Immediate pedicled gracilis flap in radial forearm flap phalloplasty for transgender male patients to reduce urinary fistula

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Summary  Background and aim: Radial forearm phalloplasty is accompanied by high rates of fistula formation. We examined the effect of placing a pedicled gracilis myofascial flap around the urethral anastomosis at the time of radial forearm flap transfer on the development of postoperative urethrocutaneous fistula.
Methods: Fifteen patients underwent phalloplasty with urethroplasty between June 2012 and October 2015, and they met the inclusion and exclusion criteria for the study. We retrospectively reviewed patients’ medical records and extracted patient demographic data, prelamination technique used (mucosa, skin graft, both, or neither), and whether or not a gracilis myofascial flap was harvested at the time of flap transfer and used to reinforce the native-neourethral anastomosis. The chi-squared test was used to evaluate the association between the presence of a gracilis flap and fistula formation.
Results: Four patients received a gracilis flap as part of their primary phalloplasty operation. None of these patients developed a fistula. Eleven patients did not receive a gracilis flap at the
time of initial surgery and seven developed a fistula. Discussion: In our patient series, inclusion of a pedicled myofascial gracilis flap at the time of radial forearm phalloplasty with urethroplasty was associated with an absence of fistula formation. Therefore, we have since made inclusion of this flap a standard practice for all transmales undergoing phalloplasty with urethroplasty.

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Introduction

Radial forearm phalloplasty was originally described by Chang in 1984 and still remains the most popular technique for phalloplasty as it offers reliable anatomy and neurotized, supple tissue with a long vascular pedicle. The medial and/or lateral antebrachial cutaneous nerves, which are transferred with the flap and Anastomosed to the ilioinguinal, genitofemoral, and clitoral nerves, often allow for both erogenous and tactile sensation. However, the radial forearm flap, such as other forms of phalloplasty with urethroplasty, is accompanied by high rates of fistula formation. Fistula rates vary widely among surgeons, with some studies reporting rates as low as 14% and others as high as 64%. The anastomosis of the neourethra and native lengthened urethra is most susceptible to fistulas. Factors contributing to fistula development following phalloplasty include infection, insufficient soft tissue at the urethral anastomosis, and compromised blood supply secondary to a scarred tissue bed. Urethral lengthening performed in transgender males, usually with labia minora tissue and anterior vaginal flaps, which are both tissues with a tenuous blood supply, further contributes to higher fistula rate among this patient demographic.

Surgical technique has evolved in an effort to reduce fistulas. At present, some surgeons perform staged flap prelaminarization and report a decrease in postoperative fistula formation. Nevertheless, further adaptations are needed. At our institution, we started treating patients who developed urethrocystocutaneous fistulas postphalloplasty with a gracilis myofascial flap to reinforce the neourethral anastomosis and observed that no recurrent fistulas developed. We therefore hypothesized that inclusion of a gracilis myofascial flap prophylactically at the time of radial forearm flap transfer would lead to a decrease in the prevalence of fistula.

The purpose of the current study is to examine the effect of using a pedicled gracilis myofascial flap around the urethral anastomosis at the time of flap transfer on the rate of urethrocystocutaneous fistula development.

Methods

Patients and methods

We performed a retrospective chart review of our experience with urethroplasty in the setting of radial forearm flap phalloplasty. We identified and reviewed the medical records of all transmale patients who underwent gender confirmation bottom surgery with radial forearm flap phalloplasty between June 2012 and October 2015 at the University of Miami Miller School of Medicine. The same surgeon (CS) performed all operations. To be included, patients had to be transmales who elected to undergo phalloplasty with urethroplasty as treatment for gender dysphoria. Patients who opted to urinate from their native urethra were excluded from the study. Of the 16 patients who underwent phalloplasty during the designated time period, one patient was excluded because he underwent phalloplasty without urethroplasty and received a tube within a tube phallus without a neourethra. The remaining 15 patients met inclusion and exclusion criteria and were selected for the present case series.

We extracted demographic data (age, race, body mass index (BMI), and medical comorbidities), type of tissue used for prelaminarization (mucosa only, skin graft only, mucosa and skin graft), whether a pedicled myofascial gracilis flap had been used (at the time of initial surgery, as part of a salvage procedure, or not at all), and whether or not the patient developed the complication of urethrocystocutaneous fistula. Urethrocystocutaneous fistula was defined as leakage of urine from disrupted skin wounds other than the urethral orifice, as confirmed at bedside clinically or with a retrograde cystourethrogram. Data are available for all patients from the time of surgery until December 2015. No patients were lost to follow-up.

