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Comparison of surgical outcomes and urinary functioning after phalloplasty with versus without urethral lengthening in transgender men

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ABSTRACT

Background: Phalloplasty in transgender men is performed with or without Urethral Lengthening (UL). To create clear expectations in the choice of UL, an overview and comparison of outcomes is useful.

Aims: To provide and compare surgical outcomes and urinary functioning after phalloplasty with versus without UL in transgender men.

Methods: A single-center, retrospective chart review was conducted among transgender men who underwent phalloplasty with or without UL between 01-2013 and 10-2020. Primary outcomes were differences in complication and reoperation rates. Secondary outcomes were end-stages of voiding at last follow-up and differences in voiding analyses pre- and postoperatively.

Results: Of 136 men, 91 (67%) underwent phalloplasty with, and 45 (33%) without UL. Wound infection (31 vs. 16%, $p=0.06$) and partial flap loss (35 vs. 13%, $p=0.008$) were predominately seen after UL. In the UL group, 43% urethral fistulas and 60% urethral strictures were observed, relative to one man without UL who had a urethral fistula (both $p<0.001$). Meatal or perineal orifice stenosis was seen in 29% with versus 11% without UL ($p=0.02$). Reoperation was needed in 81% with versus 27% without UL ($p<0.001$). At follow-up, 80/91 (88%) after UL reached end-stage of voiding, with 60/80 (75%) able to void while standing and 20/80 (25%) having a definitive urethrostomy. The remaining 11/91 (12%) men were awaiting further treatment for urological complications. The men able to void while standing had a median of one reoperation (range 0–6), and a significant decrease in maximum flow rate on postoperative uroflowmetry (21.4 vs. 29.8 mL/s, $p<0.001$). After phalloplasty without UL, all men had a definitive perineostomy without changes in voiding analyses.

Discussion: The choice for or against UL during phalloplasty has become more relevant over the years. This comparison of surgical outcomes and urinary functioning can be useful in the shared decision-making process to come to the most suitable choice of phalloplasty.

KEYWORDS
Genital gender-affirming surgery; phalloplasty; surgical outcomes; transgender men; urethral lengthening; urinary functioning

Introduction

Phalloplasty is one of the surgical treatment options for transgender men who desire genital Gender-Affirming Surgery (gGAS) as part of their transition due to gender dysphoria (Coleman et al., 2012). During phalloplasty, a fascio- or musculocutaneous flap is harvested and transferred as a pedicled or free flap to the genital area to create a neophallus (Morrison et al., 2017). If transgender men desire to void while standing, Urethral Lengthening (UL) during phalloplasty is performed (Heston et al., 2019). For neourethral lengthening, several surgical approaches exist, that can be single- or

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multistaged. In addition, different kinds of tissue can be used for neourethral construction: a tubed flap design or more distant tissue, such as additional fasciocutaneous flaps, pedicled local flaps, or skin or buccal grafts (Al-Tamimi, Pigot, Ronkes, et al., 2020). Despite surgical developments worldwide, high rates of urological complications are seen after UL (Massie et al., 2017). It is thought that a compromised vascularization at the urethral anastomoses is the main cause for urethral strictures and urethral fistulas, with reported incidence rates of 22–75% and 25–58% respectively (Levine & Elterman, 1998; Massie et al., 2017; Nikolavsky et al., 2018). These complications can cause inability to void while standing or dissatisfactory voiding with the need for prolonged intermittent or indwelling catheters, physical and emotional discomfort, and reoperations (Veerman et al., 2020).

To provide a treatment alternative with a reduced risk of complications, phalloplasty without UL is offered in our institution since 2009 (Al-Tamimi et al., 2020). A perineostomy is created as a wide urogenital opening at the perineal-scrotal junction, after which transgender men still have to void while sitting down postoperatively (G. L. S. Pigot et al., 2020). Between 2009 and 2018, 34% of transgender men chose this type of gGAS and a urological complication rate of 12% was observed in our institution (G. L. S. Pigot et al., 2020). These complications consisted of perineostomy stenoses at skin level which were surgically treated without recurrence (G. L. S. Pigot et al., 2020).

The choice for or against UL is a shared decision-making process through weighing of personal motives and the benefits and risks of different treatment options (Elfering et al., 2017). Mainly, this choice is based on the consideration of complication risk and burden, against the importance of being able to void from the tip of the phallus (and being able to void while standing) (de Rooij et al., 2021). Close involvement and multidisciplinary counseling by a team of plastic surgeons, urologists, and medical psychologists is of added value in that choice (de Rooij et al., 2021). Additionally, in our institution, a decision aid is used to further highlight all benefits and risks of the treatment options available (Ozer et al., 2018). The above mentioned complication rates are used during counseling and the decision-making process, and some of the surgical and urological outcomes can also be useful in the counseling by psychologists and other clinicians. We believe that a well-considered shared decision for or against UL will increase patient satisfaction postoperatively. In a previous study, comparable patient-reported outcomes were described after gGAS with and without UL, and satisfaction with the appearance of the neophallus and with voiding were positive predictors of overall satisfaction at follow-up, in contrast to the complication and reoperation rate, and independently of UL (de Rooij et al., 2021).

