Outcomes and Predictors of Revision Labiaplasty and Clitoroplasty after Gender-Affirming Genital Surgery

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Background: Penile inversion vaginoplasty is the most common gender-affirming procedure for transfeminine patients. Patients undergoing this procedure may require revision labiaplasty and clitoroplasty. This study describes complications and outcomes from the largest reported cohort in the United States to undergo penile inversion vaginoplasty with subsequent revision labiaplasty and/or clitoroplasty.

Methods: A retrospective chart review was performed of a single surgeon's experience with penile inversion vaginoplasty with or without revision labiaplasty and/or clitoroplasty between July of 2014 and June of 2016 in a cohort of gender-diverse patients assigned male at birth. Patient demographic data, complications, and quality of life data were collected. Univariate and multivariate comparisons were completed.

Results: A total of 117 patients underwent penile inversion vaginoplasty. Of these, 28 patients (23.9 percent) underwent revision labiaplasty and/or clitoroplasty, with nine patients (7.7 percent) undergoing both procedures. Patients who underwent penile inversion vaginoplasty necessitating revision were significantly more likely to have granulation tissue ($p = 0.006$), intravaginal scarring ($p < 0.001$), and complete vaginal stenosis ($p = 0.008$). The majority of patients who underwent revision labiaplasty and/or clitoroplasty reported satisfaction with their final surgical outcome (82.4 percent) and resolution of their genital-related dysphoria (76.5 percent).

Conclusions: Patients who developed minor postoperative complications following penile inversion vaginoplasty were more likely to require revision surgery to address functional and aesthetic concerns. Patients responded with high levels of satisfaction following revision procedures, with the majority of patients reporting resolution of genital-related dysphoria. Transfeminine patients who undergo penile inversion vaginoplasty should be counseled on the possibility of revisions during their postoperative course. (*Plast. Reconstr. Surg.* 144: 1451, 2019.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, III.

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THERAPEUTIC

Gender-affirming surgery leads to high levels of patient satisfaction and psychosocial benefits for transgender or gender diverse patients suffering from gender dysphoria.[1–5] Transgender and gender diverse are terms used to describe those whose gender identity is different from their assigned biological sex. Gender-affirming procedures most commonly include operations to align a patient's chest and genitals with their identified gender. For transfeminine

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patients, penile inversion vaginoplasty is the most common genital surgical procedure.[6,7] This procedure reproduces a vulva, a vaginal canal capable of penetrative sex, and a functional clitoris and labia minora. Although met with high levels of satisfaction, penile inversion vaginoplasty often requires revision labiaplasty, clitoroplasty, or other secondary procedures to achieve optimal appearance and functionality.[6,8–14] In the senior author's experience, revision labiaplasty and/or clitoroplasty is usually patient initiated. Indications for revision labiaplasty include lack of defined labia minora, lack of a clear anatomical junction between labia minora and labia majora, asymmetric labia, and excessive labia majora. Indications for revision clitoroplasty are exposed clitoris, which can be hypersensitive from lack of clitoral hood coverage.

Postoperative complications of penile-inversion vaginoplasty are well documented and most commonly include hematoma, seroma, and excess erectile tissue, yet there are few reports on predictors of clitoroplasty and labiaplasty revision operations following penile inversion vaginoplasty.[6,8–10,14–25] Patient-reported outcomes constitute an important metric in the gender affirmation literature and help quantify patient satisfaction and resolution of gender dysphoria.[23,26–30] A thorough understanding of the complications and patient-reported outcomes after penile inversion vaginoplasty will help inform postoperative care and the decision to undergo revision clitoroplasty and labiaplasty.

This study reports operative and quality-of-life outcomes from the largest cohort to undergo revision labiaplasty and clitoroplasty after penile inversion vaginoplasty in the United States. We hypothesized that there would be no difference in comorbidities or patient satisfaction between patients who required revision labiaplasty and/or clitoroplasty and those who did not.

PATIENTS AND METHODS

Study Population and Design

A retrospective chart review was performed of a single surgeon's experience with penile inversion vaginoplasty with or without revision labiaplasty and/or clitoroplasty in a cohort of transgender and gender diverse patients, assigned male at birth. All patients were operated on by the senior author (T.S.) between July of 2014 and June of 2016. Other types of revisions not included in this study were fat transfer to labia majora, external scar revisions, scar contracture release of vaginal introitus, correction of vaginal stenosis, ablation of granulation tissue, urethromeatoplasty (to correct urinary stream), and excision of excessive erectile tissue. All patients who underwent the indicated procedure in this timeframe were included in the study. All patients were at least 18 years old at the time of the study. All patients gave consent for all aspects of the study, and the institutional review board protocol was approved [Advarra (Columbia, Md.) Institutional Review Board protocol number Pro00031075]. Data collected included patient demographics, preoperative comorbidities, and post–penile inversion vaginoplasty complications.