Surgical technique

Radial forearm phalloplasty and urethroplasty techniques are well documented in the literature. We performed radial forearm phalloplasty in a standard manner. Before transferring the flap, grip and pinch strength testing were used to determine each patient’s nondominant hand, which was selected for flap harvest.

Prelamination was performed 6-8 weeks before radial forearm flap transfer with mucosa (buccal, vaginal, and/or uterine), a skin graft (thigh or abdomen), or both (Figure 1a). Whenever possible, we preferred to prelamine the neourethra with mucosa instead of skin graft; however, mucosal sources were not always adequate in patients who had previously undergone metiodiplasty with vaginectomy. In these patients, buccal mucosa alone was insufficient for prelaminarization and skin grafts were also used. Prelamination was not
performed in one patient. In all patients, we lengthened the urethra using labia minora tissues and a pedicled anterior vaginal flap (Figure 1b). An anastomosis was then performed between the lengthened urethra and neo-urethra (Figure 1c, d).

Our technique for the gracilis flap harvest is as follows: as we use the great saphenous veins as recipient veins for the radial forearm flap, the proximal incision made to harvest the great saphenous vein is used for the gracilis muscle harvest and visualization of the vascular pedicle and obturator nerve (Figure 2). An inferior incision is made for disinsertion of the muscle and further muscle harvest (Figure 2). The distal free end of the muscle is delivered to the proximal incision. Undermining of the soft tissues is performed from the proximal thigh incision to the level of the midline groin defect where urethral anastomosis is to be performed. The gracilis muscle is then wrapped around the urethral anastomosis (Figure 3), avoiding compression.

Figure 1  a. Vaginal mucosa used to prelamine the neourethra 6–8 weeks before radial forearm flap transfer. b. Transgender male shown at the time of urethral lengthening using labia minora tissues and an anterior vaginal flap. c. Urethral anastomosis performed between the lengthened urethra and the neo-urethra of the radial forearm flap. d. Urethral anastomosis performed between the lengthened urethra and the neo-urethra of the radial forearm flap over an 18Fr Foley catheter.

Figure 2  Gracilis muscle harvest before flap transfer.

Figure 3  Gracilis wrapped around the urethral anastomosis.
of the vascular pedicle and soft tissue coverage of the denuded clitoris, as these actions could lead to compromised blood supply and problems with erogenous sensation, respectively. Figure 4 depicts the gracilis muscle secured around the site of the urethral anastomosis.

Figure 5a and b shows the same patient immediately before and after phalloplasty. Figure 6 depicts a patient at the 6-month postphalloplasty follow-up appointment.

Statistical analysis

The chi-squared test was used to evaluate the association between categorical variables. A two-tailed $p$-value was calculated. Values for $p < 0.05$ are considered statistically significant.

Results

Sixteen patients underwent phalloplasty at our institution between June 2012 and October 2015 and 15 of these patients met the criteria for the present case series. Four patients (26.7%) received a prophylactic gracilis flap at the time of flap transfer (gracilis group) and 11 patients (73.3%) underwent phalloplasty without a prophylactic gracilis flap (non-gracilis group). Follow-up time ranged from 2.5 to 25.1 months, with an average follow-up time of 14.1 month.
patients were representative of all ages, with two patients had a BMI of 35 (<span class="mathjax" style="color: red;">n</span> = 2), gastritis (n = 2), glaucoma (n = 1), anemia (n = 1), and a history of Kawasaki disease (n = 1). The only patient with diabetes was in the gracilis group. Five patients had no medical comorbidities and the majority of these patients were present in the non-gracilis group (n = 4). The majority of patients were never smokers (n = 11). The only current smoker was present in the gracilis group. All study patients were diagnosed with gender dysphoria by a psychiatrist before the surgery and, in accordance with the World Professional Association for Transgender Health, received letters from two different psychiatrists recommending them for gender confirmation bottom surgery.

**Surgery characteristics**

As shown in Table 2, a left radial forearm flap was harvested in 12 patients and a right radial forearm flap was harvested in two patients. One patient underwent left free flap phalloplasty followed by the placement of a right radial forearm flap around the fibular head. In four patients, an osteocutaneous flap was harvested that included a segment of the radius; in the remaining 11 patients, bone was not included with the flap.