Surgical and urological outcomes after phalloplasty with and without UL have been described in separate studies, however, to create clear expectations for clinicians and transgender men in the choice for or against UL, an overview and comparison is useful. Therefore, the aim of this study was to compare the surgical outcomes and urinary functioning after phalloplasty with versus without UL.

Methods

Study design

A single center, retrospective chart review was conducted at the Center of Expertise on Gender Dysphoria at the Amsterdam University Medical Center, location VUmc, Amsterdam, The Netherlands. Transgender men who underwent phalloplasty with or without UL between January 2013 and October 2020 were eligible for the study. Since January 2013, standardized preoperative voiding assessments (i.e. International Prostate Symptom Score [IPSS], Frequency Volume Chart [FVC], and uroflowmetry with Post-Void Residual Volume [PVR]) are performed to determine possible contraindications for UL. Men who did not have a minimum of one year postoperative follow-up were excluded. If transgender men did not reach the intended end-stage of voiding after one year of follow-up, they were included for participant characteristics and complication rate analysis only. The study protocol was approved by our local Medical Ethics

Committee (FWA00017598). All participants provided written informed consent for this study.

Data collection

Primary outcomes were differences in complication and reoperation rates between transgender men who underwent phalloplasty with versus without UL. Secondary outcomes were the end-stages of voiding at last follow-up and the differences in voiding analyses pre- and postoperatively. Collected data were participant characteristics (age, BMI and smoking status at phalloplasty, previous gGAS, colpectomy before phalloplasty, and length of follow-up), surgical specifications (shaft flap type, neourethra type, operation time, length of hospital stay, and length of indwelling transurethral and suprapubic catheter), postoperative complications (hemorrhage, wound infection, partial or total flap loss, Urinary Tract Infection (UTI), urethral fistula, urethral stricture, and stenosis of the meatus or perineal orifice at skin level), number of reoperations, end-stage of voiding (voiding while standing with or without additional clean intermittent self-catheterization, temporary urethrostomy awaiting further treatment, or definitive urethrostomy), and voiding analyses (IPSS, FVC, and uroflowmetry with PVR) pre- and postoperatively. Length of follow-up was defined as the time interval in months between phalloplasty and the last visit at the Center of Expertise on Gender Dysphoria.

Type of surgery

During phalloplasty, a team of plastic surgeons and urologists work simultaneously in a single-stage procedure. The plastic surgeon harvests the flap(s) and the urologist constructs the scrotum and fixed urethra. In our center, an Anterolateral Thigh flap (ALT), Free Radial Forearm Flap (FRFF), or Superficial Circumflex Iliac Artery flap (SCIA) is typically used for neophallic shaft creation, and a FRFF (i.e. tube-in-tube or as a second fasciocutaneous flap), SCIA or a Pedicled Labia Minora Flap (PLMF) for urethral construction. In case of UL with a PLMF, the position of the neomeatus depends on the gained length after tubularization, which can be up to the tip or the ventral distal shaft of the neophallus. Prior to phalloplasty with UL, a mandatory colpectomy is performed as a separate procedure to reduce the risk of urethral fistulas postoperatively (Al-Tamimi et al., 2018). Following gGAS with UL, the transurethral catheter is removed after three weeks, and the suprapubic catheter after four weeks.

Phalloplasty without UL is performed using an ALT or SCIA, which are both pedicled flaps with a less visible donor site compared to FRFF phalloplasty. A perineal urethrostomy (perineostomy) is created as a wide urogenital opening at the perineal-scrotal junction. If transgender men opt for phalloplasty without UL, a colpectomy is not deemed necessary before the phalloplasty procedure, but may be performed if the individual desires so. A modified scrotoplasty technique is used in which cranially pedicled U-shaped labia majora flaps are rotated 90 degrees medially to bring the neoscrotum in front of the legs (video article as reference) (G. L. Pigot et al., 2020). In addition, the introitus is closed partly to create a male-like perineum with increased neoperineal length. The location of the urethral meatus is not changed but diverted underneath the scrotum, resulting in an inconspicuous perineal orifice from which voiding while sitting is possible and vaginal discharge takes place if colpectomy is not performed. A 2 cm plate of periurethral tissue is preserved in every direction, leaving the native urethra intact. Postoperatively, the transurethral catheter is removed during admission after approximately five days, and no suprapubic catheter is necessary.

