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ORIGINAL ARTICLE

Male Health

Postphalloplasty urinary function test: an observational study of novel outcome instrument to capture urinary dysfunction and quality of life after phalloplasty

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Due to growing social acceptance, there has been an increasing number of gender-affirmation surgeries performed in North America. Most research in this patient population focuses on surgical outcomes and advancing techniques. However, little work has been done to study functional outcomes. To better evaluate urinary dysfunction in the postphalloplasty trans men patient population, our group developed a novel patient-reported outcome instrument – the postphalloplasty urinary function test (PP UFT) and protocol to measure postvoid urethral volume (PVUR), and we present our preliminary results. We conducted a cross-sectional pilot study in a cohort of 15 adult trans men who had undergone phalloplasty with urethral lengthening surgery between 2018 and 2021. Patients had stable urinary function via the neophallus at the time of survey. Patients filled out the PP UFT and were asked to record their PVUR as per our protocol. The average PP UFT score was 8.9 out of 40 and the average quality-of-life (QOL) score was 2.6. Postvoid dribbling constituted the major complaint and on average comprised 63.2% of the reported PP UFT score. The average PVUR was 2.2 ml (range: 0.5–5.6 ml). There was a positive correlation between higher PP UFT and worse-reported quality of life ($P < 0.01$; $R^2 = 0.4$). Current questionnaires accepted in *cis*-male urology have limitations for accurately capturing urinary dysfunction in this specific patient group. The combination of PP UFT and PVUR measurement offers potential for quantifying urinary function and quality of life in patients who undergo phalloplasty. Future studies will validate these instruments.

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INTRODUCTION

In the past decade, there have been a growing number of gender-affirming surgeries performed in North America.[1] The increased demand has driven advances in surgical technique and approaches, as well as research exploring the surgical trends, complications, and resultant quality of life (QOL).[2–4] The two main techniques for genital gender-affirming surgery in trans men are phalloplasty (using free or pedicled tissue transfer techniques) and metoidioplasty. The majority of available literature examines outcomes of these procedures including anatomic urologic complications, esthetic result, and sexual function.[5]

Phalloplasty with urethral lengthening is a complex procedure with multiple stages and a high urologic complication profile.[6] In a recent systematic review, Nassiri *et al.*[6] identified 22 studies on phalloplasty and metoidioplasty examining complications including stricture, meatal stenosis, and fistula rates. Beyond anatomical outcome complications, the group also looked at rates of urinary incontinence (50%–59%), urinary retention (12%–20%), and voiding dysfunction separate from incontinence or retention (10%–72.7%). Examination of postoperative urinary function has mostly been limited to standing micturition assessed in a binary fashion,[5] while comparatively fewer studies have examined urinary function more qualitatively.[7,8]

Voiding dysfunction in the population of trans men is especially noteworthy because of the long-term risks of untreated bladder outlet obstruction (BOO). Trans men retain the native female urethral sphincter complex through reconstruction, which predisposes them to the same urinary dysfunction observed in *cis*-women.[9,10] After gender-affirming surgery, the phallus and neourethra add significant resistance, potentially increasing the risk of long-term BOO. As seen in the literature for *cis*-males with chronic BOO, usually of prostatic origin, the long-term sequelae can include urinary tract infections, hematuria, worsening incontinence, and even renal damage.[11,12] Therefore, functional evaluation and follow-up of trans men after gender-affirming genital surgery may be important to identify patients at risk of long-term BOO-related complications.

Despite the high incidence of urologic complications and urinary dysfunction, most patients report overall satisfaction, with high values for esthetic outcome,[5] increased sexual function,[13] and improved QOL.[14] Unfortunately, to our knowledge, there have not been urinary

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questionnaires developed to look at lower urinary tract symptoms (LUTS) in postoperative trans men which have been widely adopted. Likewise, current questionnaires and follow-up methodologies for *cis*-men may not accurately capture dysfunction and negative QOL aspects in this patient population.

One of the critical differences in a phalloplasty neourethra is the lack of surrounding muscle tone or spongy tissue. As a result, the lumen of the neourethra must be virtually constant between active voiding and rest. This large urethral volume can lead to problems with dribbling, urinary tract infection, or other issues, even if no "surgical complications" like fistula or stricture are present. This represents a major gap in our assessment of "success" in phalloplasty which we sought to address. While many trans men often describe posturination dribbling as a significant QOL detractor, there is no methodology established to assess what we have termed "post-void urethral volume (PVUR)" and its relationship to symptomatology.

