



# A Comparative Study of Urinary Complication Rates before and after the Incorporation of a Urethral Lengthening Technique during Masculinizing Genital Gender Affirmation Surgery

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Indian J Plast Surg 2022;55:196–204.

## Abstract

**Objectives:** Masculinizing genital gender affirmation surgery (MgGAS) consists of operative procedures designed to help the transition of transmen in their journey toward male gender role. Phalloplasty and urethral lengthening remain the most challenging of these surgeries, as the female urethra (4 cm long) must be lengthened to male dimensions (15–29 cm) with anastomosis at two sites, the native urethra/pars fixa urethra and the pars fixa urethra-penile urethra. As a result, there is a high incidence of urinary complications such as strictures and fistulae. Authors incorporated a urethral lengthening technique to reduce urinary complications in MgGAS. They compare the rates of urinary complications rates in cohorts before and after the introduction of this technique.

**Materials and Methods:** Authors have been performing phalloplasty since past 27 years, utilizing mainly free radial artery forearm flap (fRAFFp 431 cases) and pedicled anterolateral thigh flap (pALTp 120 cases). A retrospective review and comparison of urinary complications were performed before and after the introduction of their new technique since March 2017.

**Results:** There was a statistically significant reduction in the incidence of stricture with and without fistulae (25.94% with conventional and 4.17% with urethral lengthening technique  $p = 0.001$ ) and fistulae alone (12.81% with conventional and 2.78% with urethral lengthening technique  $p = 0.011$ ) in fRAFFp cases. In pALTp cases, the respective reductions were 43.08 to 17.07%,  $p = 0.006$  (significant), and 13.85 to 4.88%,  $p = 0.197$  (not statistically significant).

**Conclusion:** Over years, the rates of urinary complications in MgGAS have remained constant, varying from 25 to 58% for strictures and 17 to 75% for fistulae as noted by many authors. Authors noted that in most of their cases, strictures occurred at distal pars fixa urethra (DPFU)-penile urethra anastomosis and incorporated a urethral

## Keywords

- ▶ masculinizing genitoplasty
- ▶ phalloplasty
- ▶ gender incongruence
- ▶ gender affirmation surgery
- ▶ sex change surgery
- ▶ forearm flap
- ▶ anterolateral thigh flap
- ▶ urethral stricture
- ▶ urethral fistula

received  
March 24, 2021  
accepted after revision  
December 4, 2021  
published online  
July 18, 2022

Issue Theme Gender  
Incongruence

DOI <https://doi.org/10.1055/s-0042-1749104>.  
ISSN 0970-0358.

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lengthening technique, which lengthens the DPFU by 3 to 5 cm at this anastomotic site, thus significantly reducing the anastomotic tension and the rate of urinary complications.

## Introduction

Recent studies<sup>1-4</sup> indicate a significant increase in the number of patients experiencing gender incongruence (GI). As a result, there is increased demand for persons seeking gender affirmation surgery, including masculinizing genital (MgGAS).<sup>5-8</sup> MgGAS<sup>9</sup> is a complex group of operations consisting of hysterectomy, salpingo-oophorectomy, vaginectomy, perineoplasty, scrotoplasty, urethral lengthening, metoidioplasty/clitoral release or phalloplasty, and insertion of erectile and testicular prosthesis. These procedures are known to significantly relieve GI and improve the quality of life of these persons. The other indications for phalloplasty are disorders of sexual development such as absence of penis, micropenis, individuals raised as males with ambiguous genitalia, hypospadias and epispadias with erect penile length of less than 7.5 cm. Phalloplasty is also indicated in those with loss of penis due to trauma, burns, animal attacks, malignancy and oncosurgical resection, severe infections, etc. However, the commonest indication for phalloplasty today is as part of MgGAS in transmen. A multidisciplinary team consisting of plastic surgeon, urologist, gynecologist, and laparoscopic surgeon besides others as part of a gender identity clinic is necessary for providing optimum results in MgGAS.