Outcomes of Interest

Demographic data collected included age, body mass index, length of time on hormone therapy, education, employment status, relationship status, history of mental health issues, presence of medical comorbidities, and follow-up time. Postoperative complications were categorized as major and minor. Major complications requiring hospital admission or surgical intervention included necrosis requiring dressing changes or operative débridement, hematoma/excessive bleeding requiring operative management, complete vaginal stenosis, need for transfusion, infection requiring intravenous antibiotics, inpatient psychiatric care required postoperatively, rectovaginal fistula, prolapse, intraoperative urethral injury, intraoperative rectal injury, and urethral stenosis requiring operative management and placement of suprapubic catheter. Minor complications not requiring hospital admission or immediate surgical management included granulation tissue, intravaginal scarring managed with dilation, prolonged pain for 3 months, urinary issues (incontinence, disrupted stream), urinary tract infection, prolonged swelling for 3 months, excessive vaginal drainage for more than 3 months requiring dressing care, decreased sensation of the clitoris at 6 months as reported by the patient, urinary retention requiring catheter placement, introital stenosis managed with dilation, anorgasmia, pain with sex, and hypersensitivity. Minor complications may eventually lead to surgical intervention, but generally fall within the defined postoperative expectations. A binary variable of cumulative "minor complications" was created, aggregating the number of minor complications. A similar variable for "major complications" was also created.

An online 20-question survey was deployed to all patients who underwent penile inversion vaginoplasty and patients who underwent subsequent

revision labiaplasty and/or clitoroplasty. Patients were sent weekly reminders to complete the online survey for 6 weeks. Nonparticipation in the survey was attributable to patient nonresponse or inability to contact patients. The survey was adapted from the Female Genital Self-Image Scale, a seven-question survey that has previously been validated in cisgender women.[31] The survey used in this study has been used previously in other studies analyzing gender-affirming procedures.[23,30]

Statistical Analysis

Descriptive statistics including patient demographics, comorbidities, and postoperative complications were calculated. Tests of difference were chosen according to variable distribution, including *t* tests for normally distributed variables and Wilcoxon rank sum tests for variables with skewed distribution. The chi-square test was performed for comparisons between categorical variables. A multivariate logistic regression model using maximum likelihood estimates was also performed, examining the relationship between the outcome of complications (both minor and major were pooled) and the following set of predictors: revision labiaplasty or clitoroplasty, age, body mass index, and presence of comorbidities. The remaining variables were omitted because of the lack of a sufficient number of observations. All calculations were performed using the R Statistical Programming environment (R version 3.3.0). A value of $p < 0.05$ was considered significant. A Strengthening the Reporting of Observational Studies in Epidemiology checklist was completed before manuscript submission.

Surgical Approach

The goal of the penile inversion vaginoplasty is to create all aspects of the internal vagina, and the vulva, including the labia majora, labia minora, urethra, clitoris, and clitoral hood. Patients are evaluated closely in the postoperative period to assess wound healing and complications. If functional or cosmetic deficits develop, revision labiaplasty and/or clitoroplasty procedures are performed at 6 to 12 months from the time of the original operation, once wound healing has reached full maturation.

Labiaplasty Technique

In the course of wound healing after the primary penile inversion vaginoplasty, some patients may develop an effaced vulva with lack of defined labia minora and an indistinct junction between the labia minora and the labia majora. The labia minora is continuous with the clitoral hood, and in most cases, the labiaplasty is performed in conjunction with clitoroplasty to produce a harmonious result. Overall, the goal of revision labiaplasty is to recreate a more cosmetically appropriate vulva. Revision labiaplasty was most commonly addressed with the following approach. The patient was placed in the lithotomy position revealing, most commonly, a vulva with lack of defined labia minora, overlay lax skin of the labia majora, and an indiscernible clitoral hood (Fig. 1, *above, left*). An incision was made 3 cm lateral to the vaginal introitus, extending to 3 cm above the clitoris (Fig. 1, *above, second from left*). Medially based skin flaps were then raised bilaterally, in a lateral-to-medial fashion. The flaps were thinned to allow for adequate pliability (Fig. 1, *above, second from right*). The lateral edges were inset to the deep pelvic fascia to create labia minora using longer lasting absorbable suture (Fig. 1, *above, right*). Excess labia majora skin was excised and the labia majora wound edge was then inset into the deep pelvic fascia, adjacent to the labia minora. The labia majora skin was sutured to the deep pelvic fascia to create an adequate valley between the labia minor and the labia majora. This created an anatomical junction between the labia majora and labia minora (Fig. 1, *below, left*). The upper aspects of the skin flaps were folded over the clitoris to create the first layer of closure for the clitoral hood using absorbable suture (Fig. 1, *below, center*). The lateral skin edges were then closed over this to create a second layer closure, effectively creating a double-layered clitoral hood (Fig. 1, *below, right*). Final wound closure was achieved with absorbable running sutures. Finally, absorbable suture was used in an interrupted mattress fashion along the labia majora to create and maintain anterior projection.

Clitoroplasty Technique

In the primary penile inversion vaginoplasty, a clitoral hood is created using tissue from the base of the penis and from the urethral flap. The external aspect of the hood is made up of penile skin, and the internal surface is made of the urethral flap. In revision clitoroplasty, a triangular medially based flap is created in which the lateral skin edges are sutured at the midline. This technique cannot be incorporated into the original operation because it will compromise blood supply and lead to necrosis. After an appropriate delay, a clitoroplasty can be performed without concerns for ischemia.

Fig. 1. Operative approach to revision labiaplasty and clitoroplasty. (*Above*, *left*) Preoperative image before revision labiaplasty and clitoroplasty. (*Above*, *second from left*) Markings for labiaplasty and clitoroplasty. (*Above*, *second from right*) Exposure and thinning of labia minora. (*Above*, *right*) Inset of medial skin edge of labia majora and lateral skin edge of labia minora to deep pelvic fascia. (*Below*, *left*) exposure for clitoroplasty. (*Below*, *center*) Closure of clitoral hood in two layers. (*Below*, *right*) Postoperative after revision labiaplasty and clitoroplasty.

