



Urethral outcomes in metoidioplasty and phalloplasty gender affirming surgery (MaPGAS) and vaginectomy: a systematic review

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Background: There is currently a paucity of data on urethral-related outcomes in metoidioplasty and phalloplasty gender affirming surgery (MaPGAS) with urethral lengthening (UL) and vaginectomy.

Methods: A systematic review was performed utilizing MEDLINE, Web of Science, Cochrane Library, Europe PMC, OSF Preprints, and EMBASE. Methodologic quality was scored using Methodological Index for Non-Randomized Studies (MINORS) criteria. Four independent reviewers performed the article evaluation, data extraction, and methodologic quality assessment. Primary outcomes included standing to urinate/pee (STP), penile length, glanular meatus, urethral stricture, fistula, and flap necrosis. Results were summarized qualitatively with descriptive statistics.

Results: A total of 2,881 articles of which 11 retrospective reviews of 13 cohorts met criteria; 4.3/16 average (avg) MINORS score. Six metoidioplasty cohorts had an average penile length of 6 cm, 74% reported successful STP, and a quarter developed stricture or fistula. Phalloplasty cohorts included radial forearm flap (RF) and Anterolateral Thigh flap (ALT). Of the 4 RF studies nearly a third developed a stricture or fistula and only one study reported 99% STP with a glanular meatus. Three ALT studies reported no length but had 80–90% STP with a glanular meatus and a quarter with stricture or fistula.

Conclusions: Urethral complications in MaPGAS-UL in a cohort with prior vaginectomy are common and variably reported. Patient centered outcome measures as well as clearly defined outcome metrics created in partnership with community members are needed.

Keywords: Systematic review; metoidioplasty; phalloplasty; transgender; urethral stricture

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Introduction

Metoidioplasty and phalloplasty gender affirming surgeries (MaPGAS) are increasingly utilized by transgender men and non-binary individuals assigned female at birth to address incongruence between gender identity and anatomy (1). Standing micturition, or standing to pee (STP) through a penis is frequently desired and needed by this cohort which requires urethral lengthening (UL) from the natal meatus to the glans (2,3). Metoidioplasty with UL is performed following testosterone supplementation with a hypertrophied clitoris using local genital flaps with or without supplemental grafts (4,5). Phalloplasty utilizes a free or pedicled flap, most commonly, the radial forearm (RF) and anterolateral thigh (ALT) and UL is performed by creating the pars fixa (PF), from labia minora flaps, and pars pendulans (PP) urethra, a tubularized component of the skin flap, simultaneously or in stages (6).

MaPGAS-UL are complex and may be associated with urethral strictures and/or fistulas that may require unplanned surgical procedures, adding to patient cost, morbidity, and experienced trauma (7). Increasingly, vaginectomy is performed simultaneously or prior to UL to not only reduce gender dysphoria but also urethral complications (8). True rates of urethral complications are difficult to extrapolate from the literature due to varied surgical techniques, lack of standard definitions, and study heterogeneity, often including mixed vaginectomy and urethral lengthening cohorts (7,9-12). A systematic review by Frey *et al.* from 2016 analyzed 17 papers: 6 on metoidioplasty and 11 on RF, stricture and fistula rates were combined and wide ranging with 0–73% for metoidioplasty and 20–80% for RF. Importantly, this review revealed high combined urethral stricture and fistula rates in heterogeneous cohorts including those with and without vaginectomy and UL (13). The purpose of this review is to evaluate urethral related outcomes in a homogeneous cohort of individuals post vaginectomy undergoing MaPGAS-UL. We present the following article in accordance with the PRISMA reporting checklist (available at <https://tau.amegroups.com/article/view/10.21037/tau-22-174/rc>) (14).

Methods

Utilizing standard Cochrane methodology and Population, Intervention, Comparison, Outcome, and Study type (PICOS) criteria (15), we developed a protocol to inform systematic review of urethral-related outcomes following

metoidioplasty and phalloplasty with UL after vaginectomy which was registered a priori on the PROSPERO International Prospective Register of Systematic Reviews (PROSPERO 2020 CRD42020197778 https://www.crd.york.ac.uk/prospere/display_record.php?ID=CRD42020197778).