Surgical complications

A wound infection was defined as an infection of the donor-site, neophallus, neourethra, or neoscrotum, with the need for antibiotic treatment and/or incision and drainage. Total flap loss was scored if the vascularity of the phallic flap, and/or the urethral flap in case of UL, was compromised postoperatively requiring surgical removal of the flap(s). Partial flap loss was divided into severe and less severe, in which severe partial flap loss required surgical debridement in the operating room and less severe partial flap loss was treated conservatively. Necrosis of the

donor-site or neoscrotum was scored if a compromised vascularity resulted in partial loss of skin tissue, after which it may be necessary to perform a secondary correction with or without the use of a split-thickness or full-thickness skin graft.

Urological complications

A UTI was scored in case of stranguria, frequency, and/or urgency with positive urinalysis (i.e. nitrite and/or leukocyte esterase), which improved after antibiotic treatment. A urethral stricture was defined as a symptomatic (i.e. hesitancy, poor urinary stream, and/or incomplete bladder emptying) narrowing of the urethra with the need for catheterization or surgical correction. Urethral strictures were diagnosed following uroflowmetry with post-void residual volume measurement and retrograde urethrography. During uroflowmetry, bladder outlet obstruction was described as a maximum flow rate of less than 15 mL/s, which is a cutoff point derived from cisgender men (Tam et al., 2016). A retrograde urethrogram was performed to measure stricture length and diameter. If the urethrogram was indecisive, a urethroscopy was performed. A stenosis of the meatus or perineal orifice at skin level was a visible narrowing leading to obstructive voiding symptoms and the need for catheterization or surgical correction. A urethral fistula was defined as a urethrocutaneous or urethrovaginal connection that persisted or originated six weeks after gGAS, with the need for catheterization or surgical correction. This margin of six weeks was chosen to exclude small fistulas on the urethral anastomoses which close spontaneously. A reoperation was defined as a surgical correction of a complication under general or spinal anesthesia. In case of urethral complications, a temporary or definitive urethrostomy may be performed, located at the perineal-scrotal junction (perineostomy) or peno-scrotal junction (scrotostomy).

Statistical analysis

All data analyses were performed using IBM SPSS Statistics 26. Normally distributed data was described as mean with standard deviation (SD) and analyzed using the independent sample t-test. Skewed data was presented as median with interquartile range (IQR), and analyzed with the Mann-Whitney U test. Analyses of binary and categorical variables were performed using the Fisher exact test or chi-square test as appropriate. Voiding analyses pre- and postoperatively were included of transgender men who reached the intended end-stage of voiding, and compared using the paired samples t-test if normally distributed, and the Wilcoxon signed-rank test if the data was skewed. Due to multiple testing in the comparison of voiding analyses, statistical significance was determined using a Bonferroni correction and set at a p-value of 0.003 or less. In all other analyses, statistical significance was indicated with a p-value of 0.05 or less.

Results

Participant characteristics

Of 136 included transgender men, 91 (67%) underwent phalloplasty with, and 45 (33%) without UL. All participant characteristics are presented in Table 1. More transgender men underwent a colpectomy before phalloplasty with compared to without UL (86/91 [95%] vs. 16/45 [36%]). The five (5%) participants that did not undergo colpectomy prior to UL already had a metoidioplasty with UL and good urodynamic function. In addition, gGAS prior to phalloplasty was mostly seen in the UL group (20/91 [22%] vs. 2/45 [4%], $p = 0.007$), with 18 participants after metoidioplasty, and 2 participants after a failed phalloplasty. In the group without UL, one participant had a previous metoidioplasty with UL and good urodynamic function, and another participant chose for a SCIA without UL after a failed phalloplasty with UL (ALT + FRFF). In the group with UL, 31/91 (34%) of the phalloplasties were formed using a FRFF (tube-in-tube), compared to only SCIA (64%) and ALT (36%) phalloplasties in the group without UL.

Surgical outcomes

Surgical outcomes after phalloplasty with and without UL are compared in Table 2. The mean

Table 1. Participant characteristics ($n = 136$).