While a clitoral hood is created during the original penile inversion vaginoplasty, recession or necrosis of the clitoral hood can occur in some patients during the healing process, leading to an exposed clitoris. This is cosmetically unappealing and causes hypersensitivity. Revision clitoroplasty was used to recreate the hood with the goal of producing a more aesthetically appropriate result and to decrease overstimulation of the exposed clitoris. Clitoroplasty can be performed independently; however, in many cases, it is performed in conjunction with the labiaplasty. Revision clitoroplasty was most commonly approached with the following technique. The patient was placed in the lithotomy position. The area was infiltrated with 1% lidocaine with 1:100,000 epinephrine. A midline incision 1 cm above the clitoris and approximately 1 to 2 cm in length was made (Fig. 1, *below*, *left*). Sharp dissection was performed, typically through scar tissue, to unroof and identify the clitoris, which in many cases may be buried. Excess scar tissue was removed around the clitoris. The surrounding skin edges were then sutured to the perimeter of the clitoris to prevent regrowth of tissue over the clitoris. The lateral edges of the incisions were then sutured over the clitoris to create the first layer of the clitoral hood (Fig. 1, *below*, *center*). The lateral edges were then brought over this as well to create a double-layer closure (Fig. 1, *below*, *right*). Care was taken to not include any hair-bearing areas within the hood. These incision lines were continuous with the labia minora. All incisions were closed with longer lasting absorbable suture. The area was subsequently treated with 0.25% bupivacaine with 1:200,000 epinephrine including a pudendal nerve block. The area was covered with bacitracin, bulky dressings, and mesh underwear.

RESULTS

Patient Demographics

A total of 117 patients who underwent penile inversion vaginoplasty were included in the study (Table 1). Of these, 28 patients underwent revision

Table 1. Descriptive Statistics Examining Both Cohorts

Variable	No. of Respondents	Penile Inversion Vaginoplasty without Revision (%)	Revision Labiaplasty and/or Clitoroplasty (%)	*p*
Total no. of patients	117	89	28	
Highest level of education				0.760
High school	10	7 (14.0)	3 (16.7)	
College	39	30 (60.0)	9 (50.0)	
Graduate school	19	13 (26.0)	6 (33.3)	
Nonresponse	49			
Age at the time of surgery, yr				
Range	16–78	21–66	16–78	N/A
Mean ± SD	116	38.3 ± 13.2	38.5 ± 12.9	0.945
Mean length of follow-up from vaginoplasty ± SD, mo	117	20.7 ± 5.3	22.2 ± 6.5	0.228
Mean BMI ± SD, kg/m^2	111	25.5 ± 5.0	25.2 ± 5.0	0.757
Mean length of time on hormones ± SD, yr	104	5.56 ± 6.3	5.99 ± 6.7	0.774
Sexual abuse				0.704
Yes	20	16 (29.1)	4 (21.1)	
No	54	39 (70.9)	15 (78.9)	
Nonresponse	43			
Physical abuse				0.410
Yes	28	23 (40.4)	6 (33.3)	
No	48	34 (59.6)	14 (73.7)	
Nonresponse	41			
Suicide attempts				0.877
Yes	29	23 (39.0)	6 (33.3)	
No	48	36 (61.0)	12 (66.7)	
Nonresponse	40			
Employed				0.443
Yes	77	57 (69.5)	20 (80.0)	
No	30	25 (30.5)	5 (20.0)	
Nonresponse	10			
In long-term relationship				0.633
Yes	47	31 (35.2)	11 (40.7)	
No	64	50 (59.5)	14 (51.9)	
Nonresponse	6			
Medical comorbidities present				0.770
Yes	73	57 (64.8)	16 (59.3)	
No	42	31 (35.2)	11 (40.7)	
Nonresponse	2			
Diabetes				0.754
Yes	8	7 (7.9)	1 (3.7)	
No	108	82 (92.1)	26 (96.3)	
Nonresponse	1			
HIV				0.238
Yes	8	8 (9.0)	0 (0.0)	
No	108	81 (91.0)	27 (100.0)	
Nonresponse	1			
Liver disease/hepatitis				0.422
Yes	7	4 (4.5)	3 (11.1)	
No	109	85 (95.5)	24 (88.9)	
Nonresponse	1			
Hypertension				0.741
Yes	13	9 (10.1)	4 (14.8)	
No	103	80 (89.9)	23 (85.2)	
Nonresponse	1			
Heart disease				0.716
Yes	5	3 (3.4)	2 (7.4)	
No	111	86 (96.6)	25 (92.6)	
Nonresponse	1			
Pulmonary disease				0.905
Yes	7	6 (6.7)	1 (3.7)	
No	109	83 (93.3)	26 (96.3)	
Nonresponse	1			
History of tobacco use				0.427
Yes	18	12 (13.5)	6 (22.2)	
No	98	77 (86.5)	21 (77.8)	
Nonresponse	1			

(*Continued*)

Table 1. (*Continued*)

Variable	No. of Respondents	Penile Inversion Vaginoplasty without Revision (%)	Revision Labiaplasty and/or Clitoroplasty (%)	*p*
History of drug use				0.516
Yes	15	13 (14.6)	2 (7.4)	
No	101	76 (85.4)	25 (92.6)	
Nonresponse	1			
History of cancer				1.000
Yes	3	2 (2.2)	1 (3.7)	
No	113	87 (97.8)	26 (96.3)	
Nonresponse	1			
History of bleeding disorder				1.000
Yes	4	3 (3.4)	1 (3.7)	
No	112	86 (96.6)	26 (96.3)	
Nonresponse	1			
History of PE, DVT, clotting disorder				1.000
Yes	2	2 (2.2)	0 (0.0)	
No	114	87 (97.8)	27 (100.0)	
Nonresponse	1			

N/A, not available; HIV, human immunodeficiency virus; PE, pulmonary embolism; DVT, deep venous thrombosis; BMI, body mass index.

labiaplasty and/or clitoroplasty, with nine patients undergoing both procedures. Outcomes of the surgical approaches for revision labiaplasty are shown in Figure 2, those for revision clitoroplasty are shown in Figure 3, and those for revision labiaplasty and clitoroplasty are shown in Figure 4.