After Chang and Hwang<sup>10</sup> initiated the use of free radial artery forearm flap phalloplasty (fRAFFp) in 1984, it rapidly became the dominant technique for phalloplasty, replacing most pedicled flaps, due to ease of use, nearly ideal neophallus dimensions mimicking a circumcised erect penis, ability to carry out tube in tube procedure utilizing the ulnar glabrous forearm skin for urethral tube, provision of erogenous and tactile sensation on account of two sensory nerves and a stiffening mechanism with incorporation of a segment of radius (fORAFFp) by some surgeons.<sup>11</sup> Recently, the use of pedicled anterolateral thigh flap (pALTp) has increased, and it is now the second commonest flap in use for phalloplasty, on account of usage as a pedicled flap, hidden donor area, better color match, ease of use, and provision of sensation with the help of lateral femoral cutaneous nerve. However, tube-in-tube method is often impossible due to presence of hair and thicker subcutaneous fat layer resulting in unnatural neophallus girth. As a result, pALTp often needs prelamination with vaginal mucosa or skin graft. Free musculocutaneous latissimus dorsi too needs prelamination with buccal mucosa or skin graft. Other methods such as osteocutaneous free fibula, thoracodorsal artery perforator flap, lateral arm flap, deltoid flap, and suprapubic phalloplasty are performed infrequently due to various reasons. However, despite the performance of phalloplasty with many of these flaps for more than 30 years, the rates of urinary complications have

remained high, with most publications<sup>12-15</sup> reporting strictures in the range of 25 to 58% and fistulae 17 to 75%.

As per World Professional Association for Transgender Health (WPATH)<sup>16</sup> Standards of Care (SOC)'s version 7 and Indian Standards of Care for Persons with Gender Incongruence and People with differences in Sexual Development/Orientation version 1 (ISOC-I),<sup>17</sup> to be eligible for MgGAS, the patient must be gender incongruent and should have referral letters from two mental health professionals recommending GAS. The patient must also be above the legal age of majority, which is 18 years in India, must have had hormone therapy for around 12 months, unless the patient is unwilling, or the therapy is medically contraindicated. Patient should also have had the experience of living in desired gender role for at least 12 months. If the patient is on androgens, a close watch needs to be kept on hemoglobin and liver function and if necessary, hormone therapy should be stopped 2 to 4 weeks prior to surgery.

## Materials and Methods

Senior author has been carrying out GAS inclusive of MgGAS since more than 27 years. With time, the techniques have undergone a significant change. Authors realized that most of the urinary complications occurred at distal pars fixa-penile urethra anastomotic site. Hence, they devised a urethral lengthening technique to lengthen pars fixa urethra beyond the conventional technique and thus improve the last mile connectivity. Our current algorithm for MgGAS including the new urethral lengthening technique is presented in **►Fig. 1**. Hospital ethical committee approval was taken for the study. The case records of all patients, who underwent phalloplasty by fRAFFp (431 cases) and pALTp (120 cases) techniques from the period June 1993 to December 2019, were reviewed. The cohort of patients operated with conventional technique from the period June 1993 to February 2017 was compared with the cohort operated from March 2017 to December 2019 with the urethral lengthening technique, for urinary complications such as stricture and fistula by the senior urologist in team. Any urethrocutaneous communication that failed to resolve or was present at 6 weeks or more postoperatively was classified as a fistula. Uroflowmetry was done for every patient at 3 months or more postoperatively. Patients with weak urinary stream or straining and those with Q<sub>max</sub> below 15 mL per second were subjected to a retrograde urethrogram (RGU). A narrowing noted on RGU in such patients was classified as a stricture (**►Fig. 2**).

Inclusion criteria:

- 1) Eligibility for GAS as noted above.
- 2) Minimum follow-up period of 3 months.



**Fig. 1** Our protocol for masculinizing genital gender affirmation surgery.

3) No flap-related complications such as partial or total flap loss.

