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INVITED REVIEW

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Thinking outside the box: Alternative techniques for gender affirming phalloplasty

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Abstract

Aims: The benefits of gender affirmation surgery have long been established, and with improved access to care, these operations are being performed with increased frequency. As these surgeries continue to be performed, the surgical techniques continue to evolve. Phalloplasty, or the creation of a phallus, remains one of the most complex surgical endeavors in which a variety of factors influence surgical decision making. This article aims to present the lesser known and less frequently performed means of phalloplasty in gender affirming genitourinary reconstruction.

Methods: A literature review of relevant articles, whether case series or more comprehensive, was performed to describe some of the more obscure and less frequently utilized flaps for phalloplasty.

Results: The most performed or widely accepted technique is that of the radial forearm free flap, but numerous other options decorate the surgical landscape. With limited and unreliable outcomes data, a standard of care is difficult to establish.

Conclusions: Ultimately, phalloplasty reconstruction should aim to achieve standing micturition and penetrative intercourse, resolute tactile and erogenous sensation, desirable aesthetics of the phallus, and acceptable donor site morbidity. Although some procedures are more commonly performed, the standard for phalloplasty has not been established. Ultimately, approaching this reconstructive puzzle with persistent creativity will unearth more reliable options in the future.

KEYWORDS
gender affirmation surgery, phalloplasty, transgender, transmasculine

1 | INTRODUCTION

The benefits of gender affirmation surgery have long been established, and with improved access to care, these operations are being performed with increased frequency. As these surgeries continue to be performed, the surgical techniques continue to evolve. In 1945, Sir Harold Gilles began the 13-stage process of facilitating the genitourinary transformation of Laurence Michael Dillon through a combination of flaps and flap

revisions.[1–3] These operations laid the foundation for modern day phalloplasty. Phalloplasty, or the creation of a phallus, remains one of the most complex surgical endeavors in which a variety of factors influence surgical decision making. Generally, phalloplasty can be achieved through two distinct techniques, pedicled flaps and free tissue transfers. Pedicled flaps refer to those that remain attached to their native blood supply in situ whereas a free tissue transfer refers to a flap in which the vascular supply is detached, and the tissue moved to a remote area of the body.[1]

Arguably, the most performed or widely accepted technique is that of radial forearm free flap (RFFF).[1,4–6] In this technique, the soft tissue is transferred from the forearm along with its vascular supply (radial artery, vena comitantes, cephalic vein) and neural components (lateral and medial antebrachial cutaneous nerves). With the inclusion of these components, a sensate phallus and urethra can be constructed. Later stages achieve perineal reconstruction and the placement of implantable devices.[1,5,7,8] Disadvantages of this technique include the recognizable donor site along the forearm, potential adverse urologic sequelae, and the need for microsurgical abilities.[9,10] Despite its widespread acceptance as the most common form of phalloplasty, its confirmation as the standard technique is impossible as prospective randomized trials are lacking.

Regardless of the technique employed, the overall goals relate to a variety of the following factors, depending on patient preferences: functional ability in terms of standing micturition and penetrative intercourse, resolute tactile and erogenous sensation, desirable aesthetics of the phallus, and acceptable donor site morbidity. Abandoning a standard, one-size-fits-all model is necessary to achieve surgical outcomes that align with the patient's needs and desires. This article aims to present the lesser known and less frequently performed means of phalloplasty in gender affirming genitourinary reconstruction.

2 | SCAPULA FLAP

Arguably performed with relative infrequency, and detailed by one group in particular, the scapular or parascapular free flap for phalloplasty offers some benefits. This flap provides an adequate amount of tissue that can easily accommodate a prosthesis, demonstrates reliable vascularity, and offers a concealable donor site along the upper back. The most significant disadvantages to this technique relate to the hirsute nature of this anatomic region thus necessitating hair removal before flap creation, the limited sensory innervation with time given a less direct nerve conduit for coaptation, and the challenges associated with intraoperative positional changes given the donor site of the back and anterior location of the pelvic region for inset.[11]