There were no statistically significant differences in any demographic parameters, including age at the time of surgery, average follow-up time, average body mass index, and duration of hormone therapy before surgery between the primary vaginoplasty–only cohort and the revision labiaplasty and/or clitoroplasty cohort (Table 1). Of the patients who responded to the demographics survey, a majority in both groups were employed and were college-educated. A portion of patients had attempted suicide at some point in their lives (revision labiaplasty and/or clitoroplasty cohort, 33.3 percent; without revision labiaplasty and/or clitoroplasty, 39 percent), had a history of sexual abuse (revision labiaplasty and/or clitoroplasty cohort, 21.1 percent; without revision labiaplasty and/or clitoroplasty, 29.1 percent), and had a history of physical abuse (revision labiaplasty and/or clitoroplasty cohort, 33.3 percent; without revision labiaplasty and/or clitoroplasty, 40.4 percent). There was no statistically significant difference in the prevalence of psychiatric or medical comorbidities between the groups. The most prevalent patient comorbidities included tobacco use, drug use, hypertension, diabetes, and human immunodeficiency virus infection. Multivariate analysis showed that a marginally younger age indicated a greater risk for the presence of a complication (coefficient = −0.041; $p = 0.033$). (**See Table, Supplemental Digital Content 1**, which shows a multivariate model examining the relationship between predictors and complications, ***http://links.lww.com/PRS/D832***.)

Postoperative Complications

Fifty-four patients (60.7 percent) who underwent penile inversion vaginoplasty without revision labiaplasty and/or clitoroplasty had complications after the initial procedure, and all of the patients who underwent penile inversion vaginoplasty with revision labiaplasty and/or clitoroplasty had complications before the revision ($p = 0.001$). (**See Table, Supplemental Digital Content 2**, which shows a comparison of complication rates between the two cohorts, ***http://links.lww.com/PRS/D833***.) Patients who underwent penile inversion vaginoplasty necessitating revision labiaplasty and/or clitoroplasty were significantly more likely to have granulation tissue ($p = 0.006$), intravaginal scarring ($p < 0.001$), and complete vaginal stenosis ($p = 0.008$).

Overall, minor complications were significantly more common in the revision labiaplasty and/or clitoroplasty group ($p = 0.009$). The most common minor complications were granulation tissue, intravaginal scarring, and prolonged pain in the revision labiaplasty and/or clitoroplasty group; and granulation tissue, prolonged pain, and urinary issues in the non–revision labiaplasty and/or clitoroplasty group.

Both cohorts experienced similar proportions of major complications. In both the revision and nonrevision labiaplasty and/or clitoroplasty cohort, the most common major postoperative complications were complete vaginal stenosis, necrosis requiring dressing changes, and hematoma/excessive bleeding.