Characteristics	With urethral lengthening	Without urethral lengthening	*p*-value
Number of participants (%)	91 (67)	45 (33)	
Median age at phalloplasty, *y* (IQR)	29 (23–42)	27 (23–42)	0.79
Mean BMI at phalloplasty, kg/m^2 (SD)	23.6 (3.4)	23.0 (2.5)	0.25
Smoking status at phalloplasty, *n* (%)			0.37
Yes	4 (4)	0 (0)	
No	59 (65)	33 (73)	
Quit	28 (31)	12 (27)	
Number of participants with a colpectomy before phalloplasty, *n* (%)*	86 (95)	16 (36)	<0.001
Previous gGAS, *n* (%)			0.007
No	71 (78)	43 (96)	
Metoidioplasty	18 (20)	1 (2)	
Phalloplasty	2 (2)	1 (2)	
Phalloplasty type with UL, *n* (%)			–
FRFF (tube-in-tube)	31 (34)	–	
SCIA + SCIA	20 (22)	–	
SCIA + FRFF	4 (4)	–	
SCIA + PLMF	16 (18)	–	
ALT + FRFF	18 (20)	–	
ALT + SCIA	1 (1)	–	
ALT + PLMF	1 (1)	–	
Phalloplasty type without UL, *n* (%)			–
SCIA	–	29 (64)	
ALT	–	16 (36)	
Median length of follow-up time, *mo* (IQR)	32 (19–49)	30 (15–40)	0.19

BMI: Body Mass index, gGAS: genital Gender-Affirming Surgery, UL: Urethral Lengthening, FRFF: Free Radial Forearm Flap, SCIA: Superficial Circumflex Iliac Artery Flap, ALT: Anterolateral Thigh Flap, PLMF: Pedicled Labia Minora Flap.
*Colpectomy was performed with a vaginal or (robot-assisted) laparoscopic approach.

operation time of phalloplasty with UL was longer compared to without UL (mean [SD] of 381 [95] vs. 272 [65] minutes resp., $p < 0.001$). Length of hospital stay was also longer in the UL group (median [IQR] of 7 [6–8] vs. 5 [5–6] days resp., $p < 0.001$). The transurethral catheter was removed according to protocol in both groups, however, the duration of the indwelling suprapubic catheter used after UL was prolonged until a median (IQR) of 47 (35–100) days postoperatively due to complications.

Of the surgical complications, wound infections were seen more often in participants with UL (28/91 [31%] vs. 7/45 [16%] resp., $p = 0.06$). After UL, 22/28 (79%) wound infections were treated with antibiotics and 6/28 (21%) with incision and drainage, in contrast to men without UL, in which antibiotics were used in 3/7 (43%) and incision and drainage in 4/7 (57%, $p = 0.08$). Partial flap loss was observed more frequent after phalloplasty with compared to without UL (32/91 [35%] vs. 6/45 [13%] resp., $p = 0.008$). The tip of the neophallus was the primary location of partial flap loss, 18/32 (56%) after phalloplasty with UL and 4/6 (67%) without UL. A reoperation for partial flap loss was necessary in 10/32 (31%) men with, and 2/6 (33%) without UL ($p = 0.63$). Total phallic flap loss occurred in four men with UL (2 ALT, 1 FRFF, and 1 SCIA) and three men without UL (2 ALT and 1 SCIA)($p = 0.69$). After phalloplasty with UL, total urethral flap loss occurred in four men (2 FRFF and 2 SCIA). One participant after FRFF tube-in-tube phalloplasty had total flap loss of both the phallic and the urethral part.

Urological complications were seen more frequent following phalloplasty with UL. Urethral fistulas occurred in 39/91 (43%) and urethral strictures in 55/91 (60%) participants with UL, compared to only one participant without UL who had a urethral fistula (both $p < 0.001$). This participant without UL had a urethrocutaneous fistula proximal to a stenosis of the perineal orifice, which closed "spontaneously" after surgical correction of the stenosis. Overall, stenosis of the meatus or perineal orifice at skin level was observed in 26/91 (29%) participants with, and 5/45 (11%) without UL ($p = 0.02$). UTIs occurred in 45/91 (49%) after phalloplasty with UL compared to 1/45 (2%) without UL ($p < 0.001$).

A reoperation for "early" surgical complications (i.e. hemorrhage or [partial] flap loss) was performed in 23/91 (25%) participants with and 8/45 (18%) without UL ($p = 0.33$). A reoperation for urological complications (i.e. urethral fistula, urethral stricture, or meatal or perineal orifice

Table 2. Surgical outcomes.