The flap receives its vascular supply via the circumflex scapular artery, a branch of subscapular artery; this reliable blood supply branches into a variety of interconnected segments thereby facilitating a widespread perfusion of the skin and subcutaneous region. Innervating the scapular flap are the widespread branches of the second to fourth thoracic nerves, which do not travel with the vascular pedicle, making their identification, preservation, and eventual coaptation difficult. In lateral decubitus position, the Doppler is used to detect the location of circumflex scapular artery. A three-part flap is then designed centered upon this axis to facilitate the tube-within-a-tube formation. The flap is incised and dissected to the level between the fascia and musculoaponeurosis and the flap is mobilized toward the pedicle at the trilateral foramen. The pedicle is divided, and the flap is transferred to the pelvic region for inset.[11]

The authors of the presented study report having performed 20 scapular phalloplasty reconstructions with all patients describing the ability to micturate while standing. Three of the 20 patients who reported that ability required secondary revisions for urethral fistula formation and the authors report complete correctability. Additionally, they report the ability to participate in penetrative sexual intercourse with 15 patients, 10 of which report satisfaction.[5,11] It should be noted that all patients included in this study underwent penile reconstruction due to traumatic injury and not for gender affirming reconstruction.

Although a novel concept, and certainly desirable due to its concealable donor site, the scapula flap presents extreme limitations in its sensory absence. The lack of tactile or erogenous sensation encountered with the use of this flap deems it relatively objectionable as both tactile and erogenous sensation are important components to postoperative life for the patient. In the absence of other options, this free flap should be considered, but with other more advantageous options readily available, caution should be exercised with choosing this flap for use in the gender affirming phalloplasty patient population.

3 | LATISSIMUS DORSI FLAP

The latissimus dorsi flap has been extensively studied and is widely used in reconstructive surgery, but its use has been limited within gender affirming phalloplasty. Despite its limited use, the advantages are substantial; namely the large musculocutaneous flap provides ample

tissue for phallus construction while also improving the durability of a later placed implant, provides a concealable donor site, allows for standing micturition, and offers the possibility of penetrative intercourse in the absence of a prosthesis.[5,12]

The muscle and resultant flap are vascularized through the thoracodorsal artery and concomitant veins, while its innervation stems from the thoracodorsal nerve.[13] Positioning intraoperatively can be challenging as flap harvest requires a lateral decubitus position, while inset of the flap requires a supine position. At the groin, an incision along the mons is utilized for flap inset, and an inguinal incision is used to establish access to the superficial femoral artery, should this be chosen for microvascular anastomosis rather than the alterative, deep inferior epigastric system. Lastly, the venous microvascular anastomosis is best achieved using the saphenous vein, regardless of the arterial supply. For tactile sensation, the thoracodorsal is coapted to the ilioinguinal nerve, and erogenous sensation can be achieved through coaptation with the dorsal clitoral nerve.[5,13] Unique to the muscular component of this flap is the possibility for functional transfer through a coaptation of the thoracodorsal nerve to a branch of the obturator nerve thereby achieving contraction of the latissimus muscle and resultant paradoxical erection (shortening and stiffening) with patient-controlled contraction of the medial thigh.[5,14,15] Subsequent stages are required for urethral reconstruction as a one-stage approach presents an increased risk and complication profile.

In a systematic review of techniques and outcomes of phalloplasty performed by Morrison et al., the average size of the latissimus dorsi phallus ranged from 7 to 17 cm in length and 10 to 20 cm in circumference with an average diameter of 3.5 cm.[5,14–19] In the largest study examining specifically latissimus dorsi phalloplasty in the gender diverse population, the authors report 129 patients and experienced the following complications: one partial flap necrosis (0.78%), two complete flap necroses (1.56%), satisfactory voiding in all patients even in the setting of 6 urethral fistulas and 2 urethral strictures, and placement of erectile devices in 61 patients.[19] Ultimately, the donor site concealability and functional affordances of this flap suggest it be considered when presenting options for phalloplasty.

4 | ABDOMINAL FLAP

In specific patients who exhibit excess infraumbilical abdominal tissue, the abdominal flap may be an ideal choice for phalloplasty. The homogenous color and texture of the abdominal tissue allows for a more natural appearance with maintenance of tactile innervation given the neural input to the region; additionally, this technique does not require microsurgical abilities making it more feasible in a center without such capabilities.[5,20–22] A significant disadvantage to using this flap refers to the dorsal incision and resultant scar that exists along the longitudinal axis of the phallus; however, scar position is subjective, and some patients may find this unobjectionable.