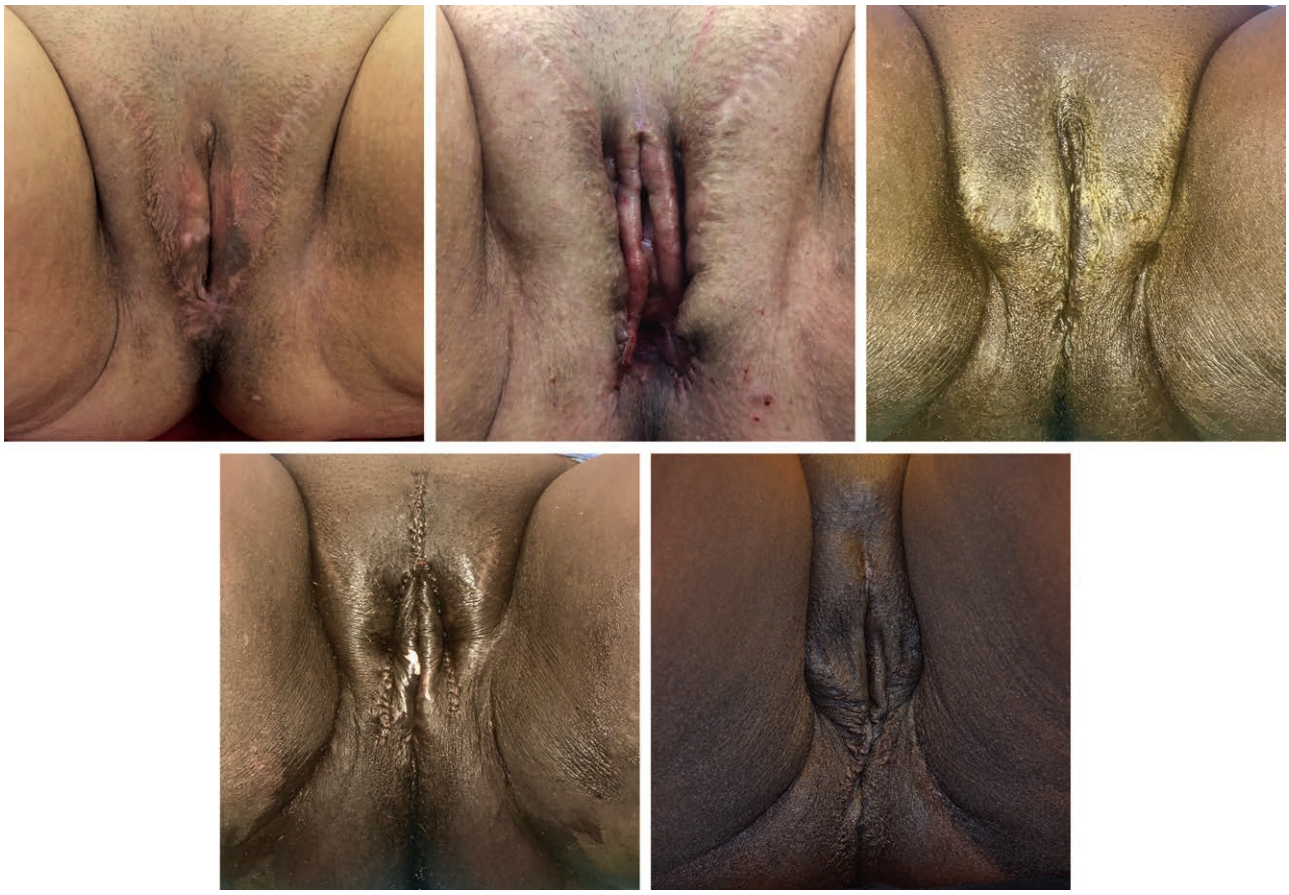

Fig. 2. Outcomes of revision labiaplasty. (*Above*, *left*) Patient 1 preoperatively. (*Above*, *center*) Patient 1 postoperatively. (*Above*, *right*) Patient 2 preoperatively. (*Below*, *left*) Patient 2 postoperatively. (*Below*, *right*) One-year outcomes after revision labiaplasty for patient 2.

Patient Satisfaction and Quality-of-Life Outcomes

Patient satisfaction and quality-of-life outcomes were collected from 28 patients who underwent revision labiaplasty and/or clitoroplasty and 89 patients who underwent penile inversion vaginoplasty without revision labiaplasty and/or clitoroplasty. (**See Table, Supplemental Digital Content 3**, which shows patient-reported outcomes, ***http://links.lww.com/PRS/D834***.) Survey respondents reported on 20 indicators of patient satisfaction. Patient satisfaction was over 50 percent in 18 of the total 20 indicators. Over 80 percent of patients in both groups reported positive feelings about the procedure and felt happier after the procedure. Over 60 percent of patients reported confidence about the appearance and smell of their genitals, felt like their partners were satisfied with their genitals, and felt comfortable showing their genitals to their partners.

The majority of patients reported that they were successfully able to engage in sexual acts, including the ability to get sexually aroused, achieve orgasm within 6 months, and engage in penetrative sex. Patients who underwent penile inversion vaginoplasty without revision labiaplasty and/or clitoroplasty reported a significantly greater improvement of the quality of orgasm compared to patients who underwent revision labiaplasty and/or clitoroplasty ($p = 0.05$). Seventy-seven percent of patients who underwent revision labiaplasty and/or clitoroplasty and 69 percent of patients who underwent penile inversion vaginoplasty without revision reported that their genital-related dysphoria was resolved. Other than the improvement in orgasm quality (80 percent of the nonrevision cohort versus 20 percent of the revision cohort; $p < 0.05$), there was no statistical significance between the responses of patients who underwent revision versus those without revision. The full patient questionnaire and response rates are listed (**see Table, Supplemental Digital Content 3**, ***http://links.lww.com/PRS/D834***).

Fig. 3. Outcomes of revision clitoroplasty. (*Above*, *left*) Patient 1 preoperatively. (*Above*, *right*) Patient 1 postoperatively. (*Below*, *left*) Patient 2 preoperatively (clitoroplasty and labiaplasty). (*Below*, *right*) Patient 2 postoperatively.

