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TOPIC PAPER

# Musculocutaneous latissimus dorsi flap for phalloplasty in female to male gender affirmation surgery

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## Abstract

**Purpose** Despite a variety of free flaps that have been described for creation of the neophallus in gender affirmation surgery, none present an ideal solution. We evaluated our patients and outcomes after gender affirmation phalloplasty using musculocutaneous latissimus dorsi free flap.

**Methods** Between January 2007 and May 2017, 129 female transsexuals, aged 20–53 years (mean 24 years) underwent total phalloplasty using latissimus dorsi free flap. Urethral lengthening was performed by combining a vaginal flap, labia minora flaps and a clitoral skin flap. Suitable sized testicular implants are inserted into the new scrotum. Penile prosthesis implantation, additional urethral lengthening and glans reshaping were performed in the following stages.

**Results** The mean follow-up period was 43 months (ranged from 13 to 137 months). There were one partial and two total flap necrosis. The average size of the neophallus was 14.6 cm in length and 12.4 cm in girth. Total length of the reconstructed urethra during the first stage ranged from 13.4 to 21.7 cm (mean 15.8 cm), reaching the proximal third or the midshaft of the neophallus in 91% of cases. Satisfactory voiding in standing position was confirmed in all patients. Six urethral fistulas and two strictures were observed and repaired by minor revision. Malleable and inflatable prostheses were implanted in 39 and 22 patients, respectively.

**Conclusion** Musculocutaneous latissimus dorsi flap is a good choice for phalloplasty in gender affirmation surgery. It provides an adequate amount of tissue with sufficient blood supply for safe urethral reconstruction and penile prosthesis implantation.

**Keywords** Female to male transgender · Gender affirmation surgery · Phalloplasty · Latissimus dorsi · Urethroplasty

## Introduction

Gender dysphoria requires a multidisciplinary approach and management, led by the idea of "adjusting the body to the mind" [1]. The multidisciplinary approach includes psychiatric evaluation, hormonal treatment followed by a real-life test and gender affirmation surgery according to Standards of Care for Gender Identity Disorders [2]. Gender affirmation surgery involves bilateral mastectomy, removal of female reproductive organs and creation of a neophallus. Bilateral mastectomy usually represents the first step in surgical transition, while the removal of female reproductive organs (hysterectomy and bilateral salpingoophorectomy) can be performed either before or at the same time as phalloplasty. Creation of the neophallus relies on free tissue flaps from the arm, the thigh, the back or the abdomen and implantation of erectile prostheses (total phalloplasty), or creation of small male genitalia from the clitoris that had previously been enlarged by androgenic hormones (metoidioplasty) [3].

Total phalloplasty is one of the most demanding tasks in gender affirmation surgery representing the creation of a neophallus using extragenital tissue. Total phalloplasty should fulfill the following requirements: good volume of the neophallus that enables insertion of a prosthetic stiffener for successful sexual penetration and creation of a competent neourethra that will allow voiding in standing position; the procedure should involve a limited number of reproducible surgical stages. Finally, the goals of the surgery should be

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the creation of a sensitive and esthetically acceptable phallus, with minimal scarring and without functional loss in the donor area. Various free flaps have been used for total phalloplasty, such as radial forearm flap, latissimus dorsi flap, anterolateral tight flap, abdominal wall flaps, free deltoid flap, scapular free flap, sensate osteocutaneous free fibula flap, tensor fasciae latae, deep epigastric artery perforator flap and dorsalis pedis flap [4].

The gold standard in gender affirmation phalloplasty is radial forearm free flap with simultaneous urethral reconstruction by "tube within a tube" technique [5, 6]. However, some disadvantages, such as visible scar of the donor area, limited volume of the neophallus and high rate of urethral complications, motivated the search for new and improved solutions. Based on the experience with mucsulocutaneous latissimus dorsi free transfer flap for total phalloplasty in children with severe congenital anomalies, we started to use the same technique for phalloplasty in female to male transgenders [7]. Herein, we evaluated our patients and outcomes after gender affirmation phalloplasty using musculocutaneous latissimus dorsi flap.