## Detailed Description of the Procedure of MgGAS

Authors perform MgGAS in three stages (►Fig. 1). The first stage consists of hysterectomy, salpingo-oophorectomy, vaginectomy, closure of perineum, reconstruction of pars fixa urethra, clitoral transposition, and scrotoplasty. Prelamination of ALT flap is performed at the same sitting. In the second stage, phalloplasty is performed together with anastomosis of penile urethra with distal pars fixa urethra (DPFU). The third stage consists of insertion of penile and testicular implants. The previous technique and novel technique differ only in the reconstruction of DPFU. ►Table 1 illustrates the differences between conventional technique, the urethral lengthening technique, and metaidoioplasty.

1) **Stage 1—The Earlier Technique (June 1993–February 2017, ►Fig. 3):** In this technique, the pars fixa urethra was reconstructed with the help of bilateral inner labia minora and intervening skin together with a turnover mucosal flap of anterior vaginal wall based distally. With this maneuver, urethra extends to the level of clitoris. The clitoris is

released from its natural attachment to flattened spongiosal tissue and transposed anteriorly and superiorly. If metaidoioplasty is being performed, some of the excised vaginal mucosa is used as a graft and together with inner labia minora inner mucosa island flap and dorsal clitoral skin flap, forms pendular urethra of the clitoris-penoid. The perineum and bulbospongiosus fibers are closed over obliterated vaginal cavity and the neo pars fixa urethra providing a waterproofing well vascularized covering layer. Bilateral labia majora are mobilized on an anterior pedicle and the distal ends sutured to themselves and the advanced urinary meatus, to form neoscrotum.

2) **Stage 1—The Urethral Lengthening Technique (March 2017 onwards, ►Figs. 4–7):** When using the earlier technique, urethral lengthening could only be performed to the point of convergence of bilateral labia minora onto paired clitoral frenulum. As a result, the anterior end of pars fixa urethra remained 3 to 4 cm short of pubic symphysis. Authors new urethral lengthening technique extends the urethra by also using all available glabrous skin anterosuperior to clitoris including dorsal clitoral skin, glabrous skin in mons veneris, and glabrous skin between labia majora near anterior commissure



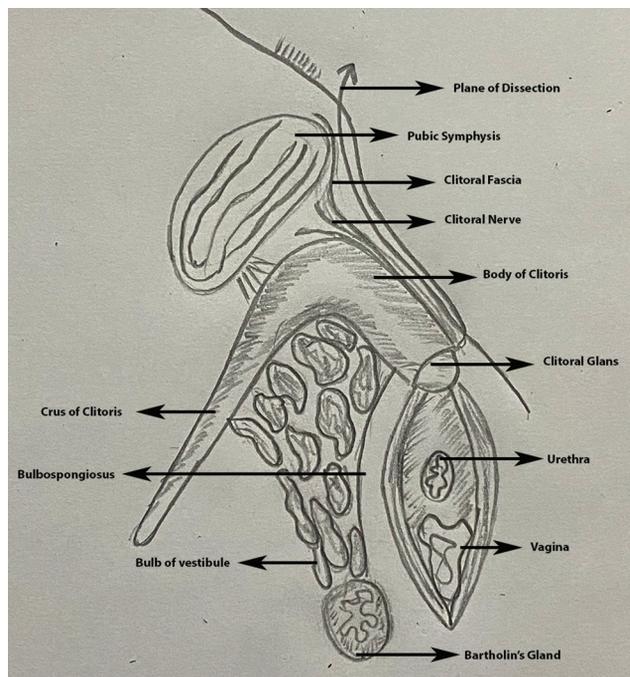
**Fig. 2** Urinary complications. (A–C) Distal urethral stricture with proximal diverticulation, repaired by stricture release and graft from redundant diverticular lining. (D–F) Classical stricture at distal pars fixa urethra–pendular urethra junction, repaired by excision and end-to-end anastomosis. (G–I) Long segment stricture at pars fixa urethra, excision, and replacement by lotus petal flap from right gluteal region.