Inclusion criteria

The population of interest included individuals greater than 18 years of age undergoing MaPGAS-UL who were assigned female at birth. Study types included all published English language case series, cohort studies, retrospective reviews, prospective studies, and randomized controlled trials. The intervention was defined as MaPGAS-UL with prior or concomitant vaginectomy including metoidioplasty or the most commonly performed types of phalloplasty [radial forearm (RF); and anterolateral thigh (ALT) flaps]. Given the heterogeneity and lack of randomized controlled trials in the published literature, no comparator was identified.

Exclusion criteria

Studies including combined or unclear urethral-related outcomes, combined vaginectomy and non-vaginectomy cohorts, combined phalloplasty cohorts with and without implanted penile prosthesis, cisgender outcomes, and uncommonly reported surgical techniques (pre-laminated urethral construction or combination flaps) were eliminated. Additionally, studies were excluded with overlapping cohorts or those from a single institution with overlapping dates of inclusion.

Outcome measures

Primary outcomes of interest included: Urethral strictures and fistulas, penile length, STP, glanular meatus, and number of planned surgeries. Secondary outcomes of interest included wound complications (including surgical site infection), hematoma, dehiscence, pelvic mucocele following vaginectomy, and flap necrosis (phalloplasty) (2). As there are no validated definitions or metrics for many of the outcomes of interest in this population, outcomes were included if reported by the author.

Data sources and search strategy

The systematic review was registered with the Open Science

Framework Registry, July 8, 2020 (<https://osf.io/e3vyx>). Two biomedical librarians (PB, HB) were involved in the search design and implementation. Search sources and databases included MEDLINE; Cochrane Library; Web of Science; EMBASE; OSF Preprint; Google Scholar; Trial Registries; and Conference Proceedings (for unpublished abstracts). An exhaustive list of MeSH terms and key words were utilized to develop the search strategy (see [Table S1](#)).

Study selection

Protocol inclusion and exclusion criteria validity was tested with 100 articles and found to be nearly 100% concordant amongst the independent reviewers in Rayyan QCRI software (16). After duplicate article titles and abstracts were removed, four independent reviewers (ED, GB, RM, CO) narrowed the preliminary article yield within the Rayyan software using inclusion and exclusion markers. The 75 full-text articles for the initial search results were then divided alphabetically amongst the four reviewers (~20 articles per reviewer). Selected articles and discrepancies were reviewed in a series of web-based review sessions by the 4 reviewers with a fifth content expert (MC) to resolve conflicts. All studies meeting inclusion criteria with the outcomes of interest were selected for final review.

Data extraction

Extracted data included: author, publication date (published literature from all available dates on the respective search sources), study design, sample size, age, length of follow up, type of surgical procedure performed, penile length, and number of planned surgical stages. Additionally, rates of aesthetic satisfaction, STP, glanular meatus, urethral stricture, urethral fistula, and wound complications were extracted. Data extraction from all included articles was completed in collaboration by two reviewers (CO, RM) by direct data collection from primary manuscripts and all available supplementary material.

Methodological quality/bias assessment

Given the lack of prospective studies and high risk of publication bias within this field, study quality was assessed using the Methodological Index for Non-Randomized Studies (MINORS) criteria (17). Scoring for non-randomized studies and non-comparative studies includes eight questions with a score of 0–2 (0 = “not reported”; 1 =

“reported but inadequate”; 2 = “reported and adequate”). The scores are summarized for a composite score of 0–16 (16 = highest quality study). Disagreements were discussed amongst reviewers until consensus was reached.

Statistical analysis

Descriptive statistics were used to summarize the data including mean values for age and length of follow up. Proportions of outcomes reported by each article were included and averaged if more than one study reported on the outcome for metoidioplasty and phalloplasty subtypes.