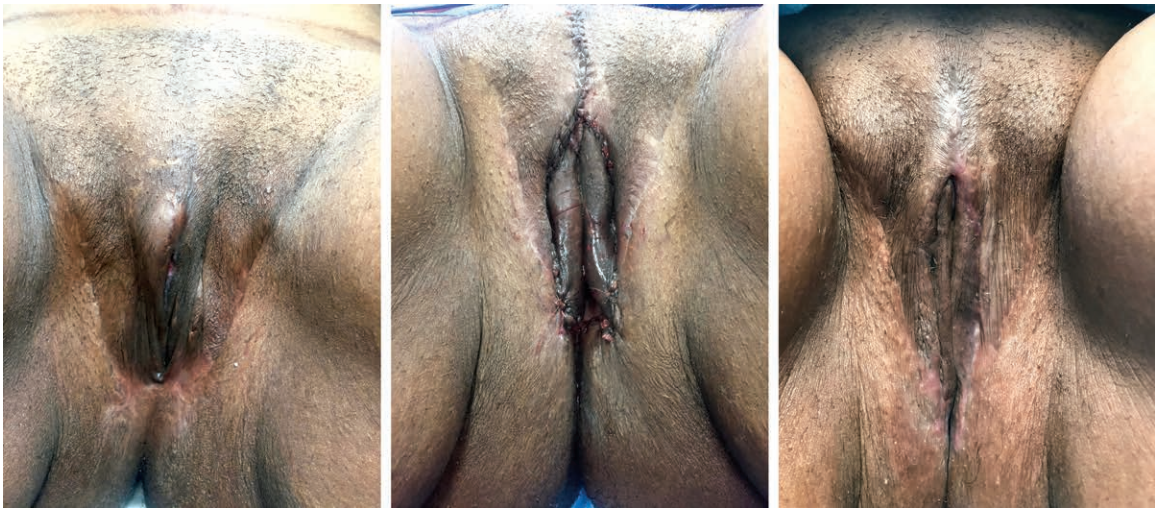

Fig. 4. Outcomes of revision labiaplasty and clitoroplasty. (*Left*) Patient shown preoperatively. (*Center*) Immediate postoperative outcome. (*Right*) Three-month postoperative outcome.

DISCUSSION

This analysis constitutes the largest cohort of transgender and gender diverse patients assigned male at birth in the United States who underwent revision clitoroplasty and/or labiaplasty after penile inversion vaginoplasty. This is the first large cohort study to look at outcomes and complications that may necessitate revision labiaplasty and/or clitoroplasty after penile inversion vaginoplasty in the United States. Although complications and outcomes following primary penile inversion vaginoplasty have been elucidated, few studies have reported the outcomes preceding revision clitoroplasty and labiaplasty.[6,8–10,14–25] We report complications that may lead to revision labiaplasty and/or clitoroplasty and patient quality-of-life outcomes associated with these procedures.

Patients who underwent revision labiaplasty and/or clitoroplasty operations experienced significantly more complications associated with penile inversion vaginoplasty than patients who underwent penile inversion vaginoplasty without revision labiaplasty and/or clitoroplasty.

Multivariate analysis showed that patients who were younger at the age of operation had a greater risk of the presence of a complication (coefficient = −0.041; $p = 0.033$) (**see Table, Supplemental Digital Content 1**, ***http://links.lww.com/PRS/D832***). Despite statistical significance, the relatively small coefficient does not bear clinical significance. Future studies including a greater number of patients may provide greater insight into risk factors associated with revision labiaplasty and/or clitoroplasty after penile inversion vaginoplasty.

It was noted that patients in our cohort who underwent revision labiaplasty and/or clitoroplasty were more likely to have developed granulation tissue and subsequent scarring after initial penile inversion vaginoplasty. One can speculate that patients who are more prone to prolonged inflammation may have more unpredictability in wound healing, which necessitates revision procedures. It is not surprising that patients who underwent labiaplasty and/or clitoroplasty often had to undergo concomitant scar contracture release of the introitus because of the development of a tight band impeding penetration (data not shown).

The majority of the complications in the revision labiaplasty and/or clitoroplasty group were minor: 22 minor complications (81.5 percent) in the revision group and 44 minor complications (49.4 percent) in the nonrevision group ($p = 0.009$). There was no difference in rates of major complications. Minor complications following initial vaginoplasty can often be managed nonsurgically. However, some complications such as significant scarring and stenosis are more likely to require revision. As previous publications have noted, those seeking revision procedures after penile inversion vaginoplasty had decreased overall satisfaction, which may be related to minor complications after initial vaginoplasty.[23]

Patient postoperative satisfaction and quality-of-life responses were overwhelmingly positive in the setting of revision labiaplasty and/or clitoroplasty. Eighty-eight percent of patients felt positively about their genitals after the revision labiaplasty and/or clitoroplasty, 82 percent of patients would undergo the operation again, and 81 percent would recommend this operation to a friend. A high proportion of patients reported positive indicators of sexual function such as the ability to achieve orgasm (70 percent). Revision labiaplasty and/or clitoroplasty after penile inversion vaginoplasty helped with the resolution of genital-related dysphoria in 77 percent of patients.

To achieve the desired appearance and provide the greatest therapeutic benefit to patients, best surgical practices and techniques should be established for revision labiaplasty and clitoroplasty. Our study presents a novel approach to revision clitoroplasty and labiaplasty procedures in gender-affirming surgery. A previous study by Hage et al. reports on multiple surgical techniques to improve labial aesthetics following penile inversion vaginoplasty.[11] They note that revision labiaplasty and/or clitoroplasty procedures are worthwhile and provide patients unique benefits; however, they acknowledge that they have not found a way to satisfactorily construct the labia minora or to limit complications. In a more recent study, Opsomer et al. present a novel technique to perform primary labiaplasty and clitoroplasty during a single-stage penile inversion vaginoplasty, by creating a W-shaped pedicle formed from the glans and prepuce in uncircumcised patients or glans and distal penile shaft skin in circumcised patients.[32] They found that of their 161 patients, seven (4 percent) required early revision to drain hematomas (six patients) or revision labiaplasty for dehiscence and skin necrosis (one patient), and 44 (27 percent) needed late revision surgery for urethral stricture (nine patients) and minor aesthetic revisions of the labia (35 patients). Our technique describes a way to consistently perform revision labiaplasty after initial inversion vaginoplasty and create an anatomical junction between the labia majora and labia minora with clear borders.

This study also provides a novel revision clitoroplasty technique. Although we do attempt to create a clitoral hood at the time of the original operation, unpredictability in wound healing, necrosis, and scarring can result in loss and recession of this anatomical structure. Many publications report the surgical approach to the creation of a neoclitoris during vaginoplasty; however, this study is the first to discuss revision clitoroplasty after penile inversion vaginoplasty.[5,8,12,17,32–37] Our technique results in a consistent and predictable appearance of the neoclitoris, complete with a realistic hood and frenulum, and provides protection to minimize overstimulation of the clitoris.

