provided evidence-based care

guidelines, *the Standards of Care v. 8.0* (2022),¹ to inform and guide the care of mental health, medical and surgery providers who care for transgender patients. These guidelines acknowledge that there are circumstances where flexibility must be allowed, as patients may have unique social and/or medical circumstances, where the overall well-being of the patient must be considered when following these guidelines. It is important for providers to be familiar with these SOC Guidelines because most U.S. health agencies (e.g. U.S. Department of Health and Human Services), government health programs (Medicaid, Medicare) and commercial health insurance companies endorse these guidelines and in many cases adopt them as care standards.^{1,5}

The WPATH *Standards of Care v. 8* recommend that patients who plan to undergo gGAS meet the following criteria:⁶

- a. Gender incongruence is marked and sustained;
- b. Meets diagnostic criteria for gender incongruence prior to gender-affirming surgical intervention in regions where a diagnosis is necessary to access health care;
- c. Demonstrates capacity to consent for the specific gender-affirming surgical intervention;
- d. Understands the effect of gender-affirming surgical intervention on reproduction and they have explored reproductive options;
- e. Other possible causes of apparent gender incongruence have been identified and excluded;
- f. Mental health and physical conditions that could negatively impact the outcome of gender-affirming surgical intervention have been assessed, with risks and benefits have been discussed;
- g. Stable on their gender affirming hormonal treatment regime (which may include at least 6 months of hormone treatment or a longer period if required to achieve the desired surgical result, unless hormone therapy is either not desired or is medically contraindicated).*

* These were graded as suggested criteria

Though not a requirement, patients should at a minimum have access to a mental health provider with whom they have established care.¹ It is recommended that those with more significant mental health histories and/or ongoing mental health medical management establish a visit schedule before and after surgery.

A good referral letter also highlights any issues that the letter writer identifies that warrant attention from the surgeon, and/or, important factors that could change in the near future, such as stable housing, financial independence sufficient to allow the patient to travel to see their surgeon when needed, stable access to health insurance services, and any unstable medico-social circumstances.¹

Ideally, the surgery referral letter should have the mental health professional's contact information so that the surgeon can in turn include the mental health provider in the ongoing care of the patient during and after surgery.

2. Surgery Related Goals and Decision Making Discussion

Common surgery-related priorities for patients seeking masculinizing surgery regarding appearance

and function parameters with genital gender-affirming surgery (gGAS) include:⁷

1. Elimination of visible anatomy/features associated with the sex they were assigned at birth
2. To have a "normal appearing" penis that, regardless of size, passes as generally similar to the penis of a cisgender man
3. A penis whose size approximates adult-size (what phalloplasty can offer), versus a significantly smaller penis (what metoidioplasty offers)
4. The ability to stand to urinate
5. The ability to achieve erection for insertive intercourse
6. Penis tactile and erogenous sensation
7. Appearance, location and function of the donor site (e.g. forearm, versus anterior thigh, versus abdomen, versus flank; desire to spare tattoos and/or to not incorporate tattoos to the penis)

Other equally important priorities and quality of life considerations related to surgery decision-making include:

8. Decreased risk of intra-operative and/or long-term complications that necessitate repeat visits and surgery
9. The net duration of the surgery pathway (i.e. the overall time required to complete all planned stages of gGAS surgery)
10. The personal and financial cost of ensuring future access to urgent and routine care

How and in what order patients prioritize the surgery-related appearance, function, and quality of life factors always varies from individual to individual. Generally, no single surgery choice can achieve optimal outcome for every factor, and compromise is needed on some priorities. Hence, as part of the informed decision-making process the surgeon should discuss each of these factors, and help the patient correlate how different surgery choices and staging strategies can meet their priorities.^{8,9,10,11,12}

The following table illustrates the ranked priority factors associated with those patients seeking masculinizing surgery who chose phalloplasty.¹³

Decision-Making Factor	Mean Ranking	Std. Dev.	Highest Ranking (1-9)	Lowest Ranking (1-9)
Elimination of birth anatomy (female genitalia)	2.6	2.6	1	8
To have a “normal appearing” penis (i.e., to have a penis that, regardless of size, passes as “generally similar” in appearance to a cis-man’s penis)	4.1	3.8	1	11
Penis size that approximates average or above average for a many my age	4.7	2.8	1	10
Ability for my new penis to become sufficiently erect so I can have insertive sexual intercourse	5.1	3.9	2	14
Preservation of erogenous (i.e., sexual) sensation of my new penis	5.6	1.7	3	8
Preservation of tactile (i.e., general, nonsexual touch) sensation of my new penis	5.7	1.5	3	8
To minimize the need for additional urgent doctor visit(s) to manage post-surgery complications	8.1	2.1	4	11
The visibility/appearance of the phalloplasty donor site (e.g., arm, thigh, or other donor site) during day-to-day activities	8.3	4.1	4	13
To minimize the need for additional corrective surgeries to manage post-surgery complications	8.6	2.9	3	12
The preservation of normal function of the donor site (i.e., where the skin flap is taken from on my body should continue to function normally)	9.1	2.8	4	14
Ability to urinate from a standing position	9.1	4.6	2	14
To minimize the overall time required to complete ALL of my genital gender-affirming surgeries	9.6	1.7	6	11
To minimize the time away from work to have and recover from my genital gender-affirming surgery	11.6	1.6	8	13
To avoid significant, long-term limitations on my ability to perform my job duties	12.7	1.7	9	14

Table 1

Surgery decision-making can require having to accept that achieving a given priority may come at the cost of accepting lesser priority of another.⁸ For example, a patient may desire phalloplasty with urethral lengthening, testicular implants, and a penile prosthesis, but this patient lives in a part of the country where there are few or no gGAS surgeons available, and this person has a history of stone disease. This patient must consider several factors: phalloplasty with implant of prosthetics by necessity requires a staged-approach, and urethral lengthening increases the risk of future complications (stricture, fistulae) as compared to perineal urethrostomy. Living far from their surgeon and trans-specialized urgent-care services requires that they must be prepared to manage possible urgencies locally until they travel to see their surgeon for ongoing care. They should also be counselled that their history of stone disease should make them strongly reconsider choosing urethral lengthening, as cystoscopy and other transurethral procedures will be much more difficult with a phalloplasty urethra.

Approaches to discussing masculinizing gGAS surgery options:

Though surgeons often have their own approach to presenting an overview of surgery options, the degree of detail and emphasis is driven by what surgery options the particular surgeon offers. Surgery options that they do not offer, or offer with equal skill, can sometimes be neglected. If we begin by accepting that surgery decision-making with gGAS must as much as possible be patient centered and a thoroughly *informed* decision-making process, then it follows that patients should be presented with *all* surgical options, in a way that offers as much choice as possible—even if this includes referral elsewhere for a surgical option not offered by the evaluating surgeon.

When we introduce masculinizing gGAS options to patients, we have found it useful to emphasize these two points: 1. Surgery options can be divided into those that yield a penis of the approximate size of their present “small penis” (i.e. native clitoris) (metoidioplasty), versus surgeries that yield a larger penis (i.e. similar in size to an adult man) (phalloplasty); 2. There are additional surgeries (e.g. hysterectomy, urethral lengthening, vaginectomy, scrotoplasty, clitoris transposition (elimination of the clitoris from view), glansplasty) that are also offered.^{1,14} Most of these additional surgeries (though not necessarily all) can be combined with metoidioplasty or phalloplasty according to the patient’s wishes.

3. Surgery Options

There are alternatives to the surgical techniques presented herein. The field of gGAS is still developing and there are few gold standard approaches to the various surgeries. Please consult the references for alternative approaches and perspectives.

3.1 Hysterectomy and oophorectomy

Most patients undergo removal of the uterus and ovaries earlier in life than genital reconstruction, as menstruation and symptoms associated with the menstrual cycle can be triggering of gender dysphoria.² Patients should be reminded that hysterectomy and oophorectomy will eliminate some or all remaining fertility options. Some providers offer preservation of a single ovary to maintain sex hormones for medical and fertility preservation purposes.^{15,16,17} Patients should consult with a provider with expertise in fertility preservation to discuss the risks and benefits of these surgery options. With any patient considering fertility preservation, it is helpful to also share basic “downstream” information about the ramifications of fertility preservation and costs (for example, the local cost to bank oocytes), that fertility preservation commits them to using some form of assisted reproductive techniques (ART), and that many ART require future out-of-pocket costs for the patient.^{17,18}

Patients should also be counseled that some open surgical approaches for hysterectomy and oophorectomy could potentially compromise specific phalloplasty options, such as using the deep inferior epigastric vessels for the recipient site. If an open¹⁹ surgical approach is planned, the patient’s gGAS surgeon and gynecologic surgeon should confer pre-operatively to review. In general, a laparoscopic hysterectomy, which avoids incisions in the suprapubic region, would be safe for most commonly used flaps for phalloplasty.

At one point, vaginal hysterectomy was not recommended for transgender men, as they typically had lower parity than cisgender women, and that testosterone exposure led to vaginal atrophy, which could make vaginal hysterectomy more challenging.²⁰ However, more recent work suggests that vaginal hysterectomy can be a safe and effective option for transgender men.²¹

3.2 Overview of surgical options for creation of a neophallus

When speaking to patients about gGAS one should make every effort to use gender-affirming

terminology. One should refer to the phallus which is constructed for the patient as a penis. Many patients prefer using the term “small penis” instead of “clitoris” during discussions. Trans-masculine individuals on testosterone hormone therapy (HT) commonly achieve maximal clitoral hypertrophy after ~ 2 years of HT.^{22,23}

Transgender men generally have two options **to create a phallus**:

1. Create a phallus using the virilized/enlarged clitoris, by a surgery called **metoidioplasty**
2. **Phalloplasty**, where an altogether new (and larger sized) phallus is created from skin outside the genital area, using free or pedicled skin-flaps harvested from surrounding areas of their body (e.g. 1. Forearm; 2. Anterior-lateral thigh (ALT); 3. Groin area; 4. Suprapubic)^{7,24,25}

Important differences between these two options: Metoidioplasty has the *potential advantages* of not requiring a skin donor site and typically has completely preserved tactile and erogenous sensation. *Potential disadvantages* include that the resulting penis is relatively small, as compared to an adult penis.

Phalloplasty has the potential advantages of affording some degree of choice regarding phallus dimensions, including creation of a phallus similar in size to an adult cisgender man’s penis. Also, implantable prosthetic devices manufactured for cisgender anatomy can be used with most neophalluses to create an erection sufficient for sexual intercourse. Relative disadvantages include the morbidity of the skin donor site, and the potential for a greater number of short- and long-term complications. There can also be variable sensation to the phallus, depending on the technique.

3.3 Overview of associated component masculinizing genital surgeries

Each of the aforementioned masculinizing surgeries can be combined with some or all of the following optional **gGAS component surgeries** below to achieve specific appearance-related and function-related outcomes:

1. *Urethral lengthening* – to provide the ability to stand to void
2. *Perineal urethrostomy* – transposition of the urethral opening to a location posterior to the neoscrotum
3. *Vaginectomy* – 1. elimination and closure* of the vaginal introitus and vaginal canal (referred to by many transgender and gender non-conforming men as the “front hole” or “front opening”) (*requires hysterectomy); or 2. preservation of the vaginal introitus and canal (with or without hysterectomy)
4. *Transposition of the clitoris* — reposition of the clitoris to allow concealment
5. *Scrotoplasty* – creation of a neoscrotum using skin from the labia majora
6. *Glansplasty** – (*with phalloplasty only) creation of a coronal ridge
7. *Implantation of testicular prostheses*
8. *Implantation of a penile prosthesis for erection function*

3.4 Metoidioplasty and associated surgeries

Although many patients who choose metoidioplasty desire to stand to void, and thus undergo urethral lengthening, hysterectomy/vaginectomy, and creation of a scrotum,^{26,27} metoidioplasty can be performed with or without urethral lengthening,²⁸ with or without scrotoplasty and with or without vaginectomy. (**Figure 1**)

Figure 1



Figure 1

Two-stage metoidioplasty with urethral lengthening (A-J), and metoidioplasty with preservation of the vaginal canal (K-N).

Stage I (A-F): The anterior ends of the labia majora are transposed to the level of the base of the small penis (**A, upper arrows**). This serves to make the small penis more visible and appear more naturally in line with male anatomy, where the scrotum is typically not anterior to the base of the penis. The blood supply to the labia majora is from vessels located at the anterior

and posterior ends (**A, upper and lower arrows**). To avoid the risk of compromising both sources of blood supply simultaneously, only the anterior ends of the labia majora are transposed inferiorly (**D,F, K-N**). A testicle can be inserted through this inverted “V” shaped incision (**D,N**); the wound is closed in a “V-Y-plasty” fashion (**L**). The posterior ends of the labia majora are transposed anteriorly at Stage 2 surgery, together with vaginectomy.

The ventral plate of the enlarged (virilized) clitoris is incised (**B-C**), and then buccal mucosa graft is onlaid (**D**) for future tubularization during Stage II surgery to create the neourethra. Punctate openings in the buccal mucosa onlay are made with a fine needle to allow seroma fluid drainage to drain. The onlay is secured to the ventral plate with a small number of quilting sutures. An indwelling urinary catheter is inserted into the urethra and bladder, and the buccal mucosa onlay is dressed with Xeroform petroleum jelly gauze, overlaid with gauze and compressed with bolster sutures placed through the labia majora on either side (**E**) to optimize wound healing and graft take.

At completion of Stage I surgery (**F**), the ventral plate has been augmented with buccal mucosa and is ready for tubularization in Stage II, and more capacious inferiorly located hemi-scrotums contain testicle prostheses. The native urethral opening, vaginal canal, and posterior scrotums remain intact and unchanged.

Stage II metoidioplasty: Stage II begins with cystoscopy and Suprapubic Catheter Tube placement (**G, red arrow**). The neourethra is created by tubularizing the mucosa of the ventral aspect of the clitoris over a catheter (**G**). A 2-cm-wide plate of mucosa is outlined in ink. Note that a 1.5 cm long flap of anterior vaginal wall mucosa (**yellow arrow**) can be incorporated and rotated anteriorly, to help cover the proximal-most portion of the neourethra. After creating the neourethra, the remaining clitoris shaft is then tubularized to surround the neourethra (**H**). The posterior ends of the labia majora are mobilized, rotated medially and anteriorly, and sutured together (**I-J**).