**Table 1** Differences between conventional/earlier technique, the new urethral lengthening technique, and metaidioplasty

Technique formation and length of urethra	Authors previous technique	Authors recent urethral lengthening technique	Metaidioplasty
Formation of proximal part of pars fixa urethra up to clitoris	Anterior vaginal wall flap + inner labia minora flaps	Anterior vaginal wall flap + inner labia minora flaps	Anterior vaginal wall flap + urethral plate/buccal/vaginal mucosal grafts
Formation of distal pars fixa urethra, beyond original clitoral location	Not performed	Use of all glabrous skin anterosuperior to clitoral location, including dorsal clitoral skin, skin of mons veneris, and anterior commissure of labia majora	Not done. Instead pendular urethra constructed with bilateral inner labia minora island flaps, dorsal clitoral skin flap, and buccal/vaginal mucosal grafts
Total length of pars fixa urethra	4–6 cm	6–10 cm	4–6 cm
The difference in techniques at time of phalloplasty	Clitoris is released and transposed to pubic area externally via incision in dorsal clitoral skin and skin near anterior commissure. The pars fixa urethra is pulled distally and anastomosed with pendular urethra usually under some tension	Clitoris is already in pubic area (having been transposed internally in a plane superficial to clitoral fascia). The distal part of pars fixa urethra is already near pubic area. Anastomosis to pendular urethra is performed easily, and without tension	



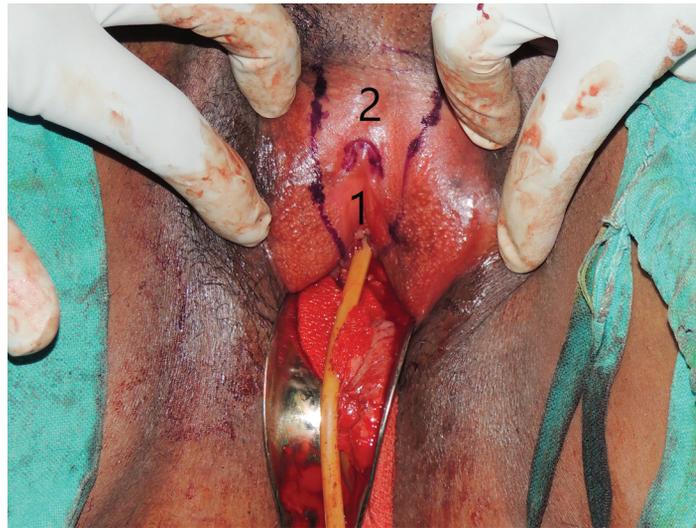
**Fig. 3** Pars fixa urethra construction with conventional technique. (A) Preoperative female pudendum. (B) 1—part of pars fixa constructed from vaginal mucosal flap, 2—part of pars fixa constructed from labia minora flap, 3—bulbospongiosus fibers. (C) Scrotoplasty begins. (D) Well-healed neo pars fixa urethra. Note the position of neomeatus. It is 3–4 cm posterior to pubic symphysis.



**Fig. 4** Dissection is performed from a small circumcoronal incision around clitoral glans, in a plane superficial to clitoral fascia. The clitoris is released from spongiosal tissue, straightened, and transposed to a small pubic incision within hairline.

(► **Figs. 5 and 6**). To facilitate this, clitoris is mobilized by a small circumcoronal incision and transposed in a plane superficial to clitoral fascia, to hair bearing area superior to anterior labial majora commissure

(► **Fig. 4**). The wound at original clitoral site is closed. Clitoral frenula too are excised, and the wounds are closed. The urethral tube formation now continues superiorly for 3 to 5 cm more and extending up to