## Methods

Between January 2007 and May 2017, 129 female to male transgenders, aged 20–53 years (mean 24 years) underwent total phalloplasty using musculocutaneous latissimus dorsi flap. All patients had been diagnosed as having gender dysphoria by a special team of psychiatrists and have been assessed as suitable candidates for surgery according to criteria of the World Professional Association for Transgender Health (WPATH) Standards of Care. They had been living in the male role for more than two years and had been receiving testosterone therapy. In most of our patients (92/129) phalloplasty was performed as a primary procedure, while in thirty-seven it followed metoidioplasty. Seven transgenders who underwent total phalloplasty as a reversal surgery due to regret after male to female gender affirmation surgery were excluded from this study [8]. Bilateral mastectomy had been performed prior to phalloplasty as a separate procedure, in all patients. Eighty-six patients had already undergone hysterectomy with bilateral oophorectomy, while in the remaining 43, these procedures were performed during the phalloplasty procedure. Institutional Review Board approval was attained prior to commencement of this study. All patients were thoroughly informed about the surgical details with possible complications and written informed consent was obtained before surgery.

### Surgical procedure

The total phalloplasty is performed in several stages. The first includes creation of the neophallus with urethral lengthening. Patient is placed in lithotomy position and hysterectomy with oophorectomy, when desired, are done using a transvaginal approach and continued with vaginectomy performed by colpocleisis. Clitoral degloving is performed and dorsal fundiform and suspensory ligaments are detached from the pubic bone to elongate the clitoris, enabling its fixation in a new position at the base of the neophallus (Fig. 1a).

Reconstruction of the urethra starts with harvesting of a well-vascularized periurethral flap, that will be joined with the proximal part of the urethral plate forming the bulbar part of the neourethra. A well-vascularized longitudinal flap with a long pedicle is created from both labia minora and dorsal clitoral skin. This flap is tubularized over the 14Fr Foley catheter forming the neourethra, with a new opening that will be placed as far as possible into the neophallus. Both labia majora are joined in the midline to create the one-sac scrotum. Appropriate sized silicone testicular implants (Polytech, Germany) are inserted, irrigated with antibiotic solution, and the space is closed in two layers (Fig. 1b–e). The drain is placed into the vaginal space through the perineum, without connection with testicular prosthesis.

Inguinal incision is made to identify, dissect and mobilize superficial femoral artery, saphenous vein and the ilioinguinal nerve. Skin incision ("Y" shape) is placed above the clitoris at the mons pubis region for later fixation of the neophallus. Incision is spread laterally for easier dissection of ilioinguinal nerve. A tunnel of sufficient width is dissected between the recipient area and the inguinal incision, so that the neurovascular pedicle of the neophallus can subsequently be passed through it.

The patient is moved into the lateral decubitus position using 'beanbags', with their upper torso placed in a full lateral position. Harvesting of the latissimus dorsi musculocutaneous flap is previously described in detail [7, 9]. The flap of the non-dominant side is designed and dissected with thoracodorsal artery, vein and nerve. The flap dimensions are created according to the patient's anatomy and desire: 12–15 cm in width and 12–21cm in length. Flap harvesting starts with an incision of the anterior skin margin down to the deep fascia, along the plane between latissimus dorsi and serratus anterior muscles, using sharp and blunt dissection. The flap is divided inferiorly and medially, cauterizing the large posterior perforators of the intercostal vessels, and then lifted to expose the neurovascular pedicle (thoracodorsal artery, vein and nerve). The pedicle, surrounded by fatty tissue, is identified and