Through the vascular supply of the superficial epigastric system and the superficial external pudendal artery, the tissue of the lower abdomen extending to the labia majora is perfused. This same tissue is innervated superiorly by the ilioinguinal nerve and inferiorly to the level of the clitoris by the pudendal nerve which terminates as the dorsal nerve of the clitoris.[20] Performed in either the supine or modified lithotomy position, the flap is marked from the base of the clitoris superiorly along the anterior abdominal wall inferior to the umbilicus. The dissection is carried to the rectus fascia where the overlying skin and subcutaneous tissue are elevated inferiorly to the base of the flap. The flap is then tubularized and the incisions are closed.[20,22–24]

The most comprehensive review of abdominal based phalloplasty revealed the average size ranged from 3.7 to 16 cm in length and 9.5 to 12 cm in diameter.[5] The diverse nature of tissue volume present at this lower abdomen is the most likely reason for such variation. Patient reported outcomes in terms of satisfaction exhibit similar variation, and complications are vast. The most common complications include fistula formation, urethral stricture or stenosis, wound infection, and need for regraft.[5,20–24] Although not widely adaptable, this flap does serve a particular portion of the population with feasibility and minimal donor site morbidity.

5 | GROIN FLAP

Similar in nature to the abdominal based pedicled flap, the groin flap provides a homogenous skin and texture to the perineal region and phallus construction with a concealable donor site. The primary disadvantage to using this flap refers to the limited innervation thereby rendering sensation of the phallus nearly absent. The flap is vascularly supplied by the superficial circumflex iliac artery and innervated primarily at the lateral margin of the flap opposite the pedicle by T12 contributions.[25]

In the supine position, the inguinal ligament is palpated and marked before the superficial circumflex iliac artery is identified with the Doppler. In the event the artery is not audible, the anticipated vascular axes can be

marked with parallel lines approximately 2.5 cm inferior to the inguinal ligament. The flap is designed from the lateral edge of the sartorius extending to the anterior inferior iliac spine centered along the vascular axis. In the flap elevation, dissection is performed superficial to the deep fascia but extends deep to the fascia at the sartorius muscle to preserve the superficial circumflex iliac artery. After exposing the vascular pedicle, dissection is carried to the femoral sheath to identify the origin of the superficial circumflex iliac artery from the femoral artery where the flap is then rotated and transposed to the site of inset.[25]

Studies demonstrate an average range of 7.5–15 cm in length and 4–5 cm in diameter. Patient reported outcomes in terms of function and satisfaction are too scattered to provide any reliable benefit, and the complications represent a similar sequela to use in other forms of reconstruction with distal necrosis and venous congestion or edema being the most prevalent.[5] Ultimately, this option provides even less reliability than the abdominal based flap thereby limiting its overall utility.

6 | ANTEROLATERAL THIGH (ALT) FLAP

The ALT flap can be utilized in a pedicled or free fashion, however one benefit of its use often relates to its pedicled nature. This flap is the second most employed flap for gender affirming phalloplasty, most often in the setting of a negative Allen's test, in which the upper extremity could become ischemic after sacrifice of the radial artery in a RFFF, when the patient desires a less conspicuous scar, or upon patient request for a variety of other reasons. Disadvantages to its use relate to the variable perforator anatomy, which should be assessed preoperatively, along with the variable tissue volume that can contribute to bulky flaps and the compromise the ability to perform a tube-within-a-tube reconstruction.[26–29]

Lying along the axis of the intermuscular septum dividing the vastus lateralis and rectus femoris along the ALT, this flap is supplied by the multiple arterial perforating vessels originating from the descending branch of the lateral circumflex femoral artery. Accompanying the artery are the concomitant veins which provide adequate drainage to this larger designed flap. Running along the surface of the deep fascia, the flap is innervated by the lateral femoral cutaneous nerve thereby allowing for coaptation with the dorsal clitoral nerves to provide erogenous sensation.[29] In the supine position, after confirmation of distal perforators through utilizing marked landmarks and Doppler assistance, a rectangular flap is marked at the distal thigh. With dissection and elevation of the flap complete, the flap is rotated and transferred to the pubic region by means of superior retraction of the rectus femoris to allow the flap to traverse the space beneath the muscle.[29] Inset proceeds accordingly in a similar fashion to other donor flaps. The donor site is closed using a split thickness skin graft from either the ipsilateral or contralateral leg.