The aim of this paper is to highlight our novel approach to assess the spectrum of urinary dysfunction in trans men who have undergone phalloplasty with urethral lengthening in a cross-sectional sample. In particular, we introduce our novel questionnaire, imaging protocol, and PVUR protocol to help practitioners better address and treat urinary issues in postoperative trans men.

Q1: Postphalloplasty urinary function tool (PP UFT)

Over the past month	Never	Less than 20% of the time	Less than 50% of the time	More than 50% of the time	More than 80% of the time	Almost always
Incomplete Emptying	0	1	2	3	4	5
Frequency	0	1	2	3	4	5
Intermittency	0	1	2	3	4	5
Urgency	0	1	2	3	4	5
Weak Stream	0	1	2	3	4	5
Straining	0	1	2	3	4	5
Dribbling	0	1	2	3	4	5
Nocturia	0	1	2	3	4	5

Q2: Do you suffer from incontinence (leakage of urine at any time)?
Yes or NO
a. Would you describe incontinence as continuous, only after urinating, dribbling, or a combination of above?
b. What do you do to avoid it?

Q3: Can/do you use the wall urinal in the restroom?
Yes or No

Q4:

Quality of life due to urinary symptoms	Delighted	Pleased	Mostly satisfied	Mixed	Mostly dissatisfied	Unhappy	Terrible
If you were to spend the rest of your life with your urinary condition just the way it is now, how would you feel about it?	0	1	2	3	4	5	6

Figure 1: PP UFT. Specific questions for PP UFT are presented in **Box 1**. PP UFT: postphalloplasty urinary function tool.

Incomplete emptying
The feeling of your bladder not completely emptying after urinating or feeling of fullness after voiding

Frequency
The act of needing to go urinating more than before (every 1 h or 2 h). Be sure to clarify if this is before gender affirmation surgery

Intermittency
Having to start, stop, and then start urinating several times while using the bathroom

Urgency
The urge to go to the bathroom immediately, feeling of difficulty postponing urination

Weak stream
Is your stream strong enough to prevent dribbling on your pants, is going to the bathroom take a long time, enough to impact your day, are you able to pee in a wall urinal-see Q3 in **Figure 1**

Straining
The need to push or straining at the beginning or end of the process of urination. If beginning or end specifically, please denote

Dribbling
Dribbling of urine from the penis after urination

Nocturia
Getting up at night to use the rest room, more than 1–2 times and/or enough to cause you lack of sleep or waking up restless and tired

Box 1: Specific questions for PP UFT. PP UFT: postphalloplasty urinary function tool.

PARTICIPANTS AND METHODS

PVUR and urinary questionnaire

Patients were enrolled in an institutional review board (IRB)-approved prospective registry (Johns Hopkins School of Medicine, Baltimore, MD, USA; approval No. IRB00182322). The study was developed by extending the validated International Prostate Symptom Score (IPSS) through multiple interviews with members of the surgical team with extensive experience managing postphalloplasty patients and their urinary issues and with input from the trans men population. It was then iteratively developed through interviews with several patients to ensure that it was intelligible to them and captured what they considered to be key factors affecting QOL or symptoms.

We then conducted an initial validation study in a cohort of 15 adult trans men who had undergone phalloplasty with urethral lengthening surgery between 2018 and 2021 by a single surgical team.

Patients were asked about our novel postphalloplasty urinary function tool (PP UFT; **Figure 1**) via a telephone interview in tandem with members of the transgender surgery and urologic surgery service. After the interview, patients were then asked to follow the PVUR protocol below to collect the postvoid volume. Results were reported back once the three samples were obtained.

Patients were also asked to obtain a PVUR by collecting the leaked amount after the first-morning void or after the first episode of urination after dinner. They were instructed to first urinate to completion and then collect the residual in a measurement cup. In addition, they would "milk" the urethra by gently pushing on the area behind the scrotum through to the tip of the urethra. The "milking" process was repeated 3–4 times to ensure that the urethra was empty. They would then record the measured volume. The PVUR was repeated three distinct times and the collected values were averaged.