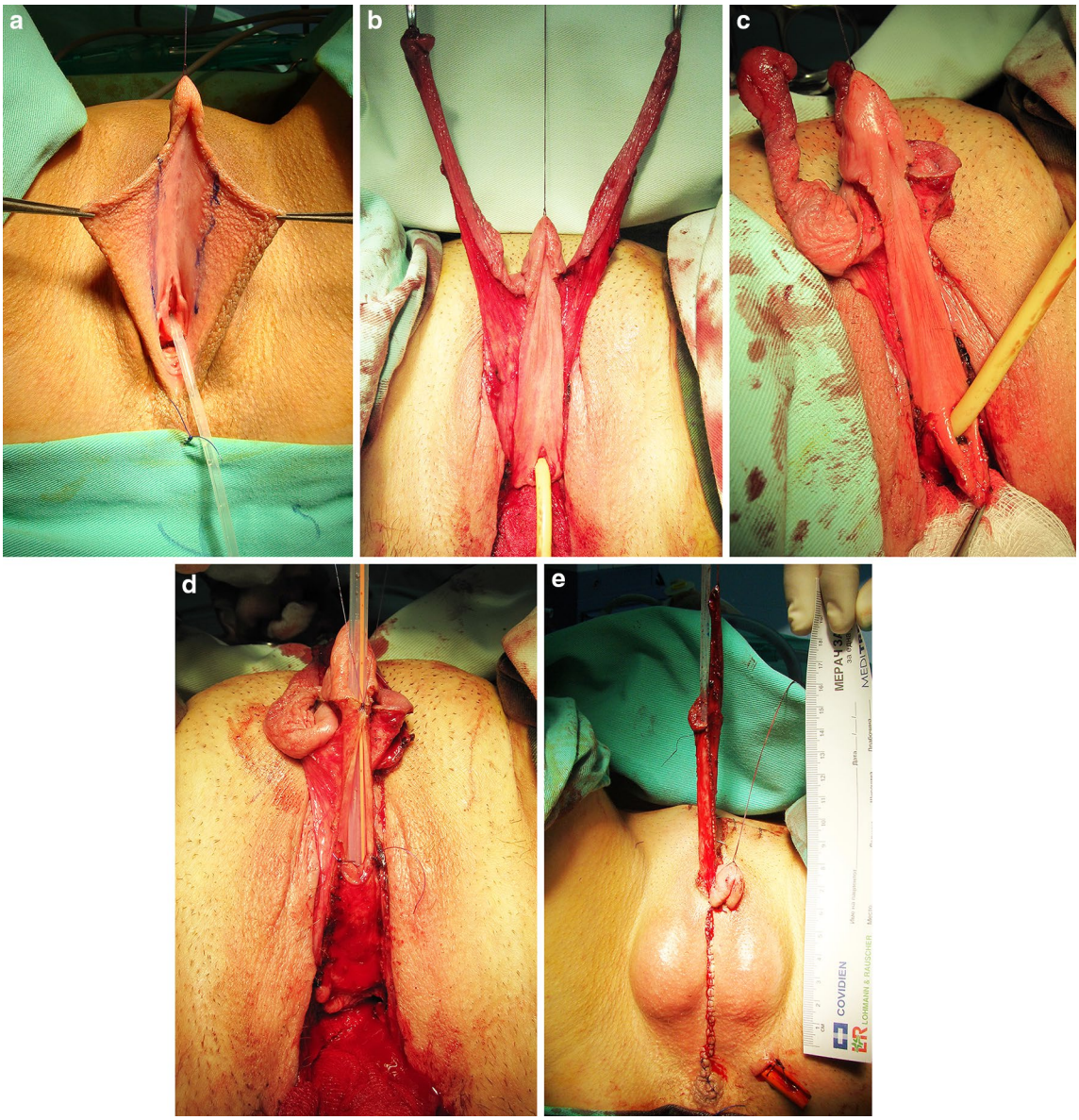


**Fig. 1** **a** Preoperative appearance. Clitoris is hormonally enlarged, with wide urethral plate. **b** A long pedicled flap is harvested from both labia minora and clitoral skin, for urethral lengthening. Urethral plate is preserved completely and prepared for tubularization. **c** Periurethral flap is created from anterior vaginal wall for creation of bulbar urethra. **d** Pendular urethra is created by further tubularization of urethral plate. **e** A well-vascularized labial/clitoral skin flap is tubularized for additional urethral lengthening. Testicular implants are inserted into the scrotum created from both labia majora

dissected proximally, up to the axillary vessels. Dissection is done very carefully, preventing injury of axillar lymph nodes and postoperative lymphoceles. The flap is elevated completely, except for the neurovascular bundle, which is not transected until the recipient vessels and nerve have been prepared for microsurgical anastomosis. The latissimus muscle is fixed to the margins of the skin at several points with interrupted absorbable sutures to prevent layer separation during further dissection. The flap is tubularized creating the neophallus while still perfusing on its vascular pedicle (Fig. 2a). Wound margins of the donor site are undermined, approximated and closed directly. If significant tension is present that may compromise healing of the donor site, a split thickness skin graft is harvested from the thigh region and used to cover the defect.