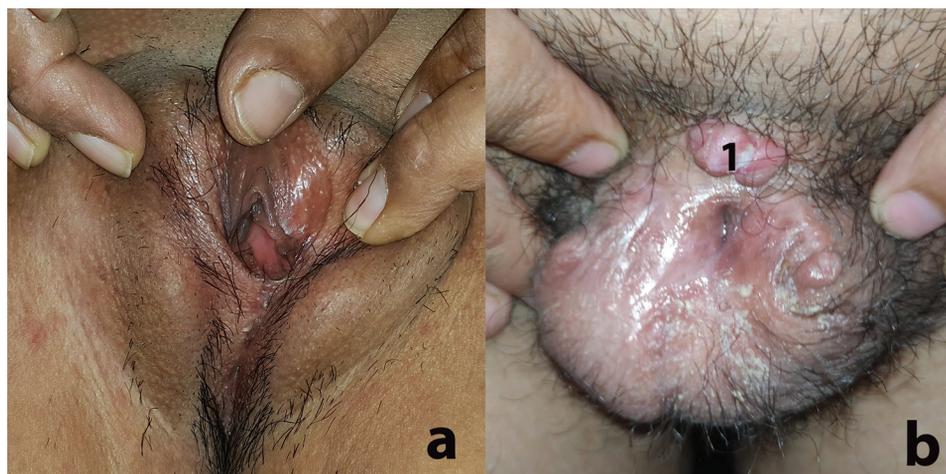
**Fig. 5** Flap 1 forms the conventional pars fixa urethra. Flap 2 is used in the novel technique and extends the pars fixa urethra for 3 to 5 cm beyond clitoris, clitoral frenula, and labia minora.



**Fig. 6** The novel (last mile) technique. (A) Normal female pudendum—the flap 1 between inner labia majora anteriorly, inclusive of dorsal clitoral skin, is nearly always glabrous, and will be tubed to form distal pars fixa urethra (DPFU) (B) Clitoris has been transposed to hair bearing pubic area and clitoral frenula excised. The resultant defect is closed. Flap 2 demonstrates the extra length of pars fixa urethra gained. (C) Flap 1 has been tubed to form extended pars fixa urethra (DPFU). (D) Completed repair after hysterectomy, salpingo-oophorectomy, vaginectomy, perineoplasty, PPFU, and DPFU construction, scrotoplasty, and clitoral transposition.

anterior labia majora commissure. This forms the DPFU. DPFU is securely covered by approximation of highly vascular bulbospongiosal tissue proximally and the labia majora flaps forming the neoscrotum

distally, thus providing a waterproofing covering layer. This maneuver extends the pars fixa urethra by 3 to 5 cm beyond the conventional technique (→ Fig. 7) and 7 to 10 cm distal to native urethral orifice. As a result,



**Fig. 7** Difference between neourinary meatus location in (A) conventional technique and (B) the novel (last mile) technique. 1—transposed clitoris.

**Table 2** RAFF and ALT phalloplasties performed during the period 1993–2019

Phalloplasty indication technique	Gender affirming (MG)	Trauma, animal attacks	Follow-up period less than 3 months
RAFF	431 (flap loss 11)	12 (flap loss 0)	9
ALT	120 (flap loss 2)	0	1
Total RAFF + ALT	551 (flap loss 13) and follow-up less than 3 months—10 cases		

Abbreviations: MgGAS, Masculinizing genital gender affirmation surgery; pALTp, pedicled anterolateral thigh flaps; RAFF, radial artery forearm flap. Total phalloplasty cases—551.

Total fRAFFp for MgGAS—399, out of which 392 were tube in tube.

Total pALTp for MgGAS—117, out of which 106 were prelaminated.

Cases included in the study—fRAFFp, 392; pALTp, 106.

there is significant reduction in the tension in DPFU-penile urethra anastomosis at the time of phalloplasty, thus decreasing the incidence of a stricture at this site. The urinary catheter is removed in 10 to 14 days.