Three-dimension (3D) computed tomography (CT) urethrogram using cinematic rendering (3DUG)

Fluoroscopic retrograde urethrograms were found to be unsatisfactory due to the tortuous, nonplanar, and sometimes overlapping nature of phalloplasty neourethra. As part of a new imaging protocol developed by Johns Hopkins School of Medicine to address this, several patients in the study had retrograde CT urethrograms performed with 3D reconstruction as a method to identify any postoperative stricture/fistulas and later in the series as part of the routine postoperative protocol. A volume of 30 ml of cystogram concentrated contrast was administered in a retrograde fashion over 15–20 s using a Foley catheter inserted into the distal urethra. A CT cystogram was obtained using institutional protocols. 3D-reconstructed images were then rendered using cinematic-rendering algorithms on a separate workstation by an attending radiologist based on a technique previously described at our institution for renal pathology (**Figure 2**).[15]

RESULTS

Fifteen patients agreed to participate in the pilot cross-sectional study. Overall findings are shown in **Table 1**. The average age was 31 years (range: 20–44 years). In our institution, patients undergo multiple staged procedures in the complete creation of a neophallus. In the first stage, only the phallus and penile urethra are created using a radial forearm or anterolateral thigh free flap. During the second stage, patients will have urethral lengthening, creation of the horizontal

portion of the urethra or "pars fixa" using tubularized labia minora flaps to anastomose the native urethra to the penile urethra within the neophallus, in addition to vaginectomy, scrotoplasty, clitoral burying, and glansplasty.

Thirteen patients were primary phalloplasty operations, while two patients (13.3%) were total redo operations after failed phalloplasty attempts at other centers. On average, patients had their second stage 252 days after Stage 1 surgery (range: 106–405 days), with 5/15 patients having had some types of urologic issue (*i.e.*, fistula managed conservatively or with repair, stricture managed with dilation or excision, and primary anastomosis). No patients failed urethral lengthening or required conversion to perineal urethrostomy. At the time of survey, none had any ongoing urinary complications, such as stricture or fistula. Given the young age of these patients at baseline, most were healthy and had no major comorbidities; of note, one patient had donated a kidney for transplant. Mean baseline creatinine for these patients was 0.9 mg dl^{-1} (range: 0.7–1.3 mg dl^{-1}), and post-Stage 1 and 2 surgeries, the mean creatinine was 0.9 mg dl^{-1} (range: 0.7–1.2 mg dl^{-1}).

Table 1: Patient demographics, postphalloplasty urinary function tool, and postvoid urethral volume findings

Variable	*Value*
Patient demographics	
Age (year), mean (range)	31 (20–44)
Days between surgeries (day), mean (range)	252 (106–405)
History of stricture, *n* (%)	4 (27.7)
History of fistula, *n* (%)	3 (20.0)
Preoperative creatinine (mg dl^{-1}), mean (range)	0.9 (0.7–1.3)
Postoperative creatinine (mg dl^{-1}), mean (range)	0.9 (0.7–1.2)
Survey findings	
PP UFT, mean (range)	8.9 (1–30)
PVUR (ml), mean (range)	2.2 (0.5–5.6)
QOL, mean (range)	2.6 (0–6)
Dribble score, mean (range)	4.1 (0–5)

PP UFT: postphalloplasty urinary function tool; QOL: quality of life; PVUR: postvoid urethral volume

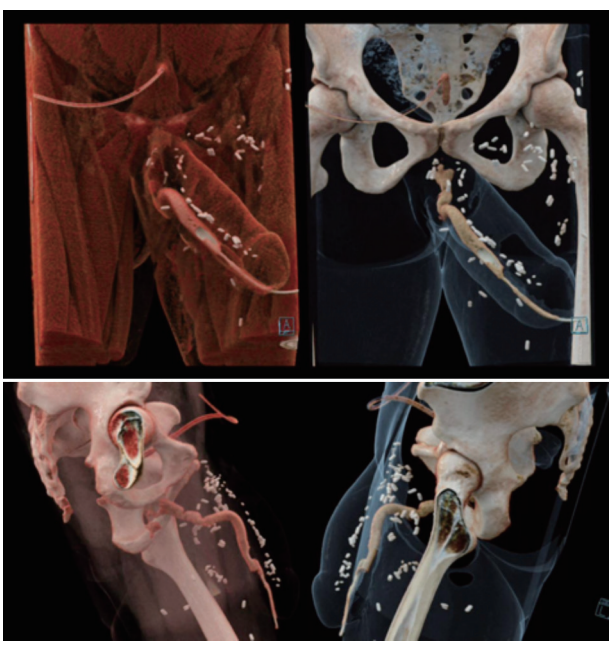

Figure 2: Images of 3D-reconstructed CT urethrograms using cinematic rendering. In the future, we intend to develop algorithms for determining characteristics such as total urethral volume and average cross-sectional area of the urethra to quantify anatomic factors that may be contributing to poor PP UFT or QOL scores. 3D: three-dimension; CT: computed tomography; PP UFT: postphalloplasty urinary function tool; QOL: quality of life.