Results

The search strategy yielded 2,881 articles, of which 1,790 remained after duplicates were removed. Title and abstract review led to full text review of 75 articles. Eleven articles met inclusion criteria (4,5,8,18-26). All eleven were retrospective reviews. Based on the design and heterogeneity of the included studies, a meta-analysis was not performed (see [Figure 1](#) for the full PRISMA diagram).

Metoidioplasty outcomes

A total of 6 studies that reported on metoidioplasty met inclusion criteria (5,8,24-27), with an average participant age of 34 (± 4) and average follow up of 31 months ([Table 1](#)). All reported cases were performed in a single stage. The average stricture and fistula rates were 25% (1.4% to 63%) and 21% (8% to 50%). Three studies reported average penile length (5.6 to 7 cm) (8,24,27); 2 reported STP average of 74% (48% to 100%) (5,27); and average wound complications of 63% (27% to 100%) (5,25).

Radial forearm flap (RF)

Four studies met inclusion criteria for RF phalloplasty with UL, the majority being single stage average follow up ranging 6 to 23 months ([Table 2](#)). All studies reported rates of wound complications, average 8% (2% to 14%), urethral strictures 32% (11% to 81%), and urethral fistulas, 36% (10% to 79%) (19,22,23). Glanular meatus was reported by 3 of the studies, 99% (70% to 100%) and STP was reported in 1 study (99%) (23). Average penile length was not clearly reported by any included study and only 2 studies reported flap necrosis, 12% (10% to 21%) (19,22).