There was total 431 cases of fRAFFp (Chang technique with ulnar urethral strip) and 120 cases of pALTp performed during the period June 1993 to December 2019 (►Table 2). Nine cases of fRAFFp and 1 case of pALTp with follow-up period less than 3 months were excluded. There were 11 cases of flap loss in fRAFFp group and 2 such cases in pALTp group. These were also excluded. Twelve cases of phalloplasty performed for non-MG indications (in biologic men) were also excluded from the study as in these cases pars fixa urethra did not require reconstruction. In the remaining 399 cases of fRAFFp group, tube in tube urethra was reconstructed in 392 cases. Urethral prelamination was performed in seven cases on account of thin forearm circumference (4 cases) and hairy ulnar aspect of forearm (3 cases). Among the 117 cases of pALTp group included in the study in 11 cases tube-in-tube urethra was constructed, and these were excluded from the analysis. Urethral prelamination of lateral aspect of ALT flap was performed with vaginal mucosa in 98 cases (►Fig. 3) and skin graft in 8 cases in whom vaginal

mucosa was insufficient or unavailable, as vaginectomy had been performed earlier, elsewhere.

### Results (►Table 3)

The data on categorical variables is shown as n (% of cases). The intergroup statistical comparisons of categorical variables are tested using chi-square test or Fisher's exact probability test if more than 20% cells have expected frequency less than 5. *p*-Values less than 0.05 are considered statistically significant. The statistical analyses were performed using Statistical Package for Social Sciences (SPSS ver. 21.0, IBM Corporation, New York, United States) for MS Windows. Of the 392 cases of fRAFFp performed with tube-in-tube technique ►Table 3, 320 were performed with conventional technique (June 1993–February 2017) and 72 with the urethral lengthening technique (March 2017–December 2019). There were 83 cases of stricture with or without fistulae (25.94%) and 41 cases of fistulae (12.81%) in the first group. In the second group, the respective values were 3 (4.17%) and 2 (2.78%). There was considerable reduction in incidence of stricture with or without fistulae ( $p = 0.001$ ) and fistulae alone ( $p = 0.011$ ), reaching statistical significance. In the pALTp group, of the 106 cases performed with flap prelamination, 65 were performed with the conventional

**Table 3** Comparison of urologic complication rates between author's previous and recent techniques in fRAFFp and pALTp

Urologic complications technique	Number of cases	Stricture with or without fistulae	Stricture with or without fistulae (%)	p-Value	Fistulae alone	Fistulae alone (%)	p-Value
fRAFFp (conventional technique)	320	83	25.94%		41	12.81%	
fRAFFp (the urethral lengthening technique)	72	3	4.17%	0.001	2	2.78%	0.011
pALTp (conventional technique)	65	28	43.08%		9	13.85%	
pALTp (the urethral lengthening technique)	41	7	17.07%	0.006	2	4.88%	0.197

Abbreviations: fRAFFp, radial artery forearm flap; pALTp, pedicled anterolateral thigh flaps.

Blue indicates statistically significant.

Red indicates statistically not significant.

technique and 41 with the additional urethral lengthening by authors new technique. There were 28 cases of stricture with and without fistulae (43.08%) and 9 cases of fistulae alone (13.85%) in the first group. The values in the 41 cases done with incorporation of urethral lengthening technique were 7 cases of stricture with and without fistulae (17.07%) and 2 cases of fistulae alone (4.88%). There was reduction in the incidence of complications in both subgroups reaching statistical significance in the case of stricture with and without fistulae ( $p = 0.006$ ) and no statistical significance in case of fistulae alone ( $p = 0.197$ ).

## Discussion

Carrying out all multiple procedures in a single sitting can increase the rate of complications especially related to urinary stream and flap. As a result, the majority of surgeons carrying out MgGAS divide the procedures in two to five sittings, thus limiting the challenges posed by ischemia, edema, avoiding multiple urinary anastomosis in one sitting and allowing the tissues to heal properly. MgGAS is a complex group of procedures designed to help the transition of female to male transsexuals in their journey toward their desired-male gender role. Goals of the procedure are removal of female internal and external genitalia and construction of male external genitalia simulating the biologic male genitalia to the extent possible. MgGAS should enable these individuals to micturate in erect position without any urologic complications, as well as be able to have penetrative sexual intercourse with good genital sensitivity and orgasmic capability. Not all the procedures that are listed as part of MgGAS may be opted for by the transmen. Patients may opt for metoidioplasty instead of phalloplasty, which preserves original erogenous sensation, physiologic erection, and orgasmic capability, though the patient may not be able to engage in penetrative sexual intercourse or micturate in erect position. Also, many patients may opt out of urethral lengthening, and preserve their native urinary meatus, which significantly simplifies the reconstruction and reduces urinary complications. Of all the procedures in MgGAS, phalloplasty with lengthening of urethra to male