Metoidioplasty with preservation of the vaginal canal: Patients who desire metoidioplasty with preservation of the vaginal canal can undergo variations of metoidioplasty as described in **A-J**. Lengthening of the clitoris suspensory ligaments and urethral lengthening can be performed in two stages as shown previously. If desired, a modified scrotoplasty can be performed, together with

testicle prosthesis implant, during Stages I-II, or, later (**K-N**). The rugated skin of the labia majora often extends anterior to the base of the small penis (**K**). A “V→Y plasty” can be performed to transpose this skin posteriorly, so that the penis is more visible and appears more in line with normal male genital anatomy (**L**). The resulting scrotal skin flanks the intact and otherwise healthy vaginal opening (**M**). If desired, testicle prostheses can be placed later (**N**).

4. Surgical Techniques

4.1 Clitoris release / lengthening

Despite hypertrophy, the native clitoris is relatively short^{26,29} when compared to the length of an adult cisgender male’s penis (mean approximately 5 inches).^{29,30,31} To augment length, the suspensory ligaments of the clitoris may be incised. Incision of the suspensory ligaments is safer upon the anterior surface of the pubic symphysis, whereas the closer to the base the dissection is carried, the greater the chance that the dorsal nerves or their branches can be injured.

Another length constraint for the clitoris is the fact that its ventral aspect is naturally shorter than its dorsal aspect. This natural chordee can be released by making a horizontal incision along the mucosa of its ventral plate. Doing so allows the shaft to become straight during stretch. The degree of net clitoris length (with the clitoris gently stretched) that can be gained by incising the suspensory ligaments and incising the ventral plate is modest, and limited to ~2 cm, though there are reports of achieving greater increased length.²⁶

Incision of the ventral plate to repair the chordee leaves a non-epithelialized area on the ventral shaft. When the patient wishes to undergo urethral lengthening, this area is covered with buccal mucosa graft during the first stage of a two-stage urethroplasty. Alternatively, urethral lengthening in a single stage using a combination of buccal mucosa graft as a dorsal onlay has been described, combined with use of a fasciocutaneous flap harvested from one of the labia minora, as a ventral onlay to complete the neourethra.³² If the patient does not elect to undergo urethral lengthening, then some of the redundant clitoris shaft skin can be released and rotated to cover this non-epithelialized area.

4.2 Urethral lengthening

Metoidioplasty can be performed either *with* or *without* urethral lengthening surgery.^{28,33,34} A common reason why a patient might wish to forego urethral lengthening is to avoid the increased peri-operative and long-term risks associated with urethral lengthening, which can include urinary obstruction, urethral strictures, and/or urinary fistulae.^{27,35,36}

Similar to proximal hypospadias surgery, local hairless skin flaps and/or grafts are used to create a short neourethra that connects the site of the native urethral opening to the tip of the new penis made from the native clitoris.^{37,38,39} In the terminology commonly used with masculinizing genital

gender-affirming surgery, the portion of the neourethra that connects the native urethral opening to the base of the pendulous portion of the new phallus is called the *pars fixa*, while the segment of neourethra that spans the pendulous portion of the phallus is referred to as the *pars pendulosa*.^{5,40} With the urethral opening at the tip of the new penis (**Figure 1, H-I**), the patient can urinate from a standing position, and direct his stream by holding the tip of the penis.^{5,41,42}

4.3 Vaginectomy

Hysterectomy alone, or hysterectomy combined with vaginectomy, can be offered with metoidioplasty. If the patient wishes to forego vaginectomy, it should be explained to him that urethral lengthening is still possible, but there is increased risk of neourethral complications.⁴³ When a patient wishes to undergo vaginectomy but forego urethral lengthening, the vaginal canal is closed (vault to introitus), but we can exclude the portion surrounding the urethral meatus (a modified *colpocleisis* procedure) to allow the patient to void.

Vaginectomy can be performed sharply by excising the vaginal wall mucosa, or by vaporization of the vaginal canal mucosa, so that the latter can no longer produce mucus secretions, as accumulation of secretions result in mucocele or lead to a persistent vaginal canal space.^{44,45}

The deepest portion of the vaginal vault can be resected together with the uterus at the time of laparoscopic hysterectomy. It is preferable that the hysterectomy be performed at least 3 months before vaginectomy, so that the vaginal vault is well healed when vaginectomy is performed. At the time of vaginectomy, the skin and vaginal epithelium of the introitus is excised sharply. The vaginal canal mucosa is then vaporized.

To do so, a narrow speculum is inserted so that the deepest portion of the vaginal vault can be stretched flat and visualized well. A ball-tip Bovie can then be used with the high Cut current (generally 70) together with suction to remove smoke from the field, the entire surface of the remaining vaginal canal is systematically fulgurated.⁷ (**Figure 2**) A drain is placed in the canal prior to closure of the vaginal canal by sequential placement of sutures starting from the deepest part of the vagina.²⁴

Figure 2

Vaginectomy

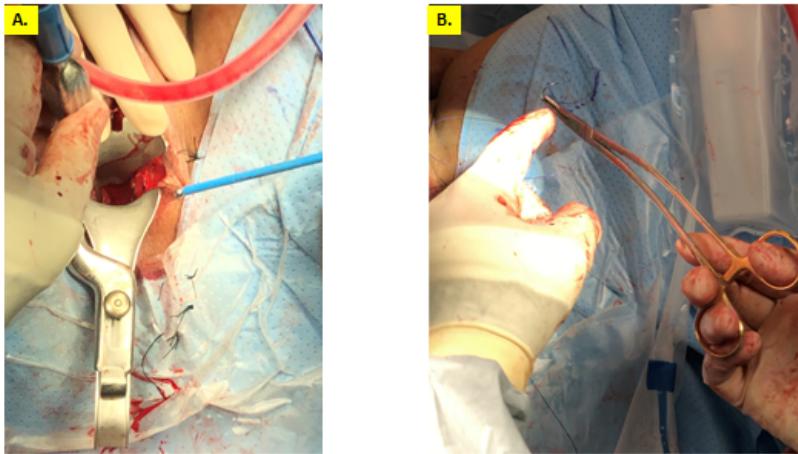


Figure 2

Vaginectomy. After the initial 2 cm of vaginal introitus mucosa are excised sharply, a narrow speculum is inserted into the vaginal canal. The entire vaginal canal lumen is surveyed, to ensure that no portion of the lining is folded on itself secondary to adhesions related to the excision of the vaginal cuff at time of hysterectomy. The vaginal mucosa is vaporized using a Bovie® ball-tip electrode, on setting 70-CUT. It is important to have suction in the field to collect the smoke that forms immediately with vaporization, which can obstruct visualization.

The mucosa is vaporized in quadrants by applying the Bovie via the lateral gaps of the speculum (shown here at 3:00 & 9:00). Vaporization is done systematically from deep within the canal towards the introitus, and then back again, (similar to mowing a lawn). Care must be taken to not apply the cautery too long in any one place, as it is not necessary and increases the chances of a deep burn. Care is also taken with the anterior portion of the canal (11:00 – 1:00), where the neourethra resides, and at ~5:00 – 7:00, where the rectum lies, and is covered only by a thin layer of Denonvillier's fascia. By rotating the speculum, untreated portions of the canal are brought into view and vaporized.

4.5 Scrotoplasty

For a transgender man, the homologue of a cisgender man's scrotal skin is the *labia majora*. Both are similarly thick, and rugated, though the labia majora is typically smaller in area and lacks the tunical tissue layers of a cisgender scrotum. The principal blood supply to the anterior portion of the labia majora comes from vessel branches from inguinal vessels, while the blood supply for the posterior portions comes from the perineum.

The homologue of a transgender man's labia minora skin for a cisgender man is the raised *median raphe* of the scrotum and penis.⁴⁶ Labia minora skin is typically thin and non-rugated, and for these reasons looks out of place on the neoscrotum. The labia minora are typically excised and discarded.

The labia majora can extend anteriorly and superiorly to the base of the small penis. In such cases, the labia majora skin effectively surrounds the penis in a way that does not look "normal" for a scrotum (i.e. similar to penoscrotal transposition in children).⁵ (**Figure 3, A, B**)

With metoidioplasty, the small penis resides in its orthotopic location. It is desirable to move the anterior labia majora skin more posteriorly and the posterior labia majora skin more anteriorly. Doing so not only eliminates rugated skin from surrounding the penis, but also makes the penis more visible. Doing so also centers the neoscrotum, and by concentrating more skin in a smaller area, it yields the redundant skin necessary to give the scrotum a "sac-like" appearance (**Figure 3, C**).

Figure 3

Metoidioplasty Scrotoplasty

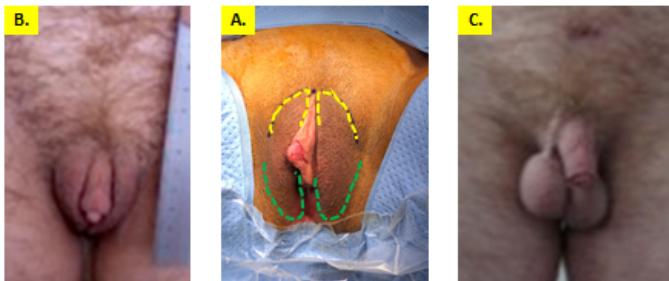


Figure 3

Metoidioplasty Scrotoplasty. The labia majora extend anterior to the clitoris/small penis (**A**) it is desirable to transpose the anterior portion of the labia majora (**B., yellow lines**) posteriorly, and to transpose the posterior portion of the labia majora anteriorly (**B., green lines**). This should be done in two stages to not interrupt all the dominant blood supply to the labia majora (which is located at the anterior and posterior ends of each labium) at once.

Of note, with phalloplasty, the phallus will be placed adjacent to the anterior end of the labia majora. Therefore, it is not necessary to transpose the anterior end with phalloplasty. However, the posterior end of the labia majora will be transposed anteriorly during Stage I or Stage II phalloplasty.

4.6 Implant of testicular prostheses

Solid silicone or saline-filled testicular prostheses can be inserted into the neoscrotum. Systemic broad spectrum antibiotics are administered at time of surgery, and the prosthetic is kept soaking in antibiotic-infused saline up to the moment of insertion. If insertion occurs at the time of anterior scrotoplasty, the testicle is inserted via the inverted “V-shaped” incision at the anterior edge of the labia majora⁵ (**Figure 1D**). Alternatively, if the scrotum has already been constructed, each testicle is inserted via a ~2 cm. curved incision, along the superior-lateral edge of the neoscrotum (**Figure 1M-N, green hatch-lines**).

Before insertion, a subdartos dissection is performed using a Kelly clamp; hemostasis is achieved using fine bipolar forceps. It is important to not dissect anterior to the incision, or too posteriorly, because after insertion the testicle will migrate to these undesired dissected areas. The wound is irrigated with antibiotic saline before insertion of the testicle prosthesis. The wound is then closed in three layers of interrupted sutures.

When a patient complains of a testicle that resides in an undesired location (e.g. too far anteriorly), an effective approach is to remove it intraoperatively so that a purse-string suture (e.g. PDS) can be placed exactly where it begins to migrate. The testicle is thoroughly washed in antibiotic infused saline and the scrotum is irrigated copiously with antibiotic solution before replacing the prosthesis.

4.7 Erectile function & penile prosthetics

There are several relative challenges for patients to achieve satisfactory erectile function with metoidioplasty. The typically short length of the metoidioplasty phallus can preclude satisfactory insertive intercourse.^{5,7,26}

A variety of wearable prosthetics, wherein the penis/phallus is inserted inside a longer and more rigid prosthetic penis used for penetration, are manufactured commercially both for trans and cisgender men. When patients demonstrate interest in pursuing alternative devices, it can be suggested to them that they consult online pre- and post- phalloplasty forums, and to search for online vendors that cater also to the LGBTQ+ community, to learn more about innovative products that may meet their needs.

Metoidioplasty Staging:

Some surgeons perform metoidioplasty with urethral lengthening as a single-stage surgery. A flap of hairless skin from the labia minora can be rotated medially to cover the ventral aspect of the neourethra. Often, with single-stage surgery only the posterior ends of the labia majora are transposed so as to not compromise both sources of the local blood supply.^{26,39,47}

There are two main reasons that some surgeons prefer a two-stage approach to metoidioplasty. 1. If buccal mucosa is used as a graft for urethroplasty, doing this in a two-stage fashion allows optimal take and (if necessary) revision before tubularization; 2. It is likely not safe to mobilize both the anterior and posterior ends of the labia majora skin (these both carry the labia majora blood supply) in the same surgery. Mobilization of both anterior and posterior ends improves cosmesis and visibility of the penis, and improves the size and shape of the neoscrotum.