In our study, the PP UFT had a mean score of 8.9 (range: 0–30) out of the total of 40. Notably, one patient was a significant outlier with a score of 30/40. When this outlier was removed, the mean PP UFT decreased considerably to 7.4. With regard to QOL, patients averaged 2.6 out of total 6, with notable complaints of "unhappy with dribbling", "smell of urine in underwear", and "frustrated with number of surgeries". This was offset by positive comments from patients being "happy to pee standing" and "happy with cosmetic outcome". Further insight into the PP UFT question on dribbling revealed a mean 4.1 out of 5 by patients and constituted a mean 63.2% of the total PP UFT score (range: 0–83%). When patients were then asked to perform PVUR after the PP UFT, patients had collected a mean PVUR of 2.2 ml (range: 0.5–5.6 ml). Statistical analysis was limited by sample size; however, there was a moderate correlation between higher PP UFT score and worse reported QOL ($P = 0.01$; $R^2 = 0.4$; Spearman test $P < 0.001$; $r = 0.8$). Interestingly, there was no clear correlation between PVUR amount and QOL (**Figure 3**).

DISCUSSION

Most existing literature on phalloplasty in trans men focuses on novel surgical techniques, postoperative anatomical complications, sexual and esthetic outcomes, and rates of standing micturition. Far fewer papers have looked at functional urinary tract symptoms and other qualitative aspects of urination after phalloplasty. Furthermore, at this

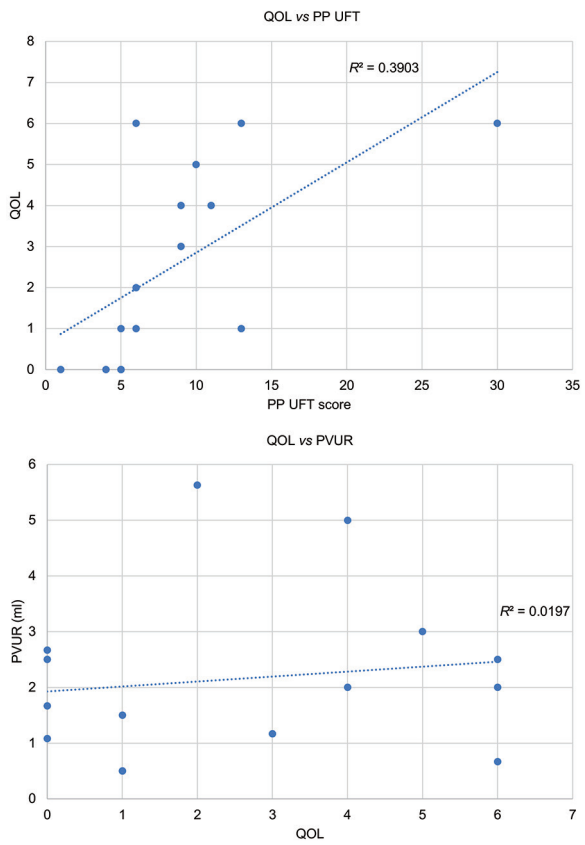

Figure 3: QOL correlations with PP UFT and PVUR. PP UFT: postphalloplasty urinary function tool; QOL: quality of life; PVUR: postvoid urethral volume.

time, there is no specific, validated tool for analyzing urinary function in postoperative trans men which is widely adopted.

Hoebeke *et al*.[7] were one of the first groups to critically investigate lower urinary tract function in trans men after phalloplasty. The group designed a questionnaire assessing voiding habits in 24 patients. Questions were largely binary regarding changes in urinary function after gender affirmation surgery and asked about urinary tract infections, nocturia, incontinence, and postvoid drippling. This questionnaire was later adopted by Srinivasan and Soni[16] to examine a similar patient population of 21 trans men in conjunction with uroflowmetry. These two studies found that worsening urinary symptoms occur in 21%–33% of patients after phalloplasty. In addition, urinary tract infection (UTI) occurs in 45%–55%, some degree of incontinence in 50%–52%, and postvoid dribbling in 78%–79% of patients.[7,16] The questionnaire was able to capture changes in urinary habits and was the first to highlight that gender affirmation can have significant impact of urination; however, it lacked further detail and grading system which would capture the subtle variances in urinary changes.