The neophallus is detached from the axillar region after thoracodorsal artery, vein and nerve are clamped and divided at their origins, to achieve maximal pedicle length. The neophallus is transferred to the recipient area and its pedicle is pulled through the previously created tunnel to recipient

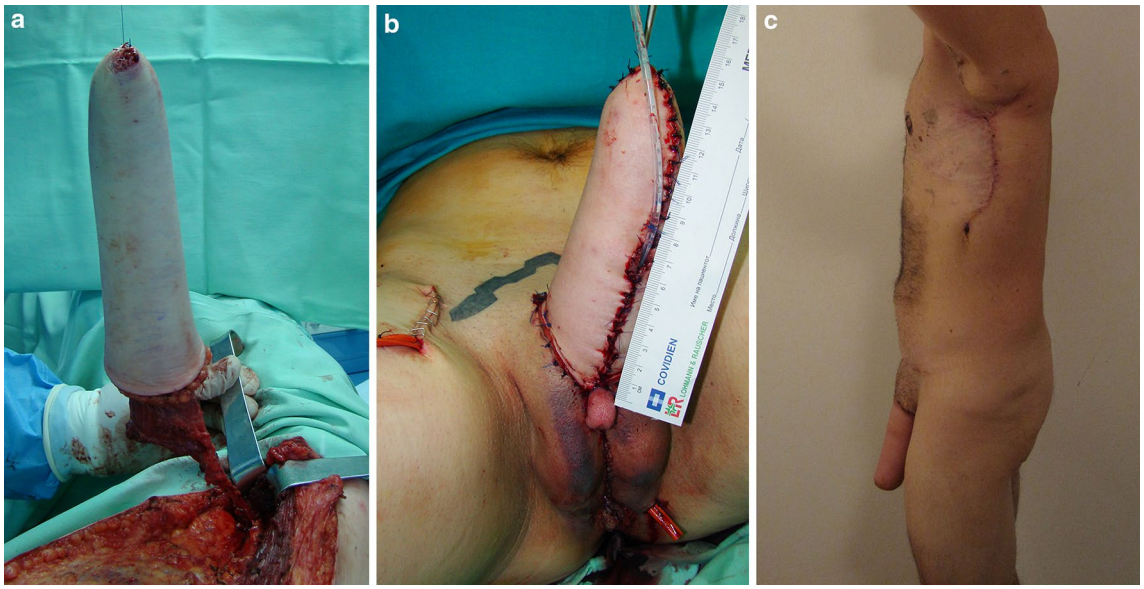


**Fig. 2** **a** Musculocutaneous latissimus dorsi flap is harvested on thoracodorsal artery and vein, and tubularized to create a neophallus. Long flap pedicle is obtained. **b** Appearance at the end of surgery. Neophallus is fixed in the proper position after microvascular anastomoses. Clitoris is placed at the base of the neophallus. Urethral opening reached the middle of the neophallus enabling voiding in standing position. **c** Outcome 4 weeks after surgery. Donor area is closed by direct approximation. Neophallus has good appearance and volume

vessels. Microsurgical anastomoses are created between the thoracodorsal and femoral artery (end-to-side), and the thoracodorsal and saphenous vein (end-to-end). Microsurgical neurorrhaphy is performed between the ilioinguinal and thoracodorsal nerve. Neourethra is incorporated into the neophallus creating the new meatus to be located at the proximal or middle third of the neophallus. Clitoral glans is fixed under the base of the neophallus (Fig. 2b, c).

A special dressing is used to keep neophallus in an elevated position, preventing pedicle kinking. A small pillow is placed under the knee to keep it in a partially flexed, tension-free position. Flap viability is assessed by clinical examination (i.e., skin color, local temperature and capillary refill) and vascular patency is monitored by pocket Doppler device. A suprapubic catheter is inserted to drain the bladder and to allow a control urethrography to be done 3 weeks after surgery.