Although size of the eventual flap is less described, one study reported an average length of 10 cm with an average diameter of 3.5 cm.[28] A systematic review of all ALT flaps performed despite etiology of aphelia reported that 66.7% of patients describe the ability for standing micturition along with 60% reporting the ability to engage in penetrative sexual intercourse.[5] Although not the overwhelming majority, these are notable results. Like the other reconstructive options described, urethral complications are the most encountered.[30]

7 | FIBULA FLAP

First introduced for phalloplasty in 1993 by Sadove et al.,[31] the free fibular osteoseptocutaneous flap offers rigidity unlike any of the other reconstructive options discussed. The fibula donor eliminates the need for subsequent prosthesis thereby eliminating the complications often associated with prosthesis placement and maintenance.[32] Other advantages include the concealable donor site, as well as technical components such as sufficient pedicle length, appropriate subcutaneous bulk, and decreased urinary complications such as urethral fistula with prelamination techniques. Disadvantages include the need for preoperative hair removal, the possibility of compromised function at the donor site of the lower extremity, and less pronounced sensation when compared to other flaps.[32,33]

Within the deep fascia of the lower leg exists three compartments, the anterior, lateral, and posterior. The free fibular osteoseptocutaneous flap is harvested from the lateral aspect of the leg where it receives its vascular supply through branches from the fibular artery, a branch of the posterior tibial artery and venous drainage is accomplished through the accompanying concomitant veins. Sensation is accomplished by identifying and preserving the lateral sural cutaneous nerve. Should prelamination of the urethra be desired, this optimally occurs 6 months before the phalloplasty.[33,34] Prelamination involves tubularizing a graft over a foley catheter with subsequent tunneling of the graft into the suprafascial subcutaneous space.[35–37] The flap markings are then fashioned along the border of the tibia and the posterior midline of the lower leg. The flap is dissected to the subfascial plane and the intermuscular septum is

preserved to maintain vascularity of the flap. Osteotomies are created at the proximal and distal ends of the fibula while maintaining at least 6 cm proximally and distally to ensure joint stability. The vascular pedicle is then dissected proximally. The phallus is transferred to the pelvic region where the vascular anastomoses are created, and the lateral sural cutaneous nerve is coapted to the dorsal clitoral nerves.[33] The creation of the urethral anastomosis is deferred until a later stage to promote healing without excessive scarring and therefore stricture.[32]

While actual dimensions were not reported in the studies that have presented results, the complications mirror similar reports with urethral stricture and fistula being the most common. In a systematic review of all fibular free flap phalloplasty reconstructions, and in those that reported the ability for penetrative sexual intercourse, 51% confirmed this faculty, however this result approaches other techniques in which prostheses are employed.[5] In sum, the significant benefit of natural rigidity seems to only offer benefit in those in which it works.

8 | DISCUSSION

Based on the literature that exists, it is impossible to draw a conclusion stating complete superiority of one technique over another. What is evident is the frequency at which the RFFF is utilized in phalloplasty, followed by the ALT pedicled flap.[4–6,9] Given the lack of outcomes data, determining the most efficient, safe, and reliable means is an unattainable task. What the existing literature does imply is the need for a tailored, patient centered approach in which the surgeon and patient consider all factors involved in making this decision—tissue available based on anatomic features and habitus, the desired size of the phallus, ability to conceal the donor site, and most importantly, the willingness to accept the complications associated with all techniques. As with many aspects of surgery, a surgeon's familiarity and level of comfortability with performing a particular technique will likely result in improved outcomes, and although not quantified in these studies, remains a factor to consider.

9 | CONCLUSION

Ultimately, phalloplasty reconstruction should aim to achieve standing micturition and penetrative intercourse, resolute tactile and erogenous sensation, desirable aesthetics of the phallus, and acceptable donor site morbidity. Although some procedures are more commonly performed, the standard for phalloplasty has not been established. Ultimately, approaching this reconstructive puzzle with persistent creativity will unearth more reliable options in the future.

CONFLICT OF INTEREST

The author declares no conflict of interest.

DATA AVAILABILITY STATEMENT

A broad search was performed using OVID (MEDLINE and EMBASE), Wiley Online Library, and PubMed along with a specific evaluation of reference lists of relevant studies.

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