4.7.1 Metoidioplasty Staging

Stage I Metoidioplasty (*with* urethral lengthening):

1. Suspensory ligament release
2. Incision of the clitoris ventral plate to lengthen clitoris and eliminate chordae
3. Buccal mucosa graft harvest and onlay onto clitoris ventral plate
4. Transposition of the anterior ends of the Labia majora, inferiorly by “V-Y plasty” technique (with or without testicle prosthesis insertion via the V-shaped incision)

Stage II Metoidioplasty (*with* urethral lengthening):

1. Cystoscopy and SP tube catheter placement
2. Tubularization of the neourethra (ventral plate of clitoris, including healed buccal graft)

3. Vaginectomy (limited sharp excision, coupled with vaporization of vaginal mucosa)
4. Tubularization of the clitoris shaft around neo-urethra
5. Scrotoplasty, with excision of Labia minora, and transposition of posterior ends of the Labia majora anteriorly to create a single scrotal sac made of Labia majora skin

Stage I Metoidioplasty (*without* urethral lengthening):

1. Suspensory ligament release
2. Incision of the clitoris ventral plate to lengthen clitoris and eliminate chordee
3. Rearrangement of clitoris shaft skin to cover entirety of now lengthened shaft
4. Transposition of the anterior ends of the Labia majora, inferiorly by “V-Y plasty” technique (with or without testicle prosthesis insertion via the V-shaped incision)

Stage II Metoidioplasty (*without* urethral lengthening):

1. Scrotoplasty, with excision of Labia minora, and transposition of posterior ends of the Labia majora anteriorly to create a single scrotal sac made of Labia majora skin located immediately anterior to the native urethral opening
2. Vaginectomy (limited sharp excision, coupled with vaporization of vaginal mucosa)
3. Perineal urethrostomy utilizing the native urethral opening (location is immediately posterior to the neo-scrotum)

5. Phalloplasty and associated surgeries

5.1 Flap options and what each offers / does not offer

To construct a *full-sized phallus* (i.e. comparable in size to a cisgender man's penis), skin flaps (pedicled or free) can be obtained from several tissue sources:⁵

1. Forearm (radial artery forearm free flap (RFFF). Blood supply: based on the radial artery and its Venae comitantes. Sensory nerves: medial and lateral antebrachial cutaneous nerves) (**Figure 4**)
2. Anterior lateral thigh (ALT). Can be a pedicled or free flap. Blood supply: based on perforators from the descending branch of the lateral circumflex femoral artery. Sensory nerves: lateral femoral nerve⁵ (**Figure 5**)
3. Suprapubic (SP) pedicled flap. Pedicled only. Blood supply: based on local blood supply at the base of the phallus. No dedicated sensory nerve)^{5,24} (**Figure 6**)
4. Suprainguinal groin flap (GF). Pedicled. Blood supply: based on superficial circumflex iliac, superficial external pudendal, and superficial epigastric arteries anterior to the inguinal ligament; No dedicated sensory nerve)^{5,25}

Figure 4

Radial Artery Forearm (RAF) Flap

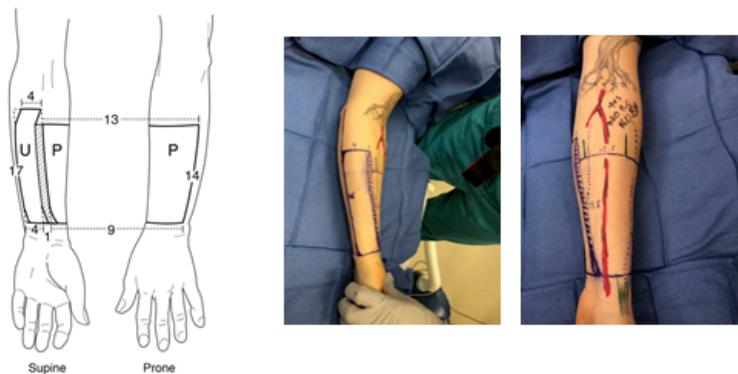


Figure 4

Radial artery forearm free flap (RFFF).

Drawing: This flap is typically harvested from the non-dominant arm. Care is taken to not harvest the flap too closely to the wrist. The distal end of the flap is located at the proximal-most wrist skin fold. The flap can nearly always yield a neourethra (U) in addition to skin from which to construct the phallus shaft (P). The final length of the phallus is based on patient preference. The length of the phallus (P) segment can be as desired, if below 15 cm. For a final phallus that is 5.25 inches in length, the U segment is typically 17×4 cm and the P segment is 14 cm long \times 9 cm wide (proximal flap width is 13 cm, mid flap width 11 cm, distal flap width 9 cm in length).

The urethral segment (U) is typically 4 cm longer than the phallus portion as the portion proximal to the base of the phallus will be used to construct the urethra below the phallus base. The urethra segment is 4 cm wide and will be tubularized with the skin surface inside the tube. A 1 cm-wide segment of skin located between the urethral and phallus segments (textured area) is de-epithelialized. This eliminates skin on the flap segment joining the tubularized urethral segment and the phallus segment of the flap.

Photographs: These show the flap markings, and the location of the radial artery within the flap.

Figure 5

Anterior Lateral Thigh (ALT) Flap

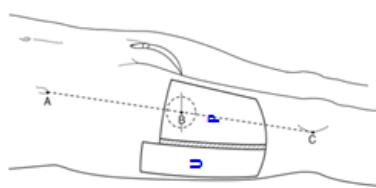


Figure 5

Anterior Lateral Thigh (ALT) Flap.

Drawing: The flap dimensions are almost identical to those used for a forearm flap. The exact location of the flap will depend on the location of the perforator vessels from the descending branch of the lateral circumflex femoral artery. The flap will be centered over these perforator vessels. The perforator vessels are usually found in the region (**B**) outlined with a hatched circle, which is usually located along a straight line at the half-way point between the anterior superior iliac spine (**A**) and the lateral aspect of the patella (**C**).

The urethral segment can be outlined on the lateral aspect of the flap (as shown) or on the medial aspect.

Figure 6

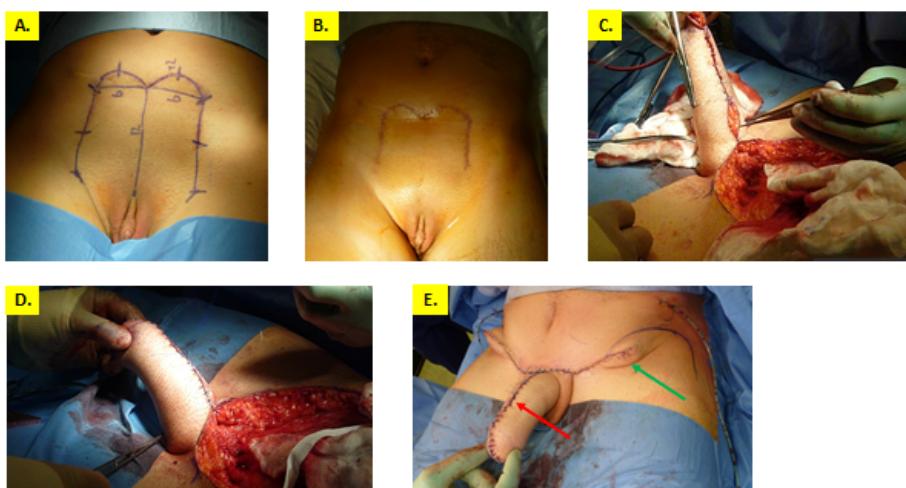


Figure 6

Suprapubic (SP) flap.

A. This is a midline flap. The flap is centered over the suprapubic area, with the posterior limit of the flap located along an invisible horizontal line that crosses the superior aspect of the clitoral skin fold. From the clitoral skin fold, the flap is typically 12 cm long at midline (see ink marking “12”). The flap will extend an additional 2 cm para-midline (see “+2” ink marking) atop two curved ends off midline, to render a net flap length of 14 cm. The flap is a net 12 cm wide. Only the outline of the flap (marked with heavy hatch ink lines) is incised.

B. When necessary, the flap can be raised in a delayed fashion, where the flap is elevated along its outline, and then sutured back into place. This both allows immediate declaration of the viability of the flap, but also, this forces the flap to develop collateral microcirculation to survive, making the flap more resilient when it is harvested in the future. At least 30 days is allowed to pass between the initial elevation and the harvest of the flap.

C. The cephalad end of the flap is first to be elevated off the anterior abdominal wall fascia. The dissection is carried caudally. Great care is taken to leave as much adipose tissue connecting the flap to abdominal wall fascia at the level of the groin folds, as this is the important source of blood supply to the distal ends of the flap. The flap is tubularized from distal to proximal (**C-D**).

E. The anterior abdominal wall is mobilized cephalad anterior to the flap donor site, so that it can be pulled down caudally to close the donor site. For this, the umbilicus is detached and re-sutured to the abdominal wall in a more caudal location.

Sutures and staples are used to close the wound. 1-2 dog-ears of skin are purposefully left intact (green arrow) so that this skin can be harvested for use as a full-thickness skin graft with the glansplasty at second-stage surgery. Note that the suture line on the phallus will be dorsal (red arrow).

Pre-operative patient decision making to choose a flap type based on what features each flap affords

There is no “one size fits all” approach to phalloplasty. Different patients have different priorities that may affect their choice of surgery. For example, some patients prioritize standing to urinate, while others prioritize the placement of an erectile device that would allow for penetrative intercourse, while others may prioritize both, or neither.

It is especially important to 1. Counsel patients thoroughly about potential complications of gGAS, and 2. Offer a net risk/benefits ratio that also include choices that offer significantly lower risk of post-op complications requiring additional surgeries.

Providers must consider that patients “don’t know what they don’t know” about short and long-term surgery risks and benefits, and surgeons “don’t know what they don’t know” about what each individual patient most wants to *gain* from surgery, and what specific outcomes each wants to *avoid*. Ultimately, different patients will prioritize potential gains and potential risks differently. The surgeon should articulate the all potential “gains” and “costs” of each surgery, to help patients arrive at an informed choice.

The vast majority of complications with phalloplasty (and metoidioplasty) come from the urethral lengthening (+UL) portion of the surgery, which allows the patient to urinate from the tip of his penis. Complications include strictures, fistulae, obstructive LUTS, and UTI's. These often require urgent management, followed by single and multi-stage (and often, repeat) repairs.^{48,49}

Option for phalloplasty with urethral lengthening:

Only forearm and anterior lateral thigh flaps afford the option of urethral lengthening using the same flap, as only these include a dedicated vascular pedicle. Because suprapubic and groin flaps have no dedicated vascular pedicle, a sub-segment tubularized to serve as a neourethra would have to rely only on local micro-vascular supply, which is insufficient.⁵ While it is possible to make a neourethra from an ALT flap, patients with excessively thick or fatty thighs are not good candidates for urethral lengthening using the ALT flap. The increased flap surface area that urethral lengthening requires results in excessive phallus girth and phallus weight when the flap is too bulky..

Option for phalloplasty without urethral lengthening:

An alternative option to phalloplasty with urethral lengthening (UL) is to offer phalloplasty without UL. These patients instead have a perineal urethral opening which is hidden behind the scrotum. This technique yields a phallus and scrotum that is identical appearing (by external view) to a phallus with UL, while minimizing the risks associated with phalloplasty + UL.¹³ (See **Section 5.2, Surgical Techniques**, below).

With this option, a short (2 cm.) distal urethra is made at the tip of the phallus, so that it appears normal and indistinguishable from a phallus +UL. The native urethral opening in the perineum remains in situ. To render the final result similar appearing to what is achieved with phalloplasty +UL, the scrotum is positioned anterior but immediately adjacent to the native urethral opening. In this way, the scrotum hangs over the urethral opening and obscures it.

Patients who chose to have phalloplasty without urethral lengthening were asked about the different factors that led them to choose this option over phalloplasty with urethral lengthening. The responses are shown in **Table 2.**¹³

Decision-Making Factor	Mean Ranking	Std. Dev.	Highest Ranking (1-9)	Lowest Ranking (1-9)
Elimination of risks of complications from +UL	2.7	1.5	1	5
Normal appearing urethral opening at tip of penis	3.6	1.8	1	6
Expected decreased risk of need for revision surgery	3.6	2.1	1	7
Ability to avoid using the forearm as the flap donor site	3.9	2.6	1	8
Urethral opening in perineum is well-hidden behind scrotum (i.e. minimally visible)	4.7	2.7	1	8
Expected decreased total number of clinic visits	6	1.9	3	9
Decreased risk of delay for penile prosthesis implant	6.7	1.5	4	9
Possibility of being able to stand to urinate over a toilet	6.9	2.6	2	9
Elimination of need for suprapubic tube	7	1.4	5	9

Table 2

Possibility for tactile and erogenous sensation:

Only forearm and anterior lateral thigh flaps afford sensation (tactile and erogenous) when the cut ends of their sensory nerves are anastomosed to one of the two clitoral nerves.^{7,8,37,50} The anatomy and location of the single nerve that supplies the anterior lateral thigh flap (lateral femoral cutaneous nerve) is variable; occasionally the nerve lies outside of the flap and cannot be included- rendering the flap less or non-sensate. The sensory nerves of the forearm flap (medial femoral cutaneous (MFC) and lateral femoral cutaneous (LFC) nerves) are more constant.

Suprapubic and groin flaps are not associated with a dedicated sensory nerve, which is necessary to anastomose to the clitoral nerve so that sensation can be supplied to the nerve's sensory distribution within the flap. When these flaps are mobilized and moved to the location of the phallus, the local sensory nerves to the flap skin are severed, and for this reason, these flaps generally lack sensation distal to the ~2-3 cm. closest to the base of the phallus.⁵⁰

Phallus dimensions:

Well before surgery, patients should be encouraged to consider what phallus length they desire. We emphasize that patients always have final choice in this matter, but that practical experience from patients finds that phalluses much longer than 5.5 inches tend to be heavy and can be bulky and difficult to conceal under clothing.^{7,30} We encourage patients to examine packer devices, as an artificial but 3-dimensional copy of a penis is a much better model to use than a simple ruler. We also remind patients that the average cisgender man's flaccid and erect penis length measurements are 3 and 5 inches, respectively- to afford perspective about what is "normal".

5.2 Surgical techniques

Stage I phallourethroplasty with urethral lengthening: Surgical steps for creation of the neophallus and neourethra

As shown in **Figure 7a (A)**, the flap is outlined with ink on the arm before it is raised (**B**). While still connected to the arm, the flap neourethra segment is tubularized using interrupted 5-0 monocryl sutures through dermis only, skin-side inward, and the phallus portion of the flap is wrapped around the neourethra with the skin facing outward; interrupted full-thickness 3-0 Monocryl sutures) (**C-D**). The suture line is located along the ventral midline; the neourethra is located immediately deep to the suture line. The proximal end of the neourethra is not tubularized, (**D**), so that it can be anastomosed to the skin located just posterior to the base of the phallus (**Figure 8**). (**E**) The recipient site is a ~12 cm in circumference (yellow circle). The lower edge of the recipient site passes over the anterior-most limit of the clitoris skin fold. (**E-F**) A straight line extending from 11:00 towards the right anterior superior iliac spine marks the incision line through which one can access the inferior epigastric artery and its two Venae Comitantes, to serve as the vascular pedicle to the phallus (**E, blue arrow**). The vascular pedicle is then dissected cephalad as far as possible. The anterior end of the vascular pedicle is then transected and delivered to the phallus base. The vascular pedicle is externalized by delivering it through a passage that is created bluntly, connecting the pelvis to the external inguinal ring.