	With urethral lengthening ($n = 91$)	Without urethral lengthening ($n = 45$)	p-value
Mean operation time, *min* (SD)	381 (95)	272 (65)	<0.001
Median length of hospital stay, *days* (IQR)	7 (6–8)	5 (5–6)	<0.001
Median length of indwelling transurethral catheter, *days* (IQR)	21 (15–26)	5 (4–7)	<0.001
Median length of indwelling suprapubic catheter, *days* (IQR)	47 (35–100)	–	–
Intraoperative complication, *n* (%)			
Hemorrhage	5 (6)	4 (9)	0.48
Postoperative surgical complications, *n* (%)			
Donor-site			
Wound infection	5 (6)	2 (4)	0.58
Necrosis	1 (1)	1 (2)	0.55
Phallus			
Wound infection	17 (19)	5 (11)	0.26
Partial flap loss	19 (21)	6 (13)	0.35
Less severe	13 (68)	4 (67)	
Severe	6 (32)	2 (33)	
Total flap loss	4 (4)	3 (7)	0.69
Urethra			
Wound infection	2 (2)	–	0.45
Partial flap loss	13 (14)	–	0.005
Less severe	9 (69)	–	
Severe	4 (31)	–	
Total flap loss	4 (4)	–	0.30
Scrotum			
Wound infection	4 (4)	0 (0)	0.20
Necrosis	2 (2)	0 (0)	0.45
Postoperative urological complications, *n* (%)			
UTI	45 (49)	1 (2)	<0.001
Urethral fistula	39 (43)	1 (2)	<0.001
PUA	–	–	
Fixed urethra	6 (15)	1 (100)	
DUA	28 (72)	–	
Pendulous urethra	5 (13)	–	
Urethral stricture	55 (60)	0 (0)	<0.001
PUA	1 (2)	–	
Fixed urethra	2 (4)	–	
DUA	43 (78)	–	
Pendulous urethra	9 (16)	–	
Meatal or perineal orifice stenosis	26 (29)	5 (11)	0.02
Number of participants that needed a reoperation, *n* (%)*	74 (81)	12 (27)	<0.001

Number of participants with complications are described, recurrences are not mentioned.
UTI: Urinary Tract Infection, PUA: Proximal Urethral Anastomosis, DUA: Distal Urethral Anastomosis.
*Under general anesthesia due to surgical and/or urological complications.

stenosis) was performed significantly more often in participants after phalloplasty with compared to without UL (64/91 [70%] vs. 4/45 [9%] resp., $p < 0.001$). Of the participants with UL, 28/39 (72%) urethral fistulas, all urethral strictures, and 20/26 (77%) meatal stenoses were treated by reoperation. After phalloplasty without UL, 4/5 (80%) stenoses of the perineal orifice were treated by reoperation.

End-stage of voiding

A flowchart of all included transgender men is shown in Figure 1. At the end of follow-up, 11/91 (12%) transgender men after phalloplasty with UL were awaiting further treatment for urological complications, and had not yet reached end-stage of voiding (10 scrotostomy and one perineostomy). Of 80 participants after phalloplasty with

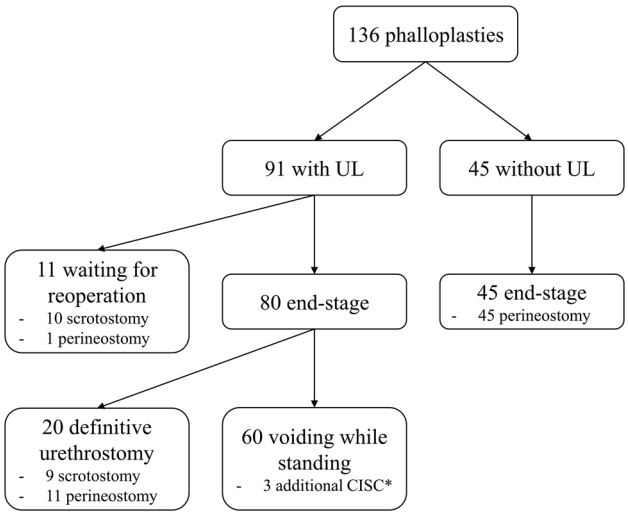

Figure 1. Flowchart of all included transgender men. The 60 men able to void while standing after phalloplasty with UL had a median of one reoperation (range 0–6). UL: Urethral Lengthening, CISC: Clean Intermittent Self-Catheterization. *Of 60 men able to void while standing, three needed to perform additional CISC, ranging from once a week to once a month.

UL at end-stage, 60 (75%) were able to void in standing position, after a median of one reoperation (range 0-6). Three of these men needed additional clean intermittent self-catheterization, ranging from once a week to once every month as long as deemed necessary. The remaining 20 (25%) participants at end-stage had a definitive urethrostomy (11 perineostomy, nine scrotostomy) due to complications. All 45 men following phalloplasty without UL at the end of follow-up had a definitive perineostomy without the need for further treatment, and had no decisional regret of their choice of gGAS.

Urinary functioning

Voiding analyses (i.e. IPSS, FVC, and uroflowmetry with PVR) pre- and postoperatively were compared separately for transgender men after phalloplasty with and without UL who reached the intended end-stage of voiding (resp. Tables 3 and 4). In the group with UL, a significant decrease in maximum flow rate was observed on uroflowmetry (mean [SD] of 21.4 [9.5] vs. 29.8 [13.2] mL/s, $p < 0.001$). Additionally, after UL, a trend was observed with more participants reporting straining in the IPSS survey postoperatively (median [IQR] of 1 [0–1] vs. 0 [0–0], $p = 0.004$). For the participants without UL, no differences were found in the comparison of voiding analyses pre- and postoperatively.