The present study has several limitations. Although it is the largest reported cohort of patients to undergo these procedures in the United States, the number of patients in the revision labiaplasty and/or clitoroplasty cohort may have been limited by the small sample size and single-surgeon sample. Our results are susceptible to a type II (false-negative) error. The questionnaire used to evaluate patient satisfaction and quality-of-life outcomes in our study also poses a limitation. This tool has been validated only in cisgender women. There is a need to develop a metric to reliably measure and reproduce patient-reported outcomes of transgender and gender diverse populations after gender-affirming surgery.[24,38–40] Patient-reported outcomes are an important metric for evaluating the efficacy of gender-affirming surgery; however, we are inherently limited by the many factors that affect patient responses to questionnaires. Future studies should consider supplementing questionnaires with free-text responses to best accommodate a variety of answers and attenuate patient response rates. Future studies assessing long-term outcomes of revision labiaplasty and/or clitoroplasty are needed.

CONCLUSIONS

Penile inversion vaginoplasty is a safe and highly satisfactory technique, yet secondary corrections are often required to achieve optimal cosmesis and functionality. This study presents the largest cohort of transgender and gender diverse patients assigned male at birth in the United States to undergo revision labiaplasty and/or clitoroplasty procedures following penile inversion vaginoplasty. Patients responded with high levels of satisfaction following revision labiaplasty and/or clitoroplasty procedures. Patients who had revision labiaplasty and/or clitoroplasty had significantly more minor postoperative complications after penile inversion vaginoplasty, without an increased risk of major complications, compared with those who did not require revision labiaplasty and/or clitoroplasty. To better address patient-reported outcomes, future studies should develop and implement a validated patient-reported questionnaire specific to the transgender and gender diverse community.

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REFERENCES

1. De Cuypere G, T'Sjoen G, Beerten R, et al. Sexual and physical health after sex reassignment surgery. *Arch Sex Behav.* 2005;34:679–690.
2. Morrison SD, Vyas KS, Motakef S, et al. Facial feminization: Systematic review of the literature. *Plast Reconstr Surg.* 2016;137:1759–1770.
3. Morrison SD, Perez MG, Nedelman M, Crane CN. Current state of female-to-male gender confirming surgery. *Curr Sex Health Rep.* 2015;**7**:38–48.
4. Berli JU, Capitán L, Simon D, Bluebond-Langner R, Plemons E, Morrison SD. Facial gender confirmation surgery: Review of the literature and recommendations for Version 8 of the WPATH Standards of Care. *Int J Transgend.* 2017;18:264–270.
5. Selvaggi G, Monstrey S, Ceulemans P, T'Sjoen G, De Cuypere G, Hoebeke P. Genital sensitivity after sex reassignment surgery in transsexual patients. *Ann Plast Surg.* 2007;58:427–433.
6. Buncamper ME, van der Sluis WB, van der Pas RS, et al. Surgical outcome after penile inversion vaginoplasty: A retrospective study of 475 transgender women. *Plast Reconstr Surg.* 2016;138:999–1007.
7. Horbach SE, Bouman MB, Smit JM, Özer M, Buncamper ME, Mullender MG. Outcome of vaginoplasty in male-to-female transgenders: A systematic review of surgical techniques. *J Sex Med.* 2015;12:1499–1512.
8. Raigosa M, Avvedimento S, Yoon TS, Cruz-Gimeno J, Rodriguez G, Fontdevila J. Male-to-female genital reassignment surgery: A retrospective review of surgical technique and complications in 60 patients. *J Sex Med.* 2015;12:1837–1845.
9. Krege S, Bex A, Lümmen G, Rübben H. Male-to-female transsexualism: A technique, results and long-term follow-up in 66 patients. *BJU Int.* 2001;88:396–402.
10. Goddard JC, Vickery RM, Qureshi A, Summerton DJ, Khoosal D, Terry TR. Feminizing genitoplasty in adult transsexuals: Early and long-term surgical results. *BJU Int.* 2007;100:607–613.
11. Hage JJ, Goedkoop AY, Karim RB, Kanhai RC. Secondary corrections of the vulva in male-to-female transsexuals. *Plast Reconstr Surg.* 2000;106:350–359.
12. Hage JJ, Karim RB. Sensate pedicled neoclitoroplasty for male transsexuals: Amsterdam experience in the first 60 patients. *Ann Plast Surg.* 1996;36:621–624.
13. Hage JJ, Karim RB, Bloemena E. Labial masses following vaginoplasty in male transsexuals: The differential diagnosis. *Plast Reconstr Surg.* 1996;97:1226–1232.
14. Van der Sluis WB, Bouman MB, Buncamper ME, Mullender MG, Meijerink WJ. Revision vaginoplasty: A comparison of surgical outcomes of laparoscopic intestinal versus perineal