dimensions remains the most challenging. Bouman<sup>18</sup> reported a high fistula rate using only labia minora flaps. Addition of anterior vaginal wall flap, first described by Thompson<sup>19</sup> in DSD patients and widely used today,<sup>20,21</sup> reduced the fistula rate at native meatus-proximal pars fixa urethra (PPFU) site. Rohrmann and Jakse<sup>22</sup> compared the use of only labial flaps versus only anterior vaginal wall flaps and experienced high fistula rates in both subgroups. Cohen et al<sup>23</sup> robotically harvested gracilis flap and used split gracilis muscle to both fill the vaginectomy cavity and waterproof the urethral sutureline and reported no fistulae in 16 transmen. Most publications continue to report a high incidence of urinary complications<sup>11-14</sup> such as strictures in the range of 25 to 58% and fistulae 17 to 75%. This is not surprising since, while normal female urethra is around 4 cm long, the male urethra ranges from 15 to 29 cm (average 22.3 cm).<sup>24</sup> In addition to the significant lengthening, a transmasculine urethra has two angulations/junctions at native female urethra/PPFU as well as DPFU/ penile urethra sites, predisposing these to stricture with or without proximal fistulation/diverticulation. In addition, a prelaminate/grafted urethra may be prone to strictures, when compared with tube in tube urethra, which has a more reliable and consistent vascularity. Most of these strictures in authors experience occurred at DPFU/penile urethra anastomotic site. Despite using a 2 to 4 cm longer urethral segment in penile flap, compared with the penile body segment, there was often undesirable tension in DPFU/penile urethra anastomosis. Therefore, the authors devised above-described novel method to extend the pars fixa urethra by 3 to 5 cm (→ Fig. 7), anterior to normal location of glans clitoris, thus improving the last mile connectivity and eliminating anastomotic tension at this site. Djordjevic<sup>25</sup> does use the dorsal clitoral skin in hormonally enlarged clitoris (based on external pudendal vessels) in addition to distally based bilateral labia minora flaps for construction of pendular urethra in cases of metoidioplasty and musculocutaneous latissimus dorsi phalloplasty, but these flaps are completely different to above-described flap. In prelaminate flaps, the penile urethral segment may be prone to strictures, while a tube-in-tube urethra nearly never develops a stricture. This may be

the reason, that though there is a statistically significant reduction in stricture rate with the use of urethral lengthening technique in both rRAFFp and pALTp groups, it is less striking in the case of pALTp, as the new technique has no impact on penile urethral strictures.

## Conclusions

Authors found a high rate of urinary complications such as stricture and fistulae in patients undergoing MgGAS. Hence, they modified their technique to increase the length of pars fixa urethra distally by around 3 to 5 cm compared with previous technique. This was achieved by tubularization of all available glabrous skin anterosuperior to clitoris, which includes dorsal clitoral skin and all glabrous skin between labia majora and anterior commissure. As a result, the new urinary meatus lies closer to pubic symphysis. Therefore, at the time of staged phalloplasty, there is a decrease in anastomotic tension between pars fixa and pendular urethra. By improving the last mile connectivity in their later cohort of patients, authors found a significant decrease in the rates of complications such as urinary stricture and fistulae when compared with the earlier cohort.

### Earlier Presentation:

Partially presented in the Webinar on masculinizing genitoplasty in patients with gender incongruence for ISRM Micro Vidyalaya on 25th August 2020.

### Institutional Review Board

Approval was given for this study.

**Funding** No financial support or benefit has been received by any author.

### Conflict of Interest

There is no conflict of interest in respect to any author.

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