Discussion

In this retrospective study of transgender men, surgical outcomes and urinary functioning after phalloplasty with and without UL were described and compared. Phalloplasty with UL is a more extensive operation compared to without UL, with longer operation time, hospital stay, and indwelling catheters postoperatively. In addition, surgical (i.e. partial flap loss and wound infection) and urological (i.e. UTI, urethral fistula, urethral stricture, and meatal stenosis) complications were observed more often following phalloplasty with UL. These complications also led to more reoperations of the neourethra to reach the intended outcome, which was not always achieved. At follow-up, 75% of men with UL who reached end-stage of voiding were able to void while standing after a median of one reoperation (range 0-6), with on postoperative uroflowmetry a significant decrease in maximum flow rate. After phalloplasty without UL, all patients had a

Table 3. Lower urinary tract function after phalloplasty with urethral lengthening.

	n	Preoperative analysis	Postoperative analysis	*p*-value
Frequency volume chart				
Day frequency*	36	6.9 (2.1)	7.2 (2.2)	0.38
Night frequency†	36	0 (0–0)	0 (0–1)	0.07
Maximum voided volume, mL*	35	436 (168)	411 (115)	0.33
24-hour urine production, L*	35	2.0 (0.8)	2.1 (0.7)	0.75
IPSS†				
Total score	34	2.5 (1–4)	4 (2–9)	0.02
Incomplete emptying	30	0 (0–0)	0 (0–1)	0.06
Frequency	30	1 (0–1)	1 (0–1)	0.96
Intermittency	30	0 (0–1)	0 (0–1)	0.25
Urgency	30	0 (0–1)	0 (0–1)	0.21
Weak stream	30	0 (0–1)	0 (0–1)	0.59
Straining	30	0 (0–0)	1 (0–1)	0.004
Nocturia	30	1 (0–1)	1 (0–2)	0.86
Quality of Life	34	0 (0–2)	1 (0–2)	0.62
Uroflowmetry				
Qmax, mL/s*	45	29.8 (13.2)	21.4 (9.5)	< 0.001
Qavg, mL/s*	39	14.2 (6.6)	12.7 (5.9)	0.16
Flow time, s†	41	23 (16–37)	25 (17–37)	0.55
Time to flow maximum, s†	41	6 (4–10)	7 (4–10)	0.57
Voided Volume, mL*	45	371 (163)	333 (148)	0.12
Post-void residual volume, mL†	45	13 (0–35)	23 (0–50)	0.36

After Bonferroni correction, the level of significance for this analysis was set at a *p*-value of < 0.003. Due to missing data, number of patients differ per variable. Of four patients, only IPSS total score and quality of life were described without separate scores per question of the IPSS. Uroflowmetry data with a voided volume of < 150 mL was excluded from analysis.

IPSS: International Prostate Symptom Score, Qmax: Maximum flow rate, Qavg: Average flow rate.

*Normally divided data, presented as mean ± SD and analyzed using the paired samples t-test.

†Skewed data, presented as median ± IQR and analyzed using the Wilcoxon signed-rank test.

Table 4. Lower urinary tract function after phalloplasty without urethral lengthening.

	n	Preoperative analysis	Postoperative analysis	*p*-value
Frequency volume chart				
Day frequency*	18	6.9 (2.0)	6.8 (1.7)	0.73
Night frequency†	18	0 (0–0)	0 (0–1)	0.24
Maximum voided volume, mL*	18	499 (184)	491 (165)	0.88
24-hour urine production, L*	18	2.2 (0.9)	2.2 (0.7)	0.78
IPSS†				
Total score	22	4 (2–8)	4 (2–10)	0.63
Incomplete emptying	16	0 (0–1)	0 (0–1)	0.58
Frequency	16	2 (0–2)	1 (0–2)	0.78
Intermittency	16	0 (0–1)	0 (0–1)	0.57
Urgency	16	0 (0–2)	0 (0–1)	1
Weak stream	16	1 (0–1)	0 (0–1)	0.48
Straining	16	0 (0–1)	0 (0–1)	0.41
Nocturia	16	1 (0–1)	1 (0–1)	0.74
Quality of Life	22	1 (0–2)	1 (0–2)	0.84
Uroflowmetry				
Qmax, mL/s*	28	32.6 (17.7)	28.3 (15.0)	0.02
Qavg, mL/s*	26	15.4 (10.3)	14.2 (8.6)	0.26
Flow time, s†	26	33 (19–45)	24 (16–35)	0.15
Time to flow maximum, s†	26	6 (4–8)	6 (4–9)	0.40
Voided Volume, mL*	28	404 (195)	335 (137)	0.03
Post-void residual volume, mL†	28	0 (0–0)	1 (0–12)	0.07

After Bonferroni correction, the level of significance for this analysis was set at a *p*-value of < 0.003. Due to missing data, number of patients differ per variable. Of four patients, only IPSS total score and quality of life were described without separate scores per question of the IPSS. Uroflowmetry data with a voided volume of < 150 mL was excluded from analysis.