full-thickness skin graft vaginoplasty. *Plast Reconstr Surg.* 2016;138:793–800.
15. Karim RB, Hage JJ, Bouman FG, de Ruyter R, van Kesteren PJ. Refinements of pre-, intra-, and postoperative care to prevent complications of vaginoplasty in male transsexuals. *Ann Plast Surg.* 1995;35:279–284.
16. Eldh J. Construction of a neovagina with preservation of the glans penis as a clitoris in male transsexuals. *Plast Reconstr Surg.* 1993;91:895–900; discussion 901–903.
17. Fang RH, Chen CF, Ma S. A new method for clitoroplasty in male-to-female sex reassignment surgery. *Plast Reconstr Surg.* 1992;89:679–682; discussion 683.
18. Perovic SV, Stanojevic DS, Djordjevic ML. Vaginoplasty in male transsexuals using penile skin and a urethral flap. *BJU Int.* 2000;86:843–850.
19. Wagner S, Greco F, Hoda MR, et al. Male-to-female transsexualism: Technique, results and 3-year follow-up in 50 patients. *Urol Int.* 2010;84:330–333.
20. Reed HM. Aesthetic and functional male to female genital and perineal surgery: Feminizing vaginoplasty. *Semin Plast Surg.* 2011;25:163–174.
21. Rossi Neto R, Hintz F, Krege S, Rubben H, Vom Dorp F. Gender reassignment surgery: A 13 year review of surgical outcomes. *Int Braz J Urol.* 2012;38:97–107.
22. Sigurjonsson H, Rinder J, Möllermark C, Farnebo F, Lundgren TK. Male to female gender reassignment surgery: Surgical outcomes of consecutive patients during 14 years. *JPRAS Open* 2015;6:69–73.
23. Massie JP, Morrison SD, Van Maasdam J, Satterwhite T. Predictors of patient satisfaction and postoperative complications in penile inversion vaginoplasty. *Plast Reconstr Surg.* 2018;141:911e–921e.
24. Massie JP, Morrison SD, Smith JR, Wilson SC, Satterwhite T. Patient-reported outcomes in gender confirming surgery. *Plast Reconstr Surg.* 2017;140:236e–237e.
25. Hage JJ, Chami SZ. Conversion of the "kangaroo pouch" neovagina to a skin inversion vaginoplasty in male-to-female transsexuals: Two unusual cases. *Plast Reconstr Surg.* 1998;101:445–450; discussion 451–452.
26. Buncamper ME, van der Sluis WB, de Vries M, Witte BI, Bouman MB, Mullender MG. Penile inversion vaginoplasty with or without additional full-thickness skin graft: To graft or not to graft? *Plast Reconstr Surg.* 2017;139:649e–656e.
27. Buncamper ME, Honselaar JS, Bouman MB, Özer M, Kreukels BP, Mullender MG. Aesthetic and functional outcomes of neovaginoplasty using penile skin in male-to-female transsexuals. *J Sex Med.* 2015;12:1626–1634.
28. van der Sluis WB, Bouman MB, de Boer NK, et al. Long-term follow-up of transgender women after secondary intestinal vaginoplasty. *J Sex Med.* 2016;13:702–710.
29. Bouman MB, van der Sluis WB, van Woudenberg Hamstra LE, et al. Patient-reported esthetic and functional outcomes of primary total laparoscopic intestinal vaginoplasty in transgender women with penoscrotal hypoplasia. *J Sex Med.* 2016;13:1438–1444.
30. Morrison SD, Satterwhite T, Grant DW, Kirby J, Laub DR Sr, VanMaasdam J. Long-term outcomes of rectosigmoid neocolporrhaphy in male-to-female gender reassignment surgery. *Plast Reconstr Surg.* 2015;136:386–394.
31. Herbenick D, Reece M. Development and validation of the female genital self-image scale. *J Sex Med.* 2010;7:1822–1830.
32. Opsomer D, Gast KM, Ramaut L, et al. Creation of clitoral hood and labia minora in penile inversion vaginoplasty in circumcised and uncircumcised transwomen. *Plast Reconstr Surg.* 2018;142:729e–733e.
33. Rehman J, Melman A. Formation of neoclitoris from glans penis by reduction glansplasty with preservation of neurovascular bundle in male-to-female gender surgery: Functional and cosmetic outcome. *J Urol.* 1999;161:200–206.
34. Jarolím L, Šedý J, Schmidt M, Naňka O, Foltán R, Kawaciuk I. Gender reassignment surgery in male-to-female transsexualism: A retrospective 3-month follow-up study with anatomical remarks. *J Sex Med.* 2009;6:1635–1644.
35. Sigurjónsson H, Möllermark C, Rinder J, Farnebo F, Lundgren TK. Long-term sensitivity and patient-reported functionality of the neoclitoris after gender reassignment surgery. *J Sex Med.* 2017;14:269–273.
36. Hess J, Hess-Busch Y, Kronier J, Rübben H, Rossi Neto R. Modified preparation of the neurovascular bundle in male to female transgender patients. *Urol Int.* 2016;96:354–359.
37. Giraldo F, Esteva I, Bergero T, et al.; Andalusia Gender Team. Corona glans clitoroplasty and urethropreputial vestibuloplasty in male-to-female transsexuals: The vulval aesthetic refinement by the Andalusia Gender Team. *Plast Reconstr Surg.* 2004;114:1543–1550.
38. Smith JR, Washington AZ III, Morrison SD, Gottlieb LJ. Assessing patient satisfaction among transgender individuals seeking medical services. *Ann Plast Surg.* 2018;81:725–729.
39. Morrison SD, Massie JP, Crowe CS, Smith JR. Patient-reported outcomes needed for chest masculinization. *Ann Plast Surg.* 2018;80:90–91.
40. Klassen AF, Kaur M, Johnson N, et al. International phase I study protocol to develop a patient-reported outcome measure for adolescents and adults receiving gender-affirming treatments (the GENDER-Q). *BMJ Open* 2018;8:e025435.