The majority of patients underwent prelamination with both buccal mucosa and thigh skin graft (n = 8). Two patients underwent prelamination with only vaginal mucosa. Two patients underwent prelamination with a combination of buccal mucosa, vaginal mucosa, and an abdominal skin graft. One patient underwent prelamination with thigh skin graft only and one patient underwent prelamination with uterine and vaginal mucosa only. One patient in the gracilis group did not undergo any form of prelamination.

**Summary of results**

As shown in Table 3, four patients received a gracilis flap at the time of forearm flap transfer as part of the primary phalloplasty operation and none of these patients developed the complication of fistula. Eleven patients did not receive a gracilis flap at the time of forearm flap transfer and seven of these 11 patients (63.6%) developed a fistula. The association between surgical technique (i.e., immediate gracilis flap or no flap) and outcome (development of fistula) was statistically significant (chi-square = 4.773; df = 1; p = 0.0289).

Two of the patients who did not receive a gracilis flap as part of their primary operation and developed a fistula during their postoperative course were treated with placement of a delayed gracilis flap (see Table 2). The original fistula resolved and no subsequent fistulas recurred in either patient.

**Discussion**

Our experience with urethroplasty in patients undergoing radial forearm flap phalloplasty demonstrates a lower incidence of postoperative fistula development when gracilis flaps are used prophylactically at the second stage (flap transfer) of gender confirmation bottom surgery. None
of the patients who received an immediate gracilis flap developed a fistula, while 63.6% of the patients who did not receive a prophylactic gracilis flap did. Two of the patients in the non-gracilis flap group who developed a fistula were treated with a delayed gracilis flap. In both patients, the fistula resolved and no subsequent fistulas developed. Aside from the benefit of decreased fistula formation, phalloplasty with a gracilis flap autoaugments the neoscrotum, thus forgoing the need for testicular implants and their associated complications.

Our finding that the use of a gracilis flap is protective against fistula formation at the site of anastomosis of the native urethra and neourethra is likely due to its ability to provide well-vascularized tissue to a hypovascular anastomotic region. The efficacy of gracilis flaps in fistula prevention is not surprising, as gracilis flaps have been used successfully to treat complex urogenital fistulas in both men and women.

We are well aware that this study has limitations. A retrospective case series design was used and patients were not randomized; each individual patient and their surgeon (CS) selected the most advantageous surgical approach. Thus, differences other than the presence or absence of a gracilis flap exist between groups and may have contributed to fistula formation. Similarly, the proportion of patients undergoing prelamination with skin alone, vaginal mucosa alone, both skin and vaginal mucosa, or neither skin nor vaginal mucosa differed between groups and may have affected fistula formation. Finally, this study included only 15 patients; therefore, although our findings were statistically significant, the study has low power and requires confirmation with a larger patient cohort.

This study does have numerous strengths. First, this is the first published study that discusses phalloplasty with an immediate gracilis flap. Although our study sample is small, our results indicate that the use of a gracilis flap may be another means by which the incidence of fistula formation can be markedly decreased. This has important implications for all patients undergoing phalloplasty, but most importantly for transmales who suffer higher rates of fistula secondary to urethral lengthening. In addition, although small, our study population is heterogeneous and represents individuals aged 20 to 50 years, and a mix of races and BMIs. Furthermore, several patients in the study were at high risk due to comorbidities such as hypertension, diabetes, and being classified as current smokers. The diversity of our patient populations allows for better generalizability of our results to the larger population of transmales diagnosed with gender dysphoria.

**Conclusion**

Our study showed that fistula rates were lower in patients who underwent phalloplasty with a gracilis flap than patients who underwent phalloplasty without a gracilis flap at our institution. These data require further validation with a
larger patient sample. Although a large randomized control trial would minimize bias and provide the best evidence regarding the protective effects of a gracilis flap in preventing urethrocutaneous fistulas, this is not possible due to the infrequency with which phalloplasty is performed and the ethical issues associated with randomizing surgical patients. Given the strength of our current data, we hope surgeons will consider phalloplasty with a prophylactic gracilis flap as a surgical alternative for transmale patients electing to undergo gender confirmation bottom surgery.

Contributors’ statements

All authors reviewed, revised, and approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

Conflicts of interests

The authors have no financial relationships or conflicts of interest relevant to this article to disclose.

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