IPSS: International Prostate Symptom Score, Qmax: Maximum flow rate, Qavg: Average flow rate.

*Normally divided data, presented as mean ± SD and analyzed using the paired samples t-test.

†Skewed data, presented as median ± IQR and analyzed using the Wilcoxon signed-rank test.

definitive perineostomy without the need for further treatment at end of follow-up, and no differences were seen in the comparison of voiding analyses pre- and postoperatively. To come to a well-considered choice for or against UL, transgender men need to be aware of all possible outcomes related to that choice, and this overview and comparison of surgical outcomes and urinary functioning can be of added value in the shared decision-making process.

Choice for or against urethral lengthening

In recent years, the opportunity for transgender men to choose between gGAS with or without UL has become a more relevant topic (Jacobsson et al., 2017). Due to the risk of complications and their influence on the surgical outcome with expected social and psychological impact, some men refrain from the possibility of UL and therefore the ability to void while standing (Beek et al., 2015). This is in contrast to 1993, when Hage et al described that voiding while standing was usually requested and a priority for 99% of men opting for gGAS (Hadj-Moussa et al., 2019; Hage et al., 1993). During that time, the aim of gGAS was also formulated from a surgeon's perspective, in which the neophallus had to resemble a penis of a cisgender man in both appearance and functionality (Hage & De Graaf, 1993). Currently, in our cohort, one third of transgender men chose for phalloplasty without UL. This difference in the number of men choosing for or against UL may be explained by the paradigm shift toward a more patient-centered care approach, in which all surgical options and their associated benefits and risks are presented and a definitive choice of treatment is made after extensive preoperative counseling and through shared decision-making (Elfering et al., 2017). It is thought that achieving the most suitable choice of gGAS for each individual will lead to the highest rates of satisfaction, and in the current situation of transgender care from a patient's point of view, the need to void while standing appears to be much more variable with in our institution more men opting for gGAS without UL (de Rooij et al., 2021; Jacobsson et al., 2017).

The extensive decision-making process for gGAS with or without UL is also important in reducing decisional regret regarding the choice of surgical procedure (Beek et al., 2015; Hadj-Moussa et al., 2019; Mokken et al., 2020). Some may indicate decisional regret of their

choice of UL due to the high number of experienced complications and the need for reoperations, after which it is sometimes required to perform a definitive urethrostomy and abandon the possibility of voiding while standing. At follow-up, 25% of the patients in our cohort who chose phalloplasty with UL had a definitive urethrostomy. On the contrary, it is more difficult to lengthen the urethra for those who initially chose phalloplasty without UL, because secondary neourethral reconstruction can be troublesome as parts needed for the fixed urethra were removed during phalloplasty. A staged procedure may be necessary for reconstruction of the fixed urethra. Furthermore, the formation of the pendulous urethra is probably at the expense of the esthetic result. In our cohort, no participants indicated decisional regret of their choice for phalloplasty without UL.

Surgical outcomes

As expected based on previous literature, in which surgical results with or without UL were described separately, more complications were seen after phalloplasty with UL (Chen et al., 2021; Massie et al., 2017; Nikolavsky et al., 2018). Of the surgical complications, more partial flap loss and wound infections were observed postoperatively after UL. The need of an extra fasciocutaneous flap or the use of a PLMF, prolonged indwelling catheters postoperatively, and the passage of urine after catheter removal possibly affect wound healing. On the other hand, the incidence of total flap loss was comparable for the patients with and without UL, keeping in mind that all free flap phalloplasties (i.e. FRFF) were in the group with UL. In addition, the number of reoperations for partial and total flap loss was also comparable for both groups.