The proximal end of the neourethra is managed in Stage I by suturing it to skin surrounding the base of the clitoris (Figure 8). The skin incision (bold lines) is made between the anterosuperior iliac spine and pubic tubercle and joins a circular incision of 12 to 13 cm circumference at the neophallus recipient site. The inferior epigastric artery (located approximately at the midpoint between the ASIS and pubic tubercle) is dissected and rotated to the recipient site to provide arterial supply to the main artery of neophallus, while the saphenous vein branches can be mobilized via a horizontal incision in the sub-inguinal region over the femoral vessels.

In stage 1 of a 2-stage phalloplasty, a **2 × 1 cm skin flap (Figure 8, yellow arrow)** of hairless labia minora skin (shown on left) is outlined and incised. The inferior end of this small flap is spatulated to the proximal end of the neourethra. Also, the labia minora ipsilateral to the site where the neourethra will be implanted is resected (green arrow).

Four months later and following healing, the neophallic neourethral opening (located at the base of the clitoris) will be anastomosed to the pars fixa neourethra (tubularized vaginal skin) that connects the native urethral opening to the proximal end of the neophallus neourethra.

The donor site is managed by applying either full-thickness skin graft (harvested from the inferior gluteal folds bilaterally) OR by harvesting split-thickness skin grafts to the arm donor site (**Figure 9, A-C**). A urethral catheter is left within the neourethra and the recipient site is dressed. (**Figure 9 D-G**)

Stage I phallourethroplasty without urethral lengthening: Surgical steps for creation of the neophallus and perineal urethra.

(**Figure 7b**) A 2-cm long distal urethra and normal appearing urethral meatus is created (**a**), and a 1 cm cuff of periurethral mucosa is preserved. (**b**) The scrotum is constructed to be longer in the center

(opposite of the Ghent technique[6]) by anchoring the posterior ends of the labia majora to the anterior aspect of the native urethral meatus (**c,d**) so the posterior end of the scrotum hangs over and obscures the urethral opening (**e**). The final result is identical in appearance to P+UL. The same techniques can also be applied to metoidioplasty-UL (**f**).

Figure 7

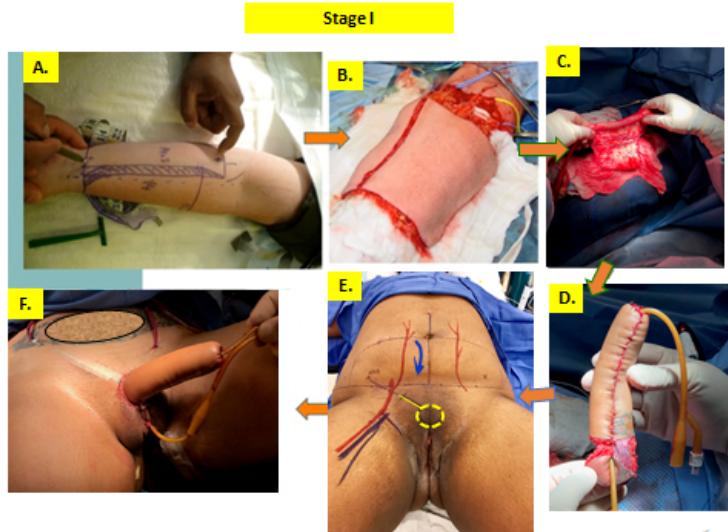


Figure 7A: Stage I Radial artery forearm flap Phallourethroplasty.

Figure 7b

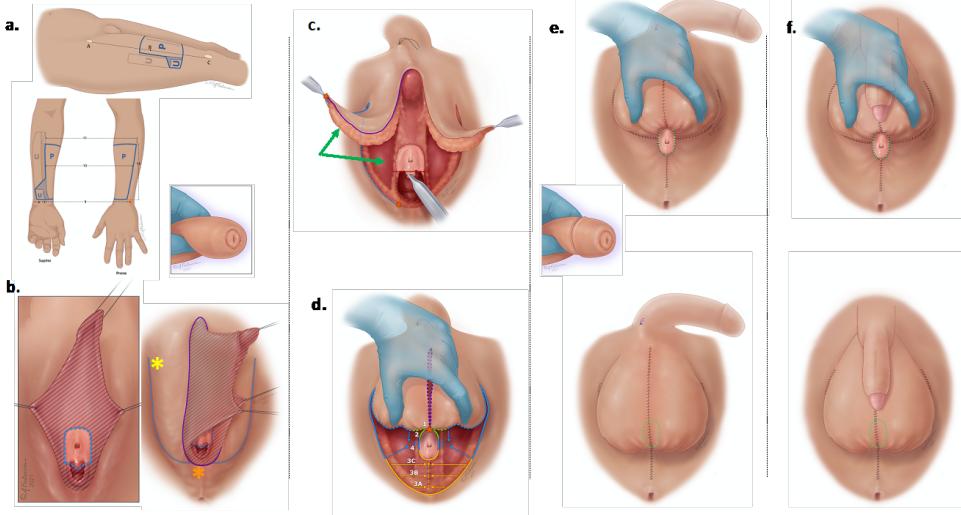
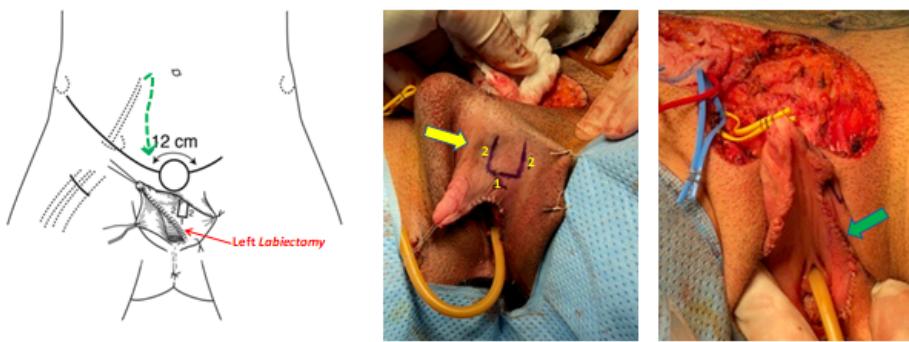


Figure 7B

Figure 8



10

Figure 8: Neophallus and neourethra recipient site markings for 2-stage phalloplasty

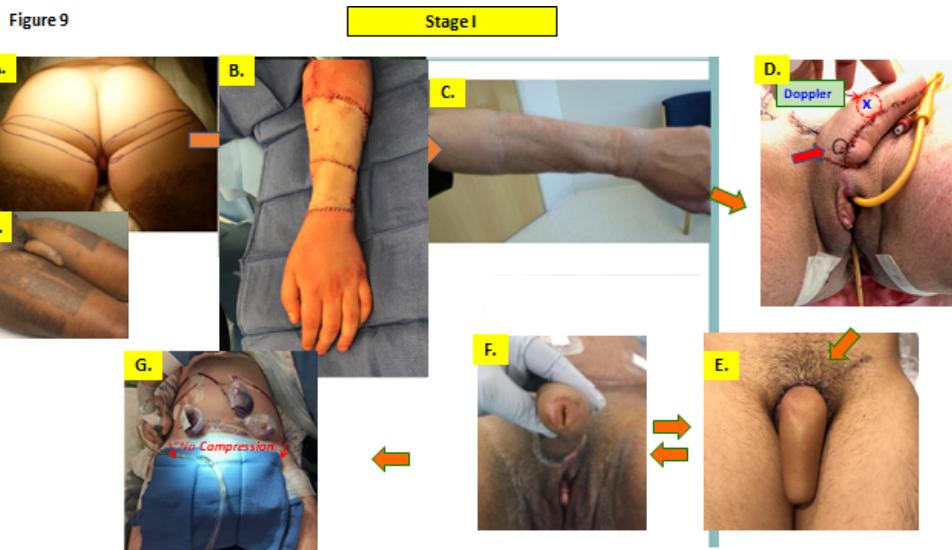


Figure 9

Additional steps of Stage I Phallourethroplasty.

After the forearm flap is raised and used to construct the phallus/neourethra, the arm donor site must be covered with a skin graft. Options include use of full-thickness skin grafts harvested from skin anterior and posterior to the inferior gluteal skin crease (A), or, the more commonly used approach- using skin harvested as a split-thickness skin graft (STSG) from the anterior thighs (A). The skin graft is used to cover the donor defect on the forearm (B). We and others find that full-thickness skin grafts heal with better cosmesis than STSG on the arm (C). The phallus and phallus-neourethra opening at completion of Stage 1 surgery (D). "X" marks the location of where the Doppler signal can be reliably

found- so that nurses can find it post-operatively. The circle marked in ink at the base of the phallus (red arrow) marks the location of where the de-epithelialized clitoris is buried. (E-F) Views of the phallus and urethral meatus. (G) The recipient site is covered with a blue towel for privacy, and a warning to not apply pressure over the phallus is written on the dressing.

Stage II phallourethroplasty: completion of the remaining associated surgeries

During Stage II surgery, the native urethral opening is connected to the neophallus' urethral opening (located at the phallus base) using local hairless vulva skin flaps. Vaginectomy is performed. The clitoris is eliminated from view by de-epithelializing it and transposing it to a subcutaneous pocket at the ventral base of the phallus. Scrotoplasty is performed. Lastly, glansplasty is performed to create a normal appearing glans ridge.

Stage II surgery commences with cystoscopy and suprapubic catheter placement.

Urethral lengthening:

In Stage I surgery, the neophallus neourethra is created. This is referred to as the pars pendulosa, because it resides within the pendulous portion of phallus. In Stage II surgery the proximal neourethra is created (**Figure 10**). This is accomplished by tubularizing hairless vulvar skin located between the native urethral opening and the neophallus neourethral opening. A small flap of midline anterior vaginal wall epithelium is developed and rotated anteriorly, to help cover the proximal end of the pars fixa (**Figure 10, red arrow**).

The junction of the pars fixa and the pars pendulosa is the most common site of neourethral stricture.^{44,49} For this reason, it is important to widen the distal pars fixa local flap by incorporating some of the clitoral shaft skin, and rotate this wider portion to cover the distal end of the pars fixa neourethra with a wide end.

Figure 10

Stage II

Urethral Join-Up & Clitoris Transposition

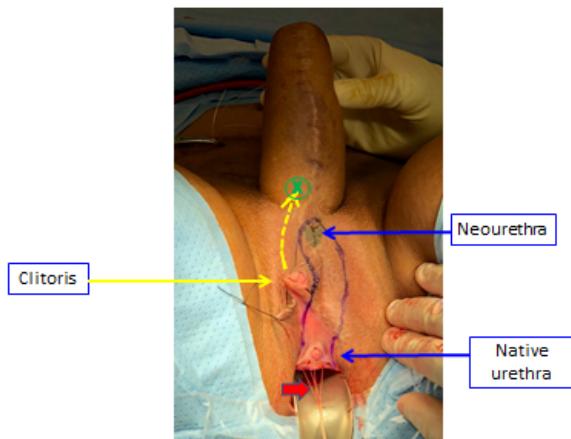


Figure 10

Urethral join-up and clitoris transposition. In Stage II surgery the native urethral opening (lower blue arrow) is joined to the phallus neourethral opening by tubularizing the hairless Vulva skin located between the two structures, on the side of midline where the Labia minora was resected at Stage 1 surgery. This portion of the overall neourethra is known as the *pars fixa*. A small flap of midline anterior vaginal wall epithelium is developed and rotated anteriorly, to help cover the proximal end of the *pars fixa* neourethra (**red arrow**). The clitoris is de-epithelialized, mobilized and buried into a sub-cutaneous pocket (**green X and circle**) located at the base of the phallus on the side opposite the *pars fixa* neourethra.

Alternatives to urethral lengthening to the phallus tip: Perineal urethrostomy and Metoidioplasty urethrostomy :

If a patient has decided to forego urethral lengthening, a perineal urethral opening can be made during Stage II surgery. For this, the periurethral skin of the native urethral opening is sutured to the perineal and neoscrotal skin that now surrounds the native urethral opening. Given the perineal location, after recovery, the patient will need to sit to void.

Alternatively, if a patient wishes to stand to void, he can undergo urethral lengthening to the tip of his “small penis” (clitoris) (similar to a metoidioplasty neourethra). This option often affords the ability to stand to void, but does preclude transposition and elimination of the native clitoris from view. It also often requires that patients use both hands during voiding: one to support the neophallus and the other to aim the small penis. These small details are not intuitive to all people, and so they must be explained to patients as they consider surgery options.

Vaginectomy

Vaginectomy is performed as described in **Section 4.3.**

Clitoris Transposition:

During Stage II surgery, following urethroplasty and vaginectomy, the clitoris is eliminated from view in anticipation of scrotoplasty. This is accomplished by sharp excision of the epithelium of the entire shaft and glans clitoris, so that the clitoris can be buried subcutaneously. Some surgeons will dissect from the perineal incision towards the lateral ventral base of the phallus shaft and create a subcutaneous pouch at the point of furthest reach by the clitoris. (**Figure 10, green X and circle**) Here, two interrupted Vicryl sutures through the glans clitoris secure it to the phallus skin overlying the subcutaneous pouch. Alternatively, the clitoris can be de-epithelialized and left in situ during Stage II surgery. During single-stage phalloplasty, it can be de-epithelialized and buried directly beneath the base of the phallus.⁴⁰ When placed in a subcutaneous pouch at the lateral ventral base it affords direct contact stimulation with either masturbation or insertive intercourse.

The clitoris is buried in the lateral aspect of the ventral phallus base, always on the same side as where the recipient the deep inferior epigastric vascular pedicle is located, so that the contralateral ventral base of the phallus is free of vital structures and can serve as the site of penile prosthesis implant later in the patient's surgery course.