Urethral lengthening i.e. neophallic urethroplasty is based on Johanson principle in two stages. In the first stage, buccal mucosa grafts of appropriate size, harvested from one or two chicks, are placed at the ventral side of the neophallus and quilted for better survival. Three months later, new urethral plate, created from buccal mucosa grafts, is dissected and tubularized creating the new urethra. Glans reconstruction is usually done using the Norfolk technique. Finally, penile prosthesis, either inflatable (AMS 700LGX, Boston Scientific, USA or Titan Touch, Coloplast, USA) or semirigid (Genesis, Coloplast, USA) are inserted into the neophallus using infrapubic and/or penoscrotal approach. The proximal end of the prosthesis is fixed to the pubic symphysis. In case of a three-component inflatable prosthesis, pump is placed in the appropriate scrotum while the reservoir is inserted retrovesically. In patients who requested clitoral glans covering, glans is de-epitelized and covered with surrounding skin of the phallic base at the same stage (Fig. 3a–c).

A retrospective evaluation of surgical outcomes and complications was performed. Satisfaction was estimated using a short questionnaire modified from a validated study for long-term outcome evaluation in hypospadias [10]. Surgery was assessed on a scale from 1 to 5, with 5 being the best (1—very dissatisfied, 2—dissatisfied, 3—satisfied, 4—somewhat satisfied and 5—completely satisfied).

## Results

In all, 129 female to male transgender patients underwent a musculocutaneous latissimus dorsi phalloplasty. The follow-up period ranged from 13 to 137 months (mean 43 months). The average size of the neophallus was 14.6 cm (ranged from 12 to 21 cm) and 12.4 cm (ranged from 12 to 15 cm) in length and girth, respectively. In the early postoperative period one partial and two total flap necrosis were seen. Partial necrosis was limited to distal part of the neophallus and healed spontaneously with minimal lost of the length. In two patients with total necrosis due to vein thrombosis, new phalloplasty with anterolateral tight flap (1) and latissimus dorsi flap from the opposite side (1) was done with

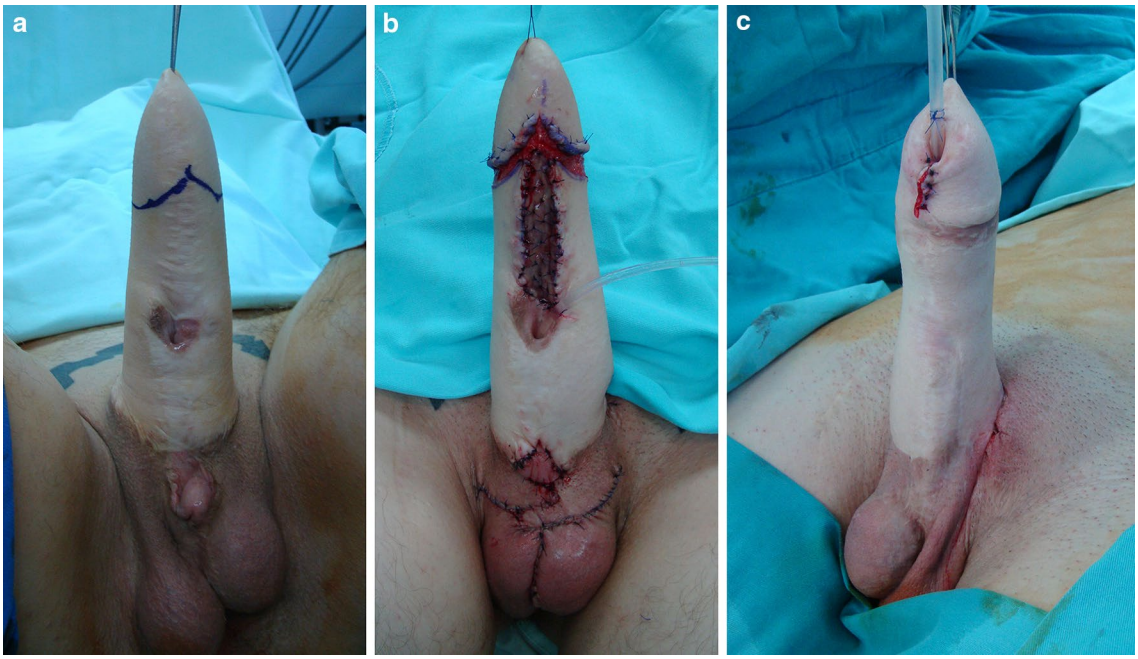


**Fig. 3** **a** Second stage includes glans reconstruction and neophallic urethroplasty. **b** Glans is reconstructed by the Norfolk technique. Buccal mucosa graft is positioned in the distal half of the neophallus, forming the new urethral plate. Clitoral glans is covered with skin. **c** Final appearance after third stage. Penile implants are inserted by infrapubic approach. Urethral opening is at the top of the neoglans