Total flap loss occurred in 4-7% of men, which was relatively high compared to previous literature (0–5%) (Baumeister et al., 2011; Carter et al., 2020; Doornaert et al., 2011; Garaffa et al., 2010; Heston et al., 2019; Leriche et al., 2008; Monstrey et al., 2005). In our study, some of the used techniques (i.e. SCIA and PLMF) and flap combinations (e.g. ALT + FRFF) were new, possibly resulting in higher initial complication rates. In general, flap loss is the result of vascular compromise due to flow problems caused by thrombosis or kinking, necessitating surgical reintervention (Santucci et al., 2021). In addition, loss of the "inner" neourethral flap may be caused by vascular compromise due to swelling and subsequent pressure from outside the flap postoperatively (van der Sluis et al., 2017). It is difficult to monitor the inner flap's vascularity, and interventions in case of vascular compromise may be too late. In recent years, stricter flap selection (e.g. on vascularity, dimensions, and thickness) based on imaging became our main focus to reduce postoperative complications. Flap thickness is interpreted using ultrasound, and if the thickness exceeds one centimeter, phalloplasty is not performed. In addition, a CT scan is used to better visualize a flap's vascularity and localize perforating flap arteries and vascular pedicles more precisely preoperatively.

Urological complications were seen more frequent following phalloplasty with UL. There is a notable difference in reported UTIs, which may be caused by more and longer urinary catheterizations after phalloplasty with UL. Urethral complications (i.e. urethral fistulas, urethral strictures, and meatal stenoses) and subsequent reoperations remain frequently seen after phalloplasty with UL. Our protocol obliges patients that prefer UL to undergo a colpectomy before gGAS to reduce the incidence of urethral fistulas postoperatively (Al-Tamimi et al., 2018). A colpectomy is an extra surgical procedure with its own risk for complications, increasing the length of surgical transition (Groenman et al., 2017; Nikkels et al., 2019). As a result, it takes longer for transgender men who opt for phalloplasty with UL to reach end-stage of voiding and subsequent implantation of testicular and penile prostheses. It is important that transgender men who choose gGAS with UL are aware of the magnitude of their transition process, and are well-prepared for possible setbacks on the way. Nevertheless, according to previous literature, satisfaction with the end-surgical result is affected by the appearance and functionality of the neophallus rather than the high prevalence of complications, reoperations, and prolonged duration of transition (de Rooij et al., 2021).

Urinary functioning

In the comparison of voiding analyses, a significant decrease in maximum flow rate from 29.8 to 21.4 mL/s was observed after phalloplasty with UL. Additionally, a trend was seen in the reporting of straining on the IPSS survey postoperatively. Due to neourethral reconstruction with a less pliable skin tube, transgender men can experience increased resistance during voiding (Hoebeke et al., 2005; Veerman et al., 2020). The formation of the fixed urethra also results in a siphon-like structure postoperatively, which leads to the highest intraurethral pressure in the neourethra (Hoebeke et al., 2005). In 2005, Hoebeke et al showed a non-significant decrease in maximum flow rate from 16 mL/s to 14 mL/s in 92 patients, in which it is striking that the value preoperatively is rather low (Hoebeke et al., 2005). In our cohort, the maximum flow rate postoperatively remains above the cutoff value of 15 mL/s, a threshold for bladder outlet obstruction derived from urinary analysis in cisgender men (Tam et al., 2016). However, after colpectomy, a significant decrease in maximum flow rate was also observed from 39.2 mL/s to 29.2 mL/s [de Rooij, unpublished data]. Even though the maximum flow rate after phalloplasty with UL remains above the threshold for bladder outlet obstruction, it is expected that about a halving of the flow rate can have clinical consequences. It is currently unclear what the long-term influence of gGAS with UL is on the urinary tract (Hoebeke et al., 2005). In the literature it is described that an increased obstruction during voiding may result in detrusor hypertrophy, urinary retention, ureteral dilation and hydronephrosis (McAninch & Lue, 2013; p 171).

Strengths and limitations

To our knowledge, this is the first study that directly compares clinical results after phalloplasty with and without UL, to provide an overview of surgical and urological outcomes. This comparison is of added value to previous literature in which outcomes were described separately, to create clear expectations in the choice for or against UL. The incorporation of urinary assessments was useful as the majority of complications and reoperations after gGAS were of a urological nature. The long-term consequences of gGAS on urinary functioning remain unclear, and should be investigated in future studies. Although the sample size was relatively large, groups became smaller during the paired voiding analyses due to missing data, nevertheless, we believe that relevant conclusions could be drawn with the current cohort. In addition, it is important to keep in mind during comparison of groups that transgender men who opt for phalloplasty with or without UL are different groups with their own goals of treatment. Yet, this overview of surgical outcomes and urinary functioning can aid transgender men and clinicians in the preoperative counseling for or against UL.

Conclusion

The choice for or against UL has become more relevant over the years, with currently one third of transgender men opting for phalloplasty without UL in our center. This comparison of clinical outcomes after phalloplasty with versus without UL can be of added value in the shared decision-making process for transgender men, to come to the most suitable choice of gGAS for each individual.

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