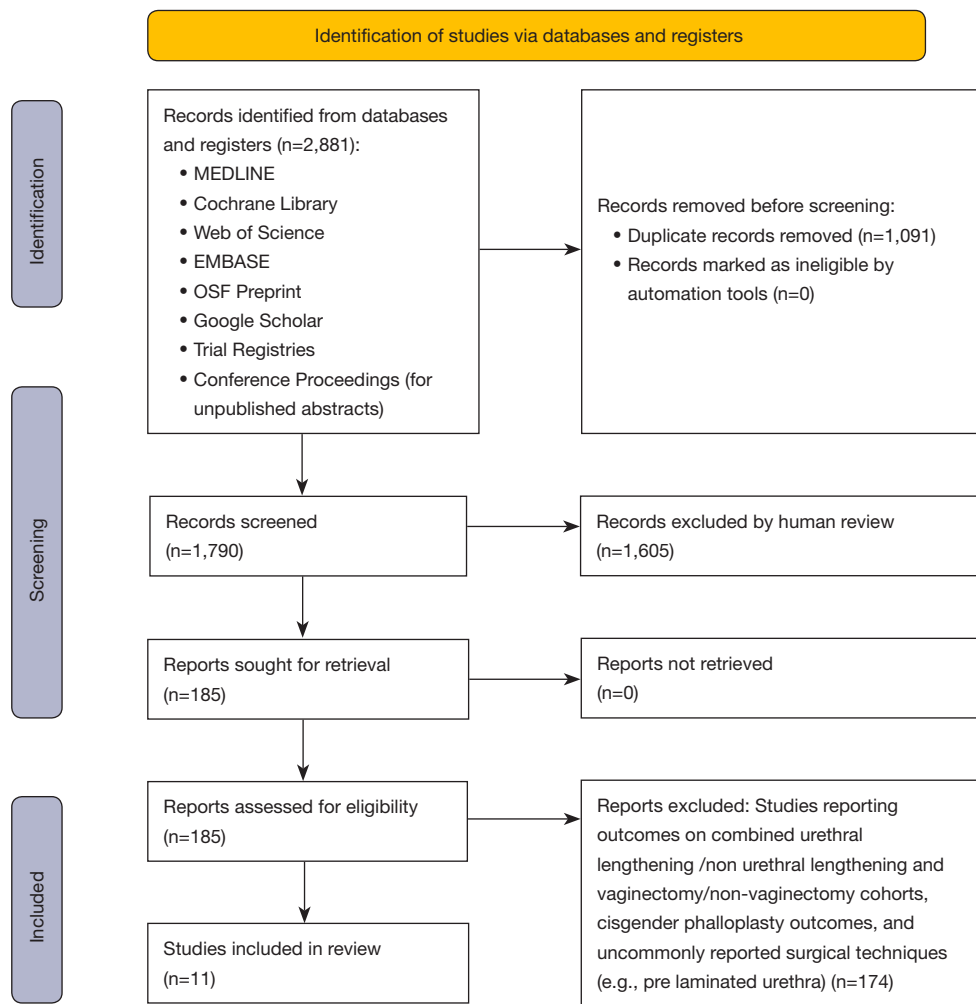


Figure 1 PRISMA 2020 flow diagram for new systematic reviews which included searches of databases and registers.

Table 1 Outcomes of metoidioplasty with urethral lengthening gender affirming surgery

First author	Publication year	N	LOF (m)	One stage, n (%)	Standing to pee, n (%)	Phallic length, Avg cm [SD]	Wound complication, n (%)	Stricture, n (%)	Fistula, n (%)	Mucocele, n (%)
Al-Tamimi	2018	12	24	NR	NR	7 [5–10.5]	NR	NR	1 (8%)	NR
Bizic	2019	793*	NR	793 (100%)	793 (100%)	5.6 [4–10]	NR	11 (1%)	70 (9%)	**96 (12%)
Perovic	2003	22	48	22 (100%)	NR	5.7 [4–10]	NR	2 (9%)	3 (14%)	NR
Takamatsu	2009	33	30	33 (100%)	16 (48%)	NR	9 (27%)	6 (18%)	14 (42%)	NR
Van de Grift	2017	2	32	2 (100%)	NR	NR	2 (100%)	2 (33%)	0 (0%)	NR
Veerman	2020	8	23	NR	NR	NR	NR	5 (63%)	4 (50%)	1 (1%)
***Avg		146	28	81%	74%	6	63%	25%	21%	6%

*, 791 or >99% had colectomy; **, two patients in series had no vaginectomy performed; ***, Avg of reported study outcomes. NR, not reported; LOF, length of follow up; mo, months; Avg, average; SD, standard deviation.

Table 2 Outcomes of phalloplasty with urethral lengthening gender affirming surgery

First author	Publication year	N	One stage, n (%)	LOF (mo)	Standing to pee, n (%)	Glanular meatus, n (%)	Avg phallic length, cm (range)	Overall complication, n (%)	Wound complication, n (%)	Stricture, n (%)	Fistula, n (%)	Mucocele, n (%)	Flap necrosis, n (%)
RF													
Ascha	2018	149	149 (100%)	6	NR	149 (100%)	NR	47 (32%)	12 (8%)	35 (23%)	15 (10%)	NR	5 (3%)
Fang	1994	**28	28 (100%)	NR	NR	NR	NR	28 (100%)	4 (14%)	4 (14%)	22 (79%)	NR	6 (21%)
Garaffa	2010	*84	0 (0%)	26	83 (99%)	83 (99%)	NR	31 (37%)	2 (2%)	9 (11%)	20 (24%)	NR	NR
Veerman	2020	27	22 (81%)	23	NR	NR	NR	NR	NR	22 (81%)	8 (30%)	NR	NR
***Avg%		72	94%	14	99%	99%	NR	53.3%	8%	32%	36%	NR	12%
ALT													
Ascha	2018	64	64 (100%)	*6	NR	NR	NR	28/64 (43%)	11 (17%)	17 (27%)	14 (22%)	NR	5 (8%)
Al-Tamimi	2020	16	4 (25%)	14	9 (56%)	12 (75%)	NR	NR	NR	6 (38%)	4 (25%)	NR	2 (13%)
D'Arpa	2019	5	5 (100%)	87	5 (100%)	5 (100%)	NR	2/5 (40%)	NR	1 (20%)	1 (20%)	NR	NR
***Avg %		28	75%	36	78%	88%	n/a	41%	17%	28%	22%	NR	10%

*, 84 of 115 with UL; **, 28 of 56 with standard tube in tube skin radial forearm