Scrotoplasty with phalloplasty

When scrotoplasty is performed with phalloplasty, only the posterior ends of the labia majora are mobilized and transposed anteriorly. The labia minora are removed (**Figure 11, A, textured red area**) and discarded, as they have no place on the male scrotum . Next, the labia majora are mobilized along their lateral and medial edges. The posterior tips of the labia majora are sutured together. The perineum is closed at midline in a V-Y plasty fashion. The tips of the labia majora are then sutured at midline more anteriorly than where they resided before transposition. The medial edges of the labia majora are sutured together (**B, green hatched lines**). The anterior transposition of the labia majora approximates the labia majora skin in the center of the scrotum, rendering a small "sac". Other approaches, where the labia majora flap is rotated to perform the scrotoplasty, have also been described.^{25,51,52}

Figure 11

Phalloplasty Scrotoplasty

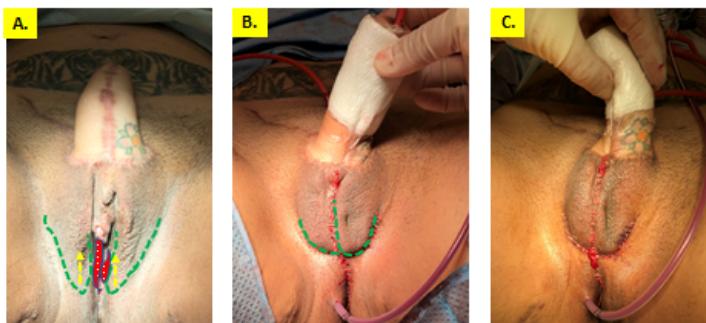


Figure 11: Phalloplasty Scrotoplasty

Glansplasty

With glansplasty, local skin flaps are raised at the end of the neophallus to create a coronal ridge and the natural appearance of a glans. **Figure 12** shows the surgical site markings.

Figure 12

Glansplasty

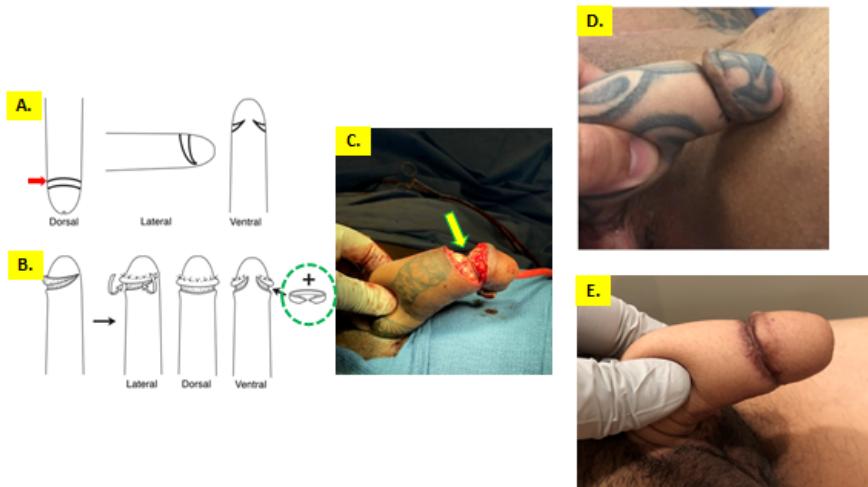


Figure 12

Glansplasty

Surgical site markings. **A.** Two curved ink lines, separated at midline by 1 cm., are made on the dorsum of glans site. The distal line should be ~ 3 cm from the tip of the phallus to ensure that the glans is 3 cm long at midline, which approximates the average cisgender man's glans length). These are extended ventrally to fuse at the ventral-lateral aspect of glans (top panel). Only the proximal line (**red arrow**) is incised with a scalpel. **B.** The proximal skin edge is undermined (between the dermis and subcutaneous fat) distally, to the distal line (lower left panel). The distal edge of the skin incision is then sutured to dermis at its own underside (distal ink line marking). A 1-cm strip of hairless skin is harvested (typically from thigh area) as a full-thickness skin graft (**green circle**). It is sutured into the glans groove, under mild tension. (**C.**) Its proximal edge is sutured to skin of the proximal edge of the original glans incision. The distal edge of this skin strip is sutured to the skin edge of the proximal glans ink marking (now located on underside of distal ink line; lower right panel). The result is a normal appearing glans sulcus and coronal ridge (**D-E**).

Figure 13

Appearance: End of Stage II



Figure 13

Appearance: End of Stage II. Appearance of the operative site, including the phallus, neosrotum, after recovery and healing from Stage II. **A.** The suprapubic tube (16 Fr Council) catheter placed at the outset of Stage II surgery is visible.

A wound drain exits the vaginalectomy site. The scrotum is complete, and the clitoris is no longer visible (it resides at the site marked with a **blue circle**). The urethra at the phallus tip has been put into continuity with the bladder. A urethral catheter (16 Fr Council) is in place. **(B-C)** The phallus scar is located along the ventral surface. By utilizing inferior epigastric vessels, and foregoing use of femoral vessels, the patient has no femoral area scars.

Penile prosthesis placement

See AUA Core Curriculum: **Erectile Dysfunction: Surgical Management**, Section 6 “Penile Prosthesis in Female to Male Transgender Population.”

Just as not all transgender men prioritize standing to urinate, not all transgender men desire a penile prosthesis. For those who do, the patients should generally wait at least 6 months after phalloplasty. If the patient chose to have phalloplasty with urethral lengthening, they must be completely free of urethral complications prior to pursuing prosthesis placement. For those patients who prioritize a prosthetic device for penetrative intercourse over standing to urinate, choosing phalloplasty without urethral lengthening will likely shorten the lead time to penile prosthesis placement.

Penile prosthesis placement in a transgender male poses different challenges than those encountered in cisgender patients.

Anatomic Differences

The phallus in a transgender male is comprised of skin and subcutaneous tissue, and lacks the bilateral corporal structures in which a penile prosthesis is placed in a cisgender man. This leads to challenges with anchoring the device on a transgender patient.

The urethra in a neophallus is typically also located more toward the center of the phallus, rather than on the ventral aspect of the phallus of a cisgender man. Great care must be taken during the surgery to ensure that the urethra is neither injured, nor compressed by the prosthetic device.

Prosthetic Devices

Currently, the available prosthetic devices available in the United States were created for the anatomy of a typical cisgender patient. There are some devices available in other countries that are manufactured specifically for transgender men (the ZSI 475 FTM Inflatable and the ZSI 100 FTM Malleable implants. Zephyr Surgical Implants, Switzerland), however, these devices are not currently FDA-approved for use in the United States. As such, the devices in use in the United States are typically the same devices used in cisgender men, which must be modified at the time of surgery for placement in the transgender patient.

An inflatable (shown) or malleable penile prosthesis (usually only a single cylinder) can be used.⁴¹ Malleable cylinders occupy more space when not in use, and they are always firm, which may contribute to malleable devices accelerating phallus tissue ischemia and loss of bulk.⁷ The cylinder must be secured to the patient's body to prevent migration and erosion, and to stabilize the device for use during intercourse.^{53,54}

The anterior face of the obturator ramus is an excellent site to anchor the device. To secure the prosthesis cylinder to the patient's body, the proximal and distal ends are wrapped in a "sock" and "cap" (respectively) made of Dacron (**Figure 14, Left**).^{5,7,53,50} The more proximal "sock" is sutured to a flat area of the ischiopubic ramus (**Right, outlined in green hatched line**) in four locations (*marked by Red X's*), located just posterior to the insertion site of the adductor longus muscle tendon (**Figure 14, Right**), using permanent (e.g. 2-0 Ethibond) sutures. Alternatively, some surgeons describe foregoing the use of a "sock" and directly anchoring a solid portion of the inflatable cylinder to periosteum in the same region.

A small "cap" of Dacron is constructed and inserted with the prosthesis so that the cap resides on the distal tip of the prosthesis cylinder. The Dacron cap will promote tissue reaction, which will protect the tip of the device from erosion and extrusion.^{7,53}

Figure 14

Penile Prosthesis Placement

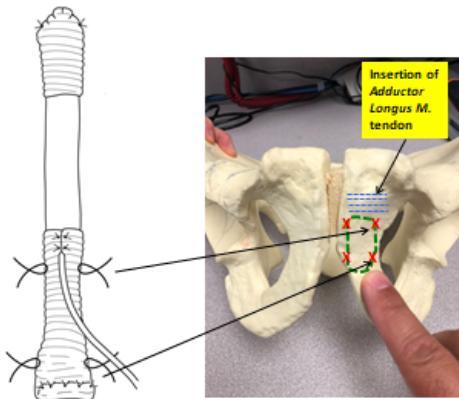


Figure 14

Inflatable penile prosthesis placement after phalloplasty. An inflatable (shown) or malleable penile prosthesis (usually only a single cylinder) is secured to the patient's Obturator ramus. To secure the prosthesis cylinder to the patient's body, the proximal and distal ends are wrapped in a "sock" and "cap" (respectively) made of Dacron (Left). The more proximal "sock" is sutured to a flat area of the Ischiopubic Ramus (**Right, outlined in blue**) in four locations (**marked by Red X's**), located just posterior to the insertion site of the Adductor Longus muscle tendon, using permanent (e.g. 2-0 Ethibond) sutures

5.3 Pre-surgery Preparation

Donor site considerations

With forearm flaps, an Allen's test is performed, to confirm that sacrifice of the radial artery with the flap can be compensated for by the ulnar artery vascular supply.²⁵ The non-dominant arm is typically chosen as the donor site. If tattoos are already present on the forearm, those located within the flap area will be present on the phallus (**Figure 13**).⁵⁵ The donor site can be covered with split-thickness skin graft (typically harvested from the anterior thighs), or full-thickness skin grafts from elsewhere.

Anterior Lateral Thigh (ALT) flaps should be evaluated with Doppler ultrasound immediately before harvest, to identify the location of the muscle-perforator vessel branches that supply the flap from the descending branch of the lateral femoral circumflex artery. The locations of the perforators are marked with ink to minimize risk of injury during dissection. The flap donor site is typically covered with split-thickness skin graft. In our experience, this is superior to use of full-thickness grafts.⁵⁶

Attention to any medical-social issues highlighted in the surgery referral letters

Because surgery referral letters are often written for patients who are early on in the process of

seeking gGAS, much time can elapse between the time that the surgery referral letters are written and the actual surgery date (especially for surgeons with long waiting periods). As the patient approaches their surgery date it is useful to review the patient's letters and review the status of any potential medical or social challenges that the letter writers highlighted in their letter.¹ In addition, the surgeon should confirm that the patient still meets the other basic requirements for surgery: good control of any medical conditions, access to a therapist, location and stability of housing, access to transportation to return for follow-up visits, and funds to care and provide for themselves.

Weight loss

Patients should ideally be at a stable weight before surgery. For many surgeons a BMI above 30-32 is a contraindication for proceeding, as excess weight increases risk of seromas, hematomas, and poor wound healing. Other adverse effects of excess weight are that excess/fat skin in the prepubic area do not support the phallus (which is sutured to this skin) well, and over time it migrates more posteriorly, potentially making it less suitable for penile prosthesis placement.

Permanent hair removal

An absolute requirement of flaps that will provide a neourethra (radial artery forearm flap [RFFF] and anterior lateral thigh flap [ALT]) is that the portion of the flap dedicated to creating the neourethra must be rendered permanently hair free before surgery.^{5,8,57,58} If there is any hair regrowth after surgery, the tubularized neourethra portion of the flap will be inaccessible to laser or electrolysis. Hair within the neourethra is obstructive to urine flow and traps urine, which augments post-void dribbling, increases risk of stone formation, and renders foul smell. Hair in the neourethra increases the risk for infection/folliculitis, that can result in flap dehiscence and urethral stricture. In our experience, there is no truly effective durable solution for removal of hair from within the neourethra.⁵⁷

The negative consequences of hair regrowth within the urethra should be explained to patients, and they should be encouraged to be diligent about complete permanent hair removal before surgery.

Permanent hair removal with more modern lasers has been suggested to be equivalent, if not superior, to electrolysis.⁵⁷ However, while electrolysis can be performed regardless of the hair follicle's pigmentation (or lack of pigmentation), permanent hair removal treatment with laser requires that the hair follicle be naturally somewhat dark-pigmented. As a consequence, permanent hair removal of blond, white, and even red hair requires treatment with electrolysis.

Research suggests that for patients who are candidates for laser hair removal, permanent hair removal with laser is more efficient, takes less time per treatment session, is less painful, is cheaper, and takes less time to complete treatment- as compared to electrolysis. (CITE Yuan, et al, 2022) Patients with a mixture of both dark and light (or non) pigmented hair can undergo combination treatment with both laser and electrolysis.⁵⁹

It is recommended to patients that they confirm no hair regrowth in the treated area for ~3 months after their last hair removal treatment before proceeding with surgery.

5.4 Phalloplasty Surgery Staging

If phalloplasty will be performed as a two-stage surgery, the staging can be performed as shown for Stage I and Stage II in **Figure 15**.⁵ Penile prosthetics are always reserved for the final stage, and only after the patient demonstrates freedom from infections and urinary tract complications that would either increase risk for infection or warrant future surgical corrective intervention.

Alternative approaches to staged surgery are possible.⁶⁰ For example, elements of Stage I and Stage II (as shown in **Figure 15**) can be reversed, where Stage I is effectively a metoidioplasty (suprapubic catheter placement, urethral lengthening to the tip of the clitoris, vaginectomy, and scrotoplasty); in Stage II the phallus and phallus-neourethra are created, the phallus neourethra is joined to the clitoris neourethra, and the clitoris is either buried beneath the neophallus (as described by Monstrey et al; more common), left in place, or integrated into the scrotal skin (less common owing to patient dissatisfaction with the visibility of natal genital structures).

Some surgeons favor performing phallourethroplasty as a single-stage surgery.²⁵ A clear advantage of single-stage surgery is that patients undergo only one hospitalization for the same surgery.

Proponents argue that the benefits of two-stage surgery (as described in **Figure 15**) offers three potential advantages:

1. Glansplasty outcomes may be better when performed after the phallus has fully healed;^{5,61}
2. The clitoris can be buried in a subepithelial pocket on the phallus shaft at the base (where its superficial location on the shaft facilitates robust direct stimulation with masturbation and/or insertive intercourse. This may be preferable to having to bury the de-epithelialized clitoris beneath the phallus base, which precludes direct stimulation. Alternatively, the clitoris can be left exposed for maximal sensation.^{5,8}
3. Any issues after that require surgical attention after Stage I surgery can be addressed either before or at Stage II surgery, depending on the nature of the complication.^{5,46}

It should be noted that there are different staging protocols, and that which is chosen should be based on a combination of surgeon preference, experience, and availability of resources, including co-surgeons. It must also be emphasized that, to date, there is still no evidence-based data to confirm whether staging is superior to single-stage surgery, nor, which staging approach is optimal.^{5,8,60} In lieu of this, careful attention to a center's own resources and outcomes and consideration for the rationale for all details of the surgery, is recommended.