A total of three studies have attempted to clarify LUTS after phalloplasty, specifically using uroflowmetry data. In all three studies, uroflowmetry identified nonsignificant decreases in maximum urine velocity (Qmax) after phalloplasty.[7,8,16] The recent study by Veerman *et al*.[8] examined a cohort of 55 phalloplasty and 8 metoidioplasty patients for surgical complications and urinary function using the International Prostate Symptom Score (IPSS), urinary QOL, and uroflowmetry to examine relationships between urinary function and outcomes. With regard to urinary function, the authors reported no clinically significant difference in IPSS, frequency volume charts, and uroflowmetry data pre- and postoperatively. However, further investigation of the data reveals that the authors observed significant decreases in Qmax (33.9 ml s^{-1} *vs* 20.7 ml s^{-1}, $P = 0.002$), average flow (15.5–11.5 ml s^{-1}, $P = 0.019$), and an increase in voiding time (23.4–29.4 s, $P = 0.091$). Likewise, out of the 35 uroflowmetries recorded, the authors reported that only 26 patients had retained the ability to void from the tip of the penis, while others had perineostomy or scrotostomy. Therefore, a subset analysis of intact phalloplasty voiding with their pre- *vs* posturoflowmetry data would be an interesting addition to the literature.

van de Grift *et al*.[13] examined motivations, psychosexual outcomes including QOL, and urinary function after phalloplasty and metoidioplasty. Despite the high incidence of stricture and LUTS as quantified by the IPSS in this study population, patients were "neutrally satisfied" with their urinary function. There were no changes between pre- and postoperative QOL and anxiety/depression; however, there were improvements in sexual function and high rates of overall satisfaction. This may indicate that patients may tolerate increased urinary symptoms in exchange for the other benefits of phalloplasty.

Melloni *et al*.[17,18] also recognized the deficiencies in contemporary patient questionnaires for the transgender community and proposed a novel questionnaire for trans women after vaginoplasty. Though this is a patient group with different anatomy and different clinical concerns, the authors highlighted that the results suggest an increased risk of developing LUTS in the trans women population. More importantly, they also integrated QOL as a metric and asked patients if they were satisfied with the surgical outcome.

Clarifying to what extent LUTS detracts from QOL after genital gender-affirming surgery is critically important to help patients make informed decisions, particularly between phalloplasty and metoidioplasty. While metoidioplasty is associated with lower rates of urologic stricture/fistula compared to phalloplasty,[5] two studies identify no difference in functional urinary outcomes between the two procedures.[8,13] Integration of these questions and perceptions into a questionnaire about the spectrum of LUTS is difficult but necessary in order to provide appropriate preoperative counseling and longitudinal evaluation. Therefore, a transmale urinary questionnaire looking at function and QOL between metoidioplasty and phalloplasty would be very helpful in guiding patient decisions-making.

Most existing studies have used the IPSS to capture patient-reported urinary function and symptoms. Although the IPSS covers the wide spectrum of urinary complaints and includes a grading system and QOL marker, it is initially designed, worded, and validated to assess BPH severity in *cis*-men. The PP UFT is based on the IPSS and captures the subtle variations in LUTS including incomplete emptying, frequency, intermittency, urgency, weak stream, straining, dribbling, and nocturia. These aspects are also rated from 0 to 5, similar to the IPSS, but are refined to be more specific to the postphalloplasty patient. To expand on the LUTS, patients were further asked that if they suffered from urinary incontinence how did they prevent or minimize the incontinence. At the end of the survey, patients were also surveyed on QOL (**Figure 1** and **Box 1**). The PP UFT was worded and redesigned with input from both plastic surgeons and urologists who perform phalloplasties and care for trans men routinely. In addition, patients were queried about the accuracy, relevancy, and ease of the questionnaire.

In our study, postvoid dribbling was the primary urinary symptom that patients identified (accounting for an average of 63.2% of the total PP UFT score). More notably, all of the patients in our cohort reported posturination dribbling. To quantify the posturinary dribbling, patients were asked to provide PVUR. The PVUR on average was 2.2 ml and patients reported several methods to help deal with this dribbling, including "shaking after urinating", "holding pressure at the base of the neo-phallus", and "gently milking the entire length of the penis after urinating". There was a notable association between worsening QOL with increasing PP UFT. However, we did not find a strong correlation between PVUR and QOL. Possible explanations would include differences in patient counseling/expectations, threshold phenomenon, and differences in patients milking. Based on our anecdotal management of these patients, many develop complex methods to adequately empty their neourethras after voiding. Ultimately, this is an area that will require further investigation, likely, through a prospective study assessing trends in PVUR and QOL over a period of time.