successful outcome. In the remaining 126 cases the graft survived and good vascularization of the neophallus was confirmed by doppler ultrasonography at 1, 3 and 6 months after surgery. Nobody reported reduction of the neophallic length during this follow-up period. Donor site was close by direct approximation in 101 and with split-thickness skin graft in 28 cases. Minor wound dehiscence of the donor site was common (27 patients) after surgery but resolved with conservative management. Finally, donor site appearance was acceptable in the majority of cases (125), while in four patients additional surgery was performed for scar repair. There were no complications related to hysterectomy and oophorectomy in any of the patients who had this surgery simultaneously with phalloplasty.

Total length of the reconstructed urethra using all vascularized genital flaps in the first stage was measured during the surgery and ranged from 13.4 to 21.7 cm (mean 15.8 cm). New urethral opening was placed either at the base, in the proximal third or at the mid part of the neophallus in 12 (9.3%), 97 (75.2%) and 20 patients (15.5%), respectively. All patients, including the cases with neophallic base urethral opening, reported voiding while standing. Six urethral fistulas and two strictures were observed and repaired by minor revision. Neophallic urethroplasty by staged buccal mucosa graft tubularization was performed in 82 cases (63.6%). Urethral fistula occurred in 28 patients and healed spontaneously in 7, while in the other 21, minor repair was necessary. Urethral stricture developed in 33 patients and was resolved by dilation or surgical revision in 8 and 25, respectively. Surgical repair included excision of the stenotic part with direct anastomosis or augmentation with new oral mucosa graft in 11 and 14 cases, respectively.

Inflatable and malleable prostheses were implanted in 22 and 39 patients, respectively. Sexual intercourse with penetration without implants was reported in 14 cases. 12 of the remaining 52 patients are currently waiting for penile implants, while the 40 patients left decided against the implants at this time. In two cases, inflatable prosthesis was replaced by a semirigid due to malfunctioning. Rejection of implants due to infection was noted in two cases.

All patients were evaluated by either a psychologist or a psychiatrist and reported being very satisfied with their surgery. According to patients' self-reports, except the patients with postoperative flap necrosis, the majority were pleased with the esthetic appearance of their male genitalia (101 "completely satisfied", 26 "somewhat satisfied") (Fig. 2c). Erogenous sensation based on clitoral stimulation was reported in all, while in only 17 patients (13.2%) tactile sensation of the neophallus was confirmed and based on sensitivity of clitoris and neourethra that were incorporated into the neophallus. Otherwise, none of the patients reported any problems or difficulties in sexual arousal (oral, penetrative), masturbation or orgasms. In all patients with penile implants, sexual intercourse with complete penetration was feasible.

## Discussion

Reconstruction of the neophallus in female to male transgender patients presents a great challenge for genital reconstructive surgeons. The indications for phalloplasty in the past were limited only to trauma victims who required surgery to restore their male anatomy. Recently, the indications expanded to many congenital anomalies such as aphallia, micropenis, disorder of sexual development, epispadias or hypospadias as well as a part of gender affirmation surgery in female to male transgenders. Moreover, the procedure itself is posing considerable challenges for all surgeons who are performing the gender affirmation surgery because of the particular psychological implications and patients' demands.

The main goal of gender affirmation phalloplasty is creation of male-like genitalia, that enable voiding while standing and allow for sexual intercourse. When choosing the genital confirmation surgery, the candidate with gender dysphoria must bear in mind the desired postoperative result he wishes to achieve and surgical options in his case. Sometimes, their wishes to have a body as similar to a male body as possible might be unrealistic and technically unfeasible. Transgender patients, in their decision-making process for transitional surgical procedure, balance between final results of the procedure, number of the surgical stages and possible complications. It is mandatory to include a full preoperative explanation of advantages and disadvantages of a specific surgical procedure, postoperative results, possible intraoperative and postoperative complications, with a goal to prevent severe postoperative depression and regret.