Figure 15

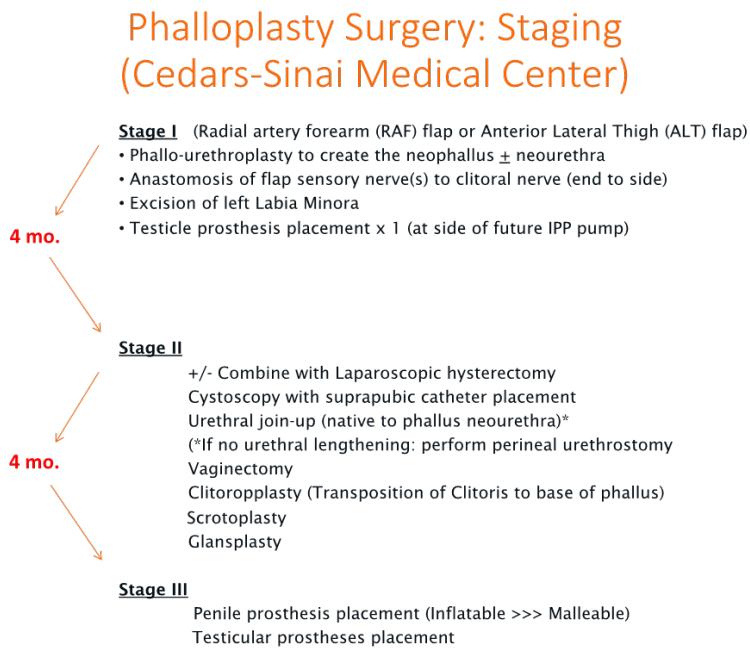


Figure 15

Phalloplasty surgery staging (Protocol at Cedars-Sinai Medical Center)

5.5 Post-phalloplasty aftercare

Post phalloplasty-surgery care regimens vary by surgeon/surgical teams. The following is a description of how to manage patients following Stage I and Stage II phalloplasty surgery, as described in **Figure 15**.

Stage 1 surgery aftercare: Upon creation of the neophallus/urethra the most important factor to focus attention to is the viability of the phallus, as interruption of arterial inflow (less common) or venous outflow (more common) threaten the viability of the phallus and neourethra. This is accomplished by frequent Doppler (e.g. bedside Doppler probe) checks and frequent, thorough visual examination. These checks are initially every hour, and decrease in frequency throughout the post-operative course, provided the neophallus remains viable.^{24,25,52} During surgery, the site of optimal Doppler ultrasound signal is marked with a single 5-0 Prolene suture in the phallus skin. This suture indicates exactly where nursing and physician staff should place the Doppler probe for frequent pulse checks.

Alternatively, an implantable Doppler transducer can be used at the time of surgery.^{25,52} The transducer is laid in proximity to the vascular pedicle, and monitoring is automatic and continuous. To optimize blood flow to the phallus, attention should be paid to the trajectory of the phallus vascular pedicle at the base of the phallus, to ensure that the pedicle is not kinked with positioning.

The typical optimal position for the newly formed phallus is forward and pointing upward 60-70° above the horizon. Positioning below the horizon favors swelling, while positioning vertically risks kinking the pedicle and obstructing blood flow. The portion of the pedicle most at risk for kinking and

obstruction is the venous outflow, as this is a low-pressure system.

On physical exam, one should look for focal duskeness of the flap edges or neourethra tip, and/or acute swelling. The part of the flap furthest from the pedicle is the distal end of the flap that is wrapped around the neourethra, and at the phallus tip; these are the locations likeliest to demonstrate necrosis when this occurs. The skin will appear increasingly dusky over time and can often be managed conservatively with focal debridement.

If acute interruption of vascular supply to the phallus is suspected, the patient should be urgently taken to the operating room to examine the pedicle, with immediate thrombolysis or re-anastomosis if needed.

Stage I, additional aftercare:

Donor site: If the donor site is the forearm or anterior thigh, a wound-vac or bandage wrap is used. The forearm is elevated and can be supported by an arm splint.

Neourethra: With Stage I surgery, as described in **Figure 15**, the neourethra will open to the skin located at the left aspect of the base of the clitoris. Because the neourethral lining is comprised entirely of skin, and because skin makes waste (dead skin cells, sweat and oil), over time patients will note an accumulation of this waste as a purulent creamy discharge from the penis tip and/or base. To help keep the neourethra clean, a $\frac{1}{4}$ -inch wide Penrose drain can be left inside the neourethra, and fashioned in a loop so that it forms a circle that runs through the neourethra and is contiguous outside the phallus. This allows naturally-produced debris from the neourethra skin (exfoliated skin cells, sweat, oil) to drain out of the urethra and not accumulate inside the neourethra, where collection typically causes local infection. The Penrose drain is less bulky than a urethral catheter and thereby likely allows better drainage. The patient can clean the portion of the Penrose inside of the urethra by pulling on one end of the loop during daily showers to expose the portion that most recently resided inside the urethra. This technique also allows the soft Penrose to rub against the skin of the neourethra (similar to a ‘flossing’ maneuver), to help eliminate the waste that accumulates inside the neourethra.

Length of stay and discharge: Patients are allowed to start to ambulate post-op day #3-4. If ambulating, and if able to sit and rise without assistance, the urethral catheter can be removed (typically on post-op day #5). We leave a closed suction wound drain near, but not on, the vascular pedicle supplying the phallus. This is typically left in place until just before discharge, and is only removed if the output is serous and <5 cc per day.

Patients typically stay in the hospital through post-op day #5 or 6. This allows sufficient time for wound care, ambulation, and serial exams to feel confident in the viability of the phallus.

Stage II surgery aftercare: While surgeon preferences and practices vary, following the surgical procedures described in **Figure 15**, patients will have a suprapubic catheter, an indwelling urethral catheter (in the phallus or perineal urethrostomy), a closed-suction wound drain located in the vaginectomy site, a Penrose drain in the neoscrotum, and a gauze compression dressing around the

glans.

Urinary catheters: After Stage 2, the patient has a fresh and long urethral anastomosis which extends from native urethra to the neophallus base. Given that the most common and challenging complications after phalloplasty with urethral lengthening relate to urinary fistulas and strictures, it is particularly important to maximize urinary drainage. Urine that extravasates across the suture line will promote fistula formation, infection, and fibrosis/stricture. Thus, the urinary catheters are connected to drainage bags, and these are maintained to gravity drainage by positioning them on the floor at all times, except when the patient is ambulating. It is important to place the urinary drainage bag on the ground because, as Garcia *et al*⁶² have shown, traditional management where the drainage bag is hung from the bed often results in the formation of a dependent loop along the drainage tubing, resulting in an air-lock that causes urine to accumulate within the bladder. (**Figure 16**) In an undrained bladder, the catheter acts like a stent and allows small amounts of urine to leak along the catheter into the neourethra and along the suture line, which is exactly what we seek to prevent with an indwelling urinary catheter.

The patient will be discharged home with the two urinary catheters. The urethral catheter is left in place for 2 weeks and the patient begins to attempt to void per urethra 1-2 days later by plugging the suprapubic catheter. The patient is instructed to measure post-void residuals by reconnecting the (empty) drainage bag immediately after voiding and measuring any urine that drains into the bag by emptying it into a urine specimen cup.

Vaginectomy wound drain: The drain is removed only after the patient is able to ambulate and only when output is minimal (<5 cc per 24 hrs.). Any accumulation of fluid within the newly closed vaginal canal space will promote epithelialization of the walls of the closed space. Trapped fluid will promote infection, which increases the risk for neourethral stricture and urethrovaginal and urethrocutaneous fistulae. Hence, one should have a low threshold to send patients home with the vaginectomy drain until outputs are satisfactorily low. While evidence-based data comparing different vaginectomy techniques and management approaches to the vaginectomy site are lacking, by the technique and aftercare described here, the incidence of complications that involve the vaginectomy site are very uncommon.

Scrotoplasty wound drain: This is removed when output is minimal; typically on post-op day #4.

Glansplasty dressing: This pressure dressing is kept through post-op day #5 to optimize take of the full-thickness glansplasty skin graft by minimizing risk of seroma formation.

Figure 16

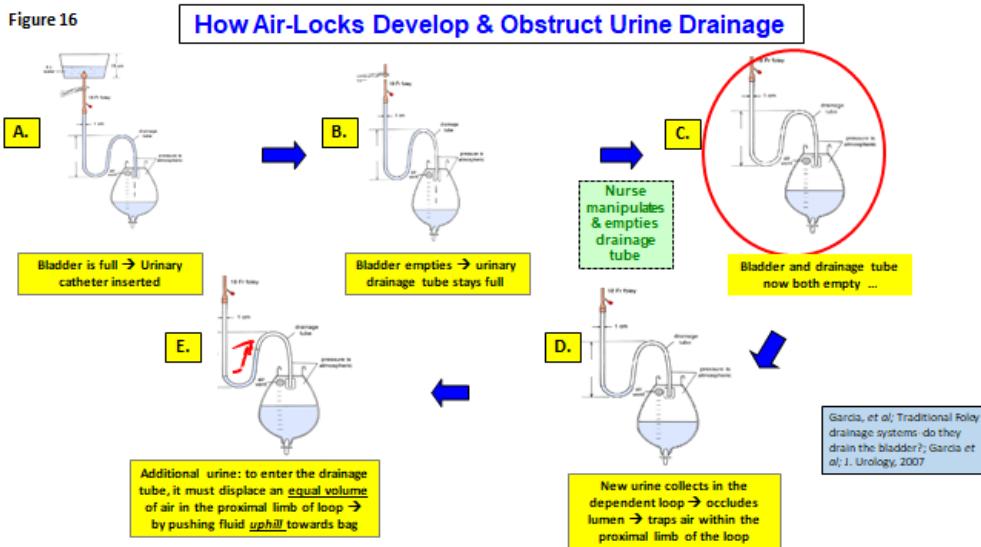


Figure 16

How airlocks develop and obstruct urine drainage

A. When the catheter is inserted into the bladder, the drainage tubing fills with urine. **B.** When the bladder finally becomes empty, the drainage tubing remains full. **C.** At some point, the nurse comes to drain the catheter bag. In doing so, the bag is un-hooked from the bed-rail, allowing the drainage tubing to become empty again. The bag is returned to its hanging position from the bedrail. **D.** As new urine drains from the bladder into the drainage tubing, it collects in the dependent-most location (the bottom of the tubing-loop), where it eventually occludes the lumen of the tube. There are now two menisci, and the column of air in the proximal limb of the loop is trapped. **E.** In order for new urine to drain into the drainage tubing, it must displace *an equal volume of air* towards the drainage bag. For this to happen, the fluid at the bottom of the dependent loop must be moved against gravity up the ascending limb of the dependent loop. The air-lock requires that in order to move 1 cm³ of urine up a height of 1 cm, a back pressure of 1 cm H₂O be applied from the bladder-end of the dependent loop. The bladder maintains a low pressure by accommodating an increasingly greater volume of undrained urine.

5.6 Erogenous sensation and orgasm function after phalloplasty

Erogenous sensation may be achieved with RAF and ALT flaps when the cutaneous sensory nerves from the skin flap are micro-surgically anastomosed to one of the two clitoral nerves. (RAF: medial and lateral femoral cutaneous nerves; ALT: lateral femoral cutaneous nerve). The flap nerve(s) are anastomosed to one of the two clitoral nerves, which is dissected and transected at the base of

the clitoris shaft and serves as the recipient nerve.^{5,41,63}

With radial artery forearm flap urethroplasty, the sensory nerve distribution of the medial antebrachial cutaneous cutaneous nerve is the medial ventral forearm (**Figure 17**), which will be incorporated into the *neourethra*.^{5,7,8} The sensory distribution of the lateral antebrachialcutaneous nerve is the lateral ventral and dorsal forearm. This skin will be wrapped around the neourethra and become the phallus shaft.

Up to 90% of patients have tactile and some degree of erogenous sensation with a RAF. The most sensitive site for erogenous sensation is at the site of the glans clitoris—if it can be reached and stimulated directly after phalloplasty.⁵⁰ It is precisely for this reason that it should be placed into a subcutaneous pocket at the ventral base of the phallus- where it can be easily reached and stimulated.^{5,24,41} Alternatively, it can be placed beneath the base of the neophallus (over the pubic symphysis).^{52,53} If the clitoris is not de-epithelialized it may be integrated into the scrotum, though this often results in the clitoris-remnant being externally visible, which may be dysphoria-inducing for some patients and should therefore be discussed pre-operatively.

Figure 17

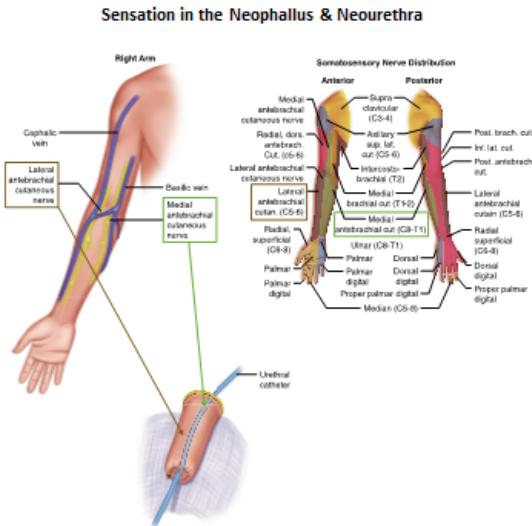


Figure 17

Tactile and erogenous sensation after radial artery forearm flap phallourethroplasty. (Top-left) Tactile and erogenous sensation of the phallus are achieved by anastomosing the sensory nerves from the radial artery forearm flap (medial and lateral antebrachial cutaneous nerves) to one of the two clitoral nerves. Only one clitoral nerve (usually the clitoral nerve ipsilateral to the phallus deep inferior epigastric artery/veins vascular pedicle) is dissected and *partially* transected so that the flaps' sensory nerves can be anastomosed to the proximal end of the clitoral nerve in an end-to-side anastomosis using three single 9-0 nylon sutures. (Top-right) The medial antebrachial cutaneous nerve provides sensory innervation to the skin of the ventral medial

forearm (**green**), which will be used to construct the neourethra.