Our interest in PP UFT development began when discussing postvoiding urinary leakage with patients and realizing it was a common issue. To our knowledge, there are no publications focusing on this, it is not discussed commonly, and most phalloplasty series report "success" in a way that severe dribbling would not factor in. While postvoid residuals (PVRs) are one of the most common urologic assessments, this term is generally descriptive of retained bladder volume as the muscular urethra generally does not retain large quantities of urine. The phenomenon of a compliant urethra which requires passive urine expression is largely unique to phalloplasty, which likely explains its under recognition in studies on this emerging procedure. To emphasize its distinct etiology, we have chosen to adopt the term "post-void urethral retention": PVUR.

Posturination dribbling is believed to be from the anatomical lack of muscle in the neourethra. To avoid excessive outflow resistance, the diameter is usually 18 Fr or larger; in a 6- to 7-inch phalloplasty with additional perineal urethral length, this results in a perpetual urethral volume of at least 3–10 ml. Many patients may experience some urethral dilatation, especially into the vaginectomy cavity, increasing volume further.[19] However, we believe that symptomatic PVUR is an intrinsic phenomenon of phalloplasty. Regardless of technique, even neourethras with near-perfect caliber have this issue (**Figure 1**).

PVUR can be functionally measured by milking out the urine after voiding, as demonstrated in our study. Alternately, an anatomical imaging study, similar to the 3DUG developed in our protocol, can also be used. This technology can be used not only to diagnose urethral complications such as fistula and stricture but also to determine the optimum neourethral caliber. It can also be used to objectively estimate PVUR to help guide patients in assessing adequate emptying or milking. Imaging alone does not reproduce the actions of active micturition and the patient's urethral clearing technique. Thus, these are complementary tools – with 3DUG showing objective anatomical detail and PVUR/PP UFT providing patient-reported symptoms and patient-measured residuals with their clearing technique.

The lack of correlation between measured PVUR and patient-reported dribbling severity is intriguing and warrants further explanation. Possible explanations include differing patient expectations for what constitutes problematic dribbling, inaccuracies in PVUR measurement, or variation in patient techniques for postvoid urine expression. This may offer potential avenues for improving patient satisfaction. Volumetric 3DUG to PVUR correlation studies will help to further explain these findings.

There are many limitations to this pilot study including the cross-sectional nature and small sample size. In subsequent studies, we will formally validate the PP UFT instrument and work with psychometric experts to further improve the survey for this patient population. Furthermore, prior researchers have obtained urodynamics to assess bladder and urinary function. However, it is noted that in the phalloplasty population, the urethra is tortuous and catheter placement to obtain uroflowmetry can be difficult or impossible. Routine urodynamics are also logistically infeasible at our institution and many others, making a patient-reported outcome more realistic for widespread adoption as a standardized metric.

The aim of this pilot project was to report our observations from our novel outcome instrument and present initial cross-sectional data and questionnaires specific to the postphalloplasty patient population, as well as highlighting the importance of PVUR. As experience with these surgeries grows and techniques improve, the emphasis should move away from surgical feasibility and complications and toward long-term functional and patient-reported outcomes. Since many of these patients are young, it is critical to establish methods to follow and assess urinary function and QOL. We believe that as these patients age, they may be at greater risk for impaired urinary function. Future work includes our ongoing prospective study following patients for at least 1-year posturethral lengthening, incorporating the PVUR and PP UFT questionnaires with cross-comparison to more objective CT imaging protocols and routine studies. We hope these future projects will help validate and educate us on how to manage best and care for these patients.

CONCLUSION

There is a paucity of studies in trans men after phalloplasty looking at functional and patient-reported urinary outcomes. We have developed a novel protocol including postvoid urethral volume and urinary questionnaires to help capture urinary function in these patients, as well as track quality of life. Our cross-sectional study shows that postvoid dribbling, attributable to postvoiding urethral retention, is a significant detriment to quality of life and encompasses most of the urinary complaints in this patient population.

AUTHOR CONTRIBUTIONS

JLL and DC conceived the presented idea, collected the data with additional assistance from LE, performed the statistical analysis, and wrote the manuscript in consultation with SP, ALB, and HND. All authors read and approved the final manuscript.

COMPETING INTERESTS

All authors declare no competing interests.

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