Several surgical procedures have been recommended for neophallic reconstruction using either available local vascularized tissue or microvascular flap transfer [5, 6, 11–14]. Since the pioneer work from Bogoraz, who described total penile reconstruction many decades ago, there have been constant endeavors to develop an ideal technique that can meet all demands [15]. In the beginning, many variants of local pedicled flaps, based on the inferior epigastric vessels were published [16–18]. Development of microsurgical techniques resulted in a huge variety of microsurgical free flaps that became very popular for female to male gender confirmation surgery [5, 7, 19, 20].

Since Chang and Hwang described their results for phalloplasty in cases after penile trauma or malignancy, radial forearm free flap became the most commonly used flap for phalloplasty worldwide [5, 6]. This technique yields a sensate neophallus with complete urethral lengthening at the same stage. However, drawbacks of this technique include the small size and circumference of the neophallus, as well as visible donor site scar that is considered stigmatizing for transgender people. Small volume of the neophallus sometimes presents a limitation for insertion of two cylinders of the penile prostheses. The most common complications in radial forearm flap phalloplasty were related to urethroplasty. The Ghent group reported that 126 of 316 transmen (40%) had complications of urethral reconstruction. Authors reported implantation of erectile prosthesis in 143 patients with a complication rate of 41% requiring surgical revision [21]. Otherwise, Garaffa et al. reported results of one stage phalloplasty with urethral reconstruction in 115 patients, out of which 112 were satisfied with the postoperative results and 99 reported good sensation of the neophallus [22].

The musculocutaneous latissimus dorsi flap, initially described by Baudet, has a reliable and suitable anatomy to meet the esthetic and functional requirements of phallic reconstruction [23]. We have published our first results with this technique in phallic reconstruction in boys with epispadias, micropenis, and intersex disorders [7]. Even though there are many alternatives for phalloplasty in transgender patients, the musculocutaneous latissimus dorsi flap technique is the preferred method in our center. This flap presents an acceptable choice for transsexual patients giving an excellent volume of the neophallus enabling feasible urethral reconstruction and full penile prosthesis implantation. Moreover, the phallus can be constructed to the size desired by the patient. Neophallus retraction seems less likely with muscle-based grafts than with fasciocutaneous forearm flaps, since well-vascularized muscle is less prone to contraction than connective tissue. Another important advantage of the latissimus dorsi flap is the acceptable scar, in contrast to stigmatizing visible scar left by the forearm flap phalloplasty.

Urethral reconstruction, which can sometimes lead to postoperative complications, is a multistaged and most difficult part of phalloplasty. Urethral lengthening is usually done simultaneously with phalloplasty using all hairless vascularized genital flaps. Thus formed, the new urethra is insufficient to reach the tip of the neophallus, and additional neophallic urethroplasty is requested later. However, the new urethral opening, located either on the base or in the proximal half of the neophallus, is always enough to enable voiding while standing.

Good results were obtained in majority of the patients in all surgical aspects, appearance and size of the neophallus, voiding function and erectile function with penile implants. However, there are disadvantages as well, including lack of tactile sensation of the neophallus and urethral complications that required surgical revision. Despite the fact that an anastomosis between the thoracodorsal (motoric) and the ilioinguinal (primarily sensory with some motor fibers) nerve was performed as a standard part of the phalloplasty, the neophallus still showed poor sensitivity, restricted to the

clitoris incorporated at the base of the neophallus. Last but not least, all patients reported good sensation of the glans clitoris, either with or without its covering. It is achieved due to complete preservation of the neurovascular bundle of the clitoris during its dissection in the first stage of phalloplasty.

## Conclusions

Total phalloplasty in female to male transgenders represents a great challenge. Despite the fact that the radial free forearm flap technique is the most commonly performed procedure, musculocutaneous latissimus dorsi flap is an acceptable choice in gender affirmation surgery. Possibilities for vaginal penetration, preserved erogenous sensibility, voiding while standing and acceptable donor site morbidity present the main advantages for a successful outcome.

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**Author contributions** MLD: Project development, Data collection, Manuscript writing. MB: Data collection and analysis, Manuscript editing. VK: Project development, Data analysis. BS: Data collection, Manuscript editing. MB: Data analysis. SK: Project development. ZK: Manuscript editing. GK: Project development.

### Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Statement of human rights** All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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