The *lateral antebrachial cutaneous nerve* provides sensory innervation to the forearm skin of the ventral lateral (and dorsal) forearm, which will constitute the phallus shaft skin. (**Bottom figure**) Ultimately, the *medial antebrachial cutaneous nerve* provides tactile and erogenous sensation to the neo-urethra, while the *lateral antebrachial cutaneous nerve* provides tactile and erogenous sensation to the phallus shaft and glans (i.e. all externally located flap skin).

6. Complications After Masculinizing Surgery

Post-surgical complications are defined as either minor or major complications. Minor complications (hematomas, wound breakdown, infections, and voiding issues like dribbling and spraying) are generally managed conservatively. Major complications (flap loss, fistulae, strictures, and issues with implants) are almost always going to require surgical correction. Complication rates vary depending on the procedure performed and specific technique used, but the most common complications are urologic in nature. For patients that underwent metoidioplasty reported rates for urethral fistula and strictures are 7-15% and 2-3% respectively.²⁷ For patients that underwent phalloplasty reported complication rates are: urethral stricture (25-58%), urethrocutaneous fistula (15-75%), partial flap loss (7%), total flap loss (1.7%). There is no evidence that rates differ between RAF and ALT flaps.⁶⁴ Any patient presenting with complications following masculinizing surgery needs a full workup (history, physical examination, and if indicated, radiographic imaging) as many patients will have multiple issues.^{64,65,66}

Flap loss:

The most severe immediate complication is vascular compromise of the flap. Complete flap loss with phalloplasty is rare (~1%) and Partial flap loss is more common (**Figure 18**).^{19,36} When flap loss is suspected to be developing, the vascular anastomosis should be evaluated and revised. If thrombosis of the flap vessels is suspected, an embolectomy catheter can be inserted in an attempt to salvage the flap.

Figure 18

Partial Flap Necrosis



Figure 18

Partial flap necrosis

Urethral stricture:

Urethral stricture is a common complication (25 to 58%) after phalloplasty.^{49,67} Knowledge of the anatomy of the urethra after phalloplasty is important for understanding how this complication arises (Figure 19).⁶⁸ After phalloplasty, the urethra can be thought of consisting of the native (female) urethra, *pars fixa* (the segment between the phallus urethra and the native urethra), the anastomotic urethra (the segment where the phallic urethra joins the *pars fixa*), and the *pars pendulans* (the portion of the urethra within the neourethra belonging to the phallus flap).

Strictures most commonly occur in the anastomotic urethra (Figure 20) (41%), but can also occur in the phallic urethra (28%), at the meatus (15%), in the fixed urethra (13%), or in multiple locations (8%). Strictures will commonly present with an associated fistula.^{49,69,70} Endoscopic techniques, such as dilation or direct visualization internal urethrotomy, to address these strictures have a recurrence rate of 88%.⁷¹ Thus, almost all of these patients should be offered a surgical correction. Excision and primary anastomosis should be avoided in these patients as the failure rate in this population is approximately 63%.⁷² Given the poor results using excising urethroplasty techniques, a buccal mucosa graft urethroplasty or a staged buccal mucosa graft urethroplasty would offer the most reliable repairs.

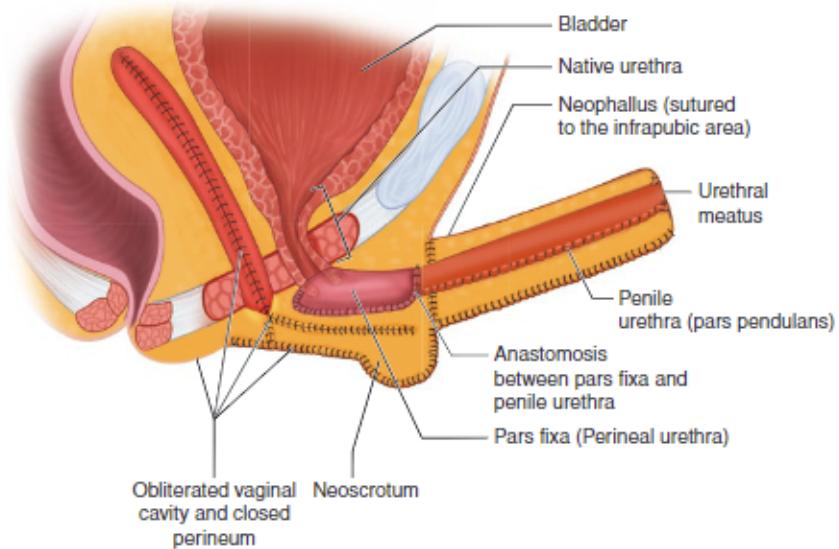


Figure 19

Schematic of a post-phalloplasty pelvis.

Any of the suture lines are vulnerabilities and sites of potential stricture or fistulae formation.

Figure 19

Retrograde Urethrogram

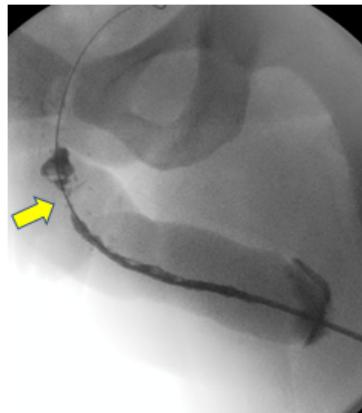


Figure 20

Retrograde urethrogram

A neourethra stricture located at the junction of the *pars fixa* (proximal) and the *pars pendulosa* (distal) segments of the neourethra.

Urethrocutaneous fistulae:

Urethrocutaneous fistula is the most common complication (15 to 70%)⁷³ after phalloplasty (**Figure 21**). Fistulas commonly occur at anastomotic sites but can occur anywhere along the neourethra. As

many are not associated with a stricture, conservative management has resulted in fistula closure in as many as 36% of patients. However, if the fistula persists after three months of conservative management the patient should be offered a surgical correction.

Figure 20

Urethrocutaneous Fistula



Figure 21

Urethrocutaneous fistula

Urethrocutaneous fistula after *metoidioplasty* (left) and *phallourethroplasty* (right).

Prosthetics related complications:

There is limited data regarding longevity of penile prostheses in the phalloplasty population, but as transgender men tend to undergo erectile prosthesis placement at younger ages compared with cisgender men with erectile dysfunction, they may require more revisions throughout their lifetime.^{53,74} Erosion of an inflatable penile prosthesis pump or testicular implant can occur more easily when it is placed into a small neoscrotum—especially if the neoscrotum is positioned overly posteriorly, such that the patient sits upon it frequently. (**Figure 22**)

Infection. As with cis-gender patients, any infection of the penile or testicle prosthetics requires immediate explant of all components. When Dacron graft material and/or non-absorbable sutures are used to wrap a prosthesis cylinder to anchor it to bone, respectively, every effort should be made to explant all of these components, as well, as retention of infected foreign body material risks infecting any subsequent implanted prosthetics.

Figure 21

Eroded Inflatable Penile Prosthesis Pump



Figure 22

Eroded inflatable penile prosthesis pump.

Assessment of LUTS after masculinizing gGAS:

The assessment of lower urinary tract symptoms after phalloplasty should start by ruling out the frequent complications of phalloplasty. A post-void bladder ultrasound test to assess bladder emptying is a key starting point. As urine analysis and urine culture studies may be confounded by bacterial colonization of the neourethra, a careful query of symptoms that would suggest urinary infection is warranted.

Obstructive symptoms are consistent with (but alone do not confirm diagnosis of) urethral stricture.⁵⁸ Hair within the urethra may lead to urethral stones and infections. Flexible cystoscopy is useful for ruling out strictures and stones. (A flexible ureteroscope is often useful to navigate the neourethral lumen). General urologic causes, such as urinary stones and malignancy should always be considered.

A patient without strictures can still develop voiding symptoms, such as post-void dribbling.^{5,75} The difference in lumen size between the pars fixa and the phallic urethra and the absence of the bulbospongiosus muscle can result in pooling of urine within the pars fixa. Another potential cause of post-void dribbling is the presence of a vaginal remnant incorporated into the urethral reconstruction.⁴⁴ Residual skin-hair within the phallus neourethra, and an especially long neourethra may exacerbate this. Patients who have undergone urethral lengthening find it useful to manually “massage” the pooled urine distally to expel residual urine after voiding.^{5,76} The volume of post-void dribbling may be sufficiently copious to be described by the patient as urinary incontinence.⁷⁴

Functional complications from excess phallus length and/or girth after phalloplasty:

The phallus girth deemed likely to be excessive for many patients and partners is patient-dependent. Certainly, excess length and girth result in increased phallus weight, which can be uncomfortable for some patients (but not others). Excess length, and/or change in phallus location due to weight-related stretching of pre-pubic skin can both complicate subsequent penile prosthesis

insertion. Isaacson *et al*³⁰ reported on how excess girth can present complications related to insertion of the phallus into a partner (e.g. pain for the partner). They found that outside of novelty and fetish-related products, best-selling insertable sex toys with insertable circumference > 15 cm are rare on the open market. Their results suggest that a phallus circumference of >15 cm (which is just over two standard deviations above average male erect insertable length) (Figure 23), is likely to result in insertion-related complications and challenges.

Figure 22

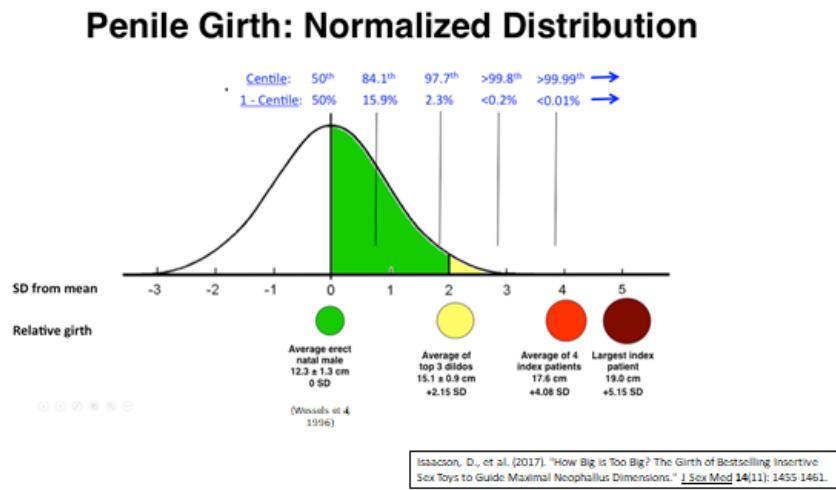


Figure 23

Research on which we estimate what the upper-limits of functional phallus girth should be with phalloplasty.

Considerations when the patient undergoes future related or unrelated surgeries

Utmost care must be taken for surgery involving any *incisions near the pedicle* of the neophallus. The pedicle for the neophallus is a single artery and one or more veins. Incision of the pedicle can result in necrosis of the phallus. The inferior epigastric artery and the femoral artery are common recipient vessels for the neophallus, and can be injured with any incision near these vessels. Doppler ultrasound is useful when there is doubt about the location of the pedicle.

Patients who have undergone phalloplasty and now undergo additional surgeries may need to undergo insertion of a urethral catheter. This should be done by a urologist, and almost always over a guidewire under direct vision, as the neourethra can easily be injured with even gentle instrumentation.

Since the neourethra is generally smaller and always less compliant and well-supported than a cis-male's urethra, the principle of ALARA (as low as reasonably achievable) should be applied regarding the size of endoscopes needed. Use of urethral lubrication (e.g. injection of 10 cc. Water-based lubricant per urethra) and a pediatric flexible cystoscope or ureteroscope reduces the need for dilation and risk of post-procedural stricture and fistula.

It is good practice for gGAS surgeons to ensure that their patients have their emergency direct

contact information and know that they should share their surgeon's name and urgent contact information with other surgeons operating upon them, so that their gGAS surgeon can answer any important questions and help the latter avoid an unintended injury.

7. Other Resources

AUAUniversity Podcast Series: Episode No. 168

Videos

Stage II Urethroplasty Part 1

Stage II Urethraoplasty Part 2

Vaginectomy

CLITORIS TRANSPOSITION

References

1 Coleman E, Radix AE, Bouman WP, et al. Standards of Care for the Health of Transgender and Gender Diverse People, Version 8. *Int J Transgend Health*. 2022;23(Suppl 1):S1-S259. Published 2022 Sep 6. doi:10.1080/26895269.2022.2100644

2 Wierckx, K., et al., Quality of life and sexual health after sex reassignment surgery in transsexual men. *J Sex Med*, 2011. 8(12): p. 3379-88.

3 Go, J.J., Should gender reassignment surgery be publicly funded? *J Bioeth Inq* 2018. 15(4): p. 527-534.

4 El-Hadi, H., et al., Gender-Affirming Surgery for Transgender Individuals: Perceived Satisfaction and Barriers to Care. *Plast Surg (Oakv)*, 2018. 26(4): p. 263-268.

5 ☆ Garcia, M.M., Christopher, N.A., Thomas, P., and Ralph, D.J. , AUA Updates Series Lesson 5: Genital Gender Affirming Surgeries for Transgender Patient. AUA Updates, 2017.

6 WPATH. (2022). WPATH. Retrieved August 18, 2022, from <https://www.wpath.org/soc8>

7 Garcia, M.M., Men's health and transgender surgery: a urologist's perspective. *Transl Androl Urol*, 2016. 5(2): p. 225-7.

8 Garcia, M.M., Decision-Making Challenges for Patients and Surgeons Regarding Genital Gender Affirming Surgery (In: Dmitriy Nikolavsky, Stephen A. Blakely, editors. *Urological Care for the Transgender Patient*). Springer Nature, Switzerland, 2020.

- 9 Ozer, M., et al., Development of a Decision Aid for Genital Gender-Affirming Surgery in
Transmen. *J Sex Med*, 2018. 15(7): p. 1041-1048.
- 10 Mokken, S.E., et al., Evaluation of the Decision Aid for Genital Surgery in Transmen. *J Sex
Med*, 2020. 17(10): p. 2067-2076.
- 11 Nolan, I.T., C.J. Kuhner, and G.W. Dy, Demographic and temporal trends in transgender
identities and gender confirming surgery. *Transl Androl Urol*, 2019. 8(3): p. 184-190.
- 12 Walton, A. B., Hellstrom, W. J. G., Garcia, M. M., 2021 Options for Masculinizing Genital
Gender Affirming Surgery: A Critical Review of the Literature and Perspectives for Future
Directions. *Sex Med Rev*
- 13 Smith, S., et al., 'Modified Phallourethroplasty' as a Surgical Alternative to Phalloplasty With
Urethral Lengthening: Technique, How We Present This Option to Patients, and Clinical
Outcomes. *Sex Med*. 2022. 10(2).
- 14 Gardner, I.a.S., Joshua D., Progress on the road to better medical care for transgender patients.
Current Opinion in Endocrinology, Diabetes and Obesity, 2013. 20(6): p. 553-558.
- 15 Maxwell, S., et al., Pregnancy Outcomes After Fertility Preservation in Transgender Men.
Obstet Gynecol, 2017. 129(6): p. 1031-1034.
- 16 Nahata, L., et al., Understudied and Under-Reported: Fertility Issues in Transgender Youth-A
Narrative Review. *J Pediatr*, 2019. 205: p. 265-271.
- 17 Sterling, J. and M.M. Garcia, Fertility preservation options for transgender individuals. *Transl
Androl Urol*, 2020. 9(Suppl 2): p. S215-S226.
- 18 Cathcart-Rake EJ. Cancer in Sexual and Gender Minority Patients: Are We Addressing Their
Needs? *Curr Oncol Rep*. 2018;20(11):85.
- 19 Yuan, N., et al. Primary Use of the Deep Inferior Epigastric Pedicle for Free-flap phalloplasty:
Rationale, technique, and outcomes. *Plast Reconstr Surg Glob Open*. 2022;10:6:e4307.
- 20 O'Hanlan, K., Dibble, S., Young-Spint, M. Total Laparoscopic Hysterectomy for female-to-male
transsexuals. *Obstetrics Gynecol* 2007; 100:1096-1101.
- 21 Obedin-Maliver, J., Light, A., de Haan, G., Jackson, R. Feasibility of Vaginal Hysterectomy for
female-to-male transgender men. *Obstet Gynecol* 2017;129:457-463.
- 22 Mayhew, A.C. and V. Gomez-Lobo, Fertility Options for the Transgender and Gender Nonbinary
Patient. *J Clin Endocrinol Metab*, 2020. 105(10).

- 23 UCSF Transgender Care, D.o.F.a.C.M., University of California San Francisco. Guidelines for
the Primary and Gender-Affirming Care of Transgender and Gender Nonbinary People; 2nd
edition. Deutsch MB, ed. June 2016, transcare.ucsf.edu/guidelines.
- 24 Garaffa, G., N.A. Christopher, and D.J. Ralph, Total phallic reconstruction in female-to-male
transsexuals. *Eur Urol*, 2010. 57(4): p. 715-22.
- 25 Monstrey, S.J., P. Ceulemans, and P. Hoebeke, Sex Reassignment Surgery in the
Female-to-Male Transsexual. *Semin Plast Surg*, 2011. 25(3): p. 229-44.
- 26 Djordjevic, M.L., et al., Metoidioplasty as a single stage sex reassignment surgery in female
transsexuals: Belgrade experience. *J Sex Med*, 2009. 6(5): p. 1306-13.
- 27 Djordjevic, M.L., B. Stojanovic, and M. Bizic, Metoidioplasty: techniques and outcomes. *Transl
Androl Urol*, 2019. 8(3): p. 248-253.
- 28 Djordjevic, M.L., et al., Urethral Lengthening in metoidioplasty (female-to-male sex
reassignment surgery) by combined buccal mucosa graft and labia minora flap. *Urology*, 2009.
74(2): p. 349-53.
- 29 King, B.M., Average-Size Erect Penis: Fiction, Fact, and the Need for Counseling. *J Sex Marital
Ther*, 2020: p. 1-10.
- 30 Isaacson, D., et al., How Big is Too Big? The Girth of Bestselling Insertive Sex Toys to Guide
Maximal Neophallus Dimensions. *J Sex Med*, 2017. 14(11): p. 1455-1461.
- 31 ☆ Wessells, H., T.F. Lue, and J.W. McAninch, Penile length in the flaccid and erect states:
guidelines for penile augmentation. *J Urol*, 1996. 156(3): p. 995-7.
- 32 Djordjevic, M. L. (2018). Novel surgical techniques in female to male gender confirming surgery.
Translational Andrology and Urology, 7(4), 628–638. doi:10.21037/tau.2018.03.17
- 33 Djordjevic, M.L. and M.R. Bizic, Comparison of two different methods for urethral lengthening in
female to male (metoidioplasty) surgery. *J Sex Med*, 2013. 10(5): p. 1431-8.
- 34 Pigot, G. L. S., Al-Tamimi, M., Nieuwenhuijzen, J. A., van der Sluis, W. B., Moorselaar, Rjav,
Mullender, M. G., van de Grift, T. C., Bouman, M. B. 2020 Genital Gender-Affirming Surgery
Without Urethral Lengthening in Transgender Men-A Clinical Follow-Up Study on the Surgical
and Urological Outcomes and Patient Satisfaction *J Sex Med*
- 35 Al-Tamimi, M., et al., The First Experience of Using the Pedicled Labia Minora Flap for Urethral
Lengthening in Transgender Men Undergoing Anterolateral Thigh and Superficial Circumflex
Iliac Artery Perforator Flap Phalloplasty: A Multicenter Study on Clinical Outcomes. *Urology*,
2020. 138: p. 179-187.

- 36 Veerman, H., de Rooij, F. P. W., Al-Tamimi, M., Ronkes, B. L., Mullender, M. G., B. Bouman M,
van der Sluis, W. B., Pigot, G. L. S. 2020 Functional Outcomes and Urological Complications
after Genital Gender Affirming Surgery with Urethral Lengthening in Transgender Men J Urol
- 37 Lin-Brande, M., et al., Metoidioplasty with Urethral Lengthening: A Stepwise Approach. Urology, 2020.
- 38 Bizic, M., et al., Overview on metoidioplasty: variants of the technique. Int J Impot Res, 2020.
- 39 Chen, M.L., et al., Overview of surgical techniques in gender-affirming genital surgery. Transl Androl Urol, 2019. 8(3): p. 191-208.
- 40 Monstrey, S., et al., Penile reconstruction: is the radial forearm flap really the standard
technique? Plast Reconstr Surg, 2009. 124(2): p. 510-8.
- 41 Garcia, M.M., et al., Overall satisfaction, sexual function, and the durability of neophallus
dimensions following staged female to male genital gender confirming surgery: the Institute of
Urology, London U.K. experience. Transl Androl Urol, 2014. 3(2): p. 156-62.
- 42 Horbach, S.E., et al., Outcome of Vaginoplasty in Male-to-Female Transgenders: A Systematic
Review of Surgical Techniques. J Sex Med, 2015. 12(6): p. 1499-512.
- 43 Massie, J.P., et al., Phalloplasty with Urethral Lengthening: Addition of a Vascularized
Bulbospongiosus Flap from Vaginectomy Reduces Postoperative Urethral Complications. Plast
Reconstr Surg, 2017. 140(4): p. 551e-558e.
- 44 Dy, G.W., et al., Presenting Complications to a Reconstructive Urologist After Masculinizing
Genital Reconstructive Surgery. Urology, 2019. 132: p. 202-206.
- 45 Hougen, H. Y., Dugi, D. D., 3rd, Berli, J. U., Sajadi, K. P. 2021 Outcomes of Transperineal
Gender-Affirming Vaginectomy and Colpocleisis Female Pelvic Med Reconstr Surg
- 46 Frank Netter, M., Atlas of Human Anatomy, Seventh Edition. Elsevier, Inc., 2019.
- 47 Perovic, S.V. and M.L. Djordjevic, Metoidioplasty: a variant of phalloplasty in female
transsexuals. BJU Int, 2003. 92(9): p. 981-5.
- 48 Nikolavsky, D., M. Hughes, and L.C. Zhao, Urologic Complications After Phalloplasty or
Metoidioplasty. Clin Plast Surg, 2018. 45(3): p. 425-435.
- 49 Lumen, N., et al., Urethroplasty for strictures after phallic reconstruction: a single-institution
experience. Eur Urol, 2011. 60(1): p. 150-8.
- 50 Blecher, G.A., N. Christopher, and D.J. Ralph, Prosthetic Placement After Phalloplasty. Urol Clin
North Am, 2019. 46(4): p. 591-603.

- 51 Pigot, G.L.S., et al., Surgical Outcomes of Neoscrotal Augmentation with Testicular Prostheses
in Transgender Men. *J Sex Med*, 2019. 16(10): p. 1664-1671.
- 52 Al-Tamimi, M., et al., Genital Gender-Affirming Surgery in Transgender Men in The Netherlands
from 1989 to 2018: The Evolution of Surgical Care. *Plast Reconstr Surg*, 2020. 145(1): p.
153e-161e.
- 53 Falcone, M., et al., Outcomes of inflatable penile prosthesis insertion in 247 patients completing
female to male gender reassignment surgery. *BJU Int*, 2018. 121(1): p. 139-144.
- 54 Kocjancic, E., Jaunarena, J. H., Schechter, L., Acar, Ö 2020 Inflatable penile prosthesis
implantation after gender affirming phalloplasty with radial forearm free flap. *Int J Impot Res*
- 55 Benson, T. A., Boskey, E. R., Ganor, O. 2020 The Effect of Forearm Tattoos on Flap Choice in
Transmasculine Phalloplasty Patients. *MDM Policy Pract*
- 56 Garaffa, G., D.J. Ralph, and N. Christopher, Total urethral construction with the radial
artery-based forearm free flap in the transsexual. *BJU Int*, 2010. 106(8): p. 1206-10.
- 57 Zhang, W.R., et al., Laser hair removal for genital gender affirming surgery. *Transl Androl Urol*,
2016. 5(3): p. 381-7.
- 58 Hoebeka, P., et al., Impact of sex reassignment surgery on lower urinary tract function. *Eur Urol*,
2005. 47(3): p. 398-402.
- 59 Yuan et al, 2022: Nance Yuan, Alexandra Terris Feldman, Patrick Chin, Michael Zaliznyak,
Susan Rabizadeh, Maurice M. Garcia, Comparison of Permanent Hair Removal Procedures
before Gender-Affirming Vaginoplasty: Why We Should Consider Laser Hair Removal as a
First-Line Treatment for Patients Who Meet Criteria, *Sexual Medicine*, Volume 10, Issue 5,
2022, 100545, ISSN 2050-1161
- 60 Danker, S., N. Esmonde, and J.U. Berli, "Staging" in Phalloplasty. *Urol Clin North Am*, 2019.
46(4): p. 581-590.
- 61 Garcia, M.M., Decision-Making Challenges for Patients and Surgeons Regarding Genital
Gender Affirming Surgery. *Urological Care for the Transgender Patient*; Editors: Dmitriy
Nokolavsky & Stephen Blakely; Springer Nature Switzerland, AG, 2020.
- 62 ☆ Garcia, M.M., et al., Traditional Foley drainage systems--do they drain the bladder? *J
Urol*, 2007. 177(1): p. 203-7; discussion 207.
- 63 Rubino, C., et al., Innervated island pedicled anterolateral thigh flap for neo-phallic
reconstruction in female-to-male transsexuals. *J Plast Reconstr Aesthet Surg*, 2009. 62(3): p.
e45-9.

- 64 M. Hadj-Moussa, S. Agarwal, D.A. Ohl, W.M. Kuzon Jr. Masculinizing genital gender
confirmation surgery *Sex Med Rev*, 7 (2019), pp. 141-155
- 65 A.L. Heston, N.O. Esmonde, D.D. Dugi 3rd, J.U. Berli Phalloplasty: techniques and outcomes
Transl Androl Urol, 8 (2019), pp. 254-265
- 66 Dmitriy Nikolavsky, Yuka Yamaguchi, Jamie P. Levine, Lee C. Zhao, Urologic Sequelae
Following Phalloplasty in Transgendered Patients, *Urologic Clinics of North America*, Volume
44, Issue 1, 2017, Pages 113-125, ISSN 0094-0143, ISBN 9780323496810,
<https://doi.org/10.1016/j.ucl.2016.08.006>.
- 67 Schardein, J., et al., Single-stage Double-face Buccal Mucosal Graft Urethroplasty for
Neophallus Anastomotic Strictures. *Urology*, 2020. 143: p. 257.
- 68 Schardein, J., Blakely, S., Nikolavsky, D. (2021). Management of Urologic Complications
Following Metoidioplasty and Phalloplasty. In: Nikolavsky, D., Blakely, S.A. (eds) *Urological
Care for the Transgender Patient*. Springer, Cham.
https://doi.org/10.1007/978-3-030-18533-6_11
- 69 Schardein, Jessica N., Lee C. Zhao, and Dmitriy Nikolavsky. "Management of vaginoplasty and
phalloplasty complications." *Urologic Clinics* 46.4 (2019): 605-618.
- 70 Rohrmann D, Jakse G. Urethroplasty in female-to-male transsexuals. *Eur Urol*.
2003;44(5):611-4.
- 71 ☆ Levine LA, Elterman L. Urethroplasty following total phallic reconstruction. *J Urol*.
1998;160(2): 378-82
- 72 Verla, Wesley, et al. "Excision and primary anastomosis for isolated, short, anastomotic
strictures in transmen." *Plastic and Reconstructive Surgery Global Open* 8.2 (2020).
- 73 Santucci, R.A., Urethral Complications After Transgender Phalloplasty: Strategies to Treat Them
and Minimize Their Occurrence. *Clin Anat*, 2018. 31(2): p. 187-190.
- 74 Hoebeke, P.B., et al., Erectile implants in female-to-male transsexuals: our experience in 129
patients. *Eur Urol*, 2010. 57(2): p. 334-40.
- 75 Park K, Moon JI, Kim SI, et al. Exchange Donor Program in Kidney Transplantation.
Transplantation. 1999; 67(2): 336-338.
- 76 Cohen, O.D., et al., Robotic Excision of Vaginal Remnant/Urethral Diverticulum for Relief of
Urinary Symptoms Following Phalloplasty in Transgender Men. *Urology*, 2020. 136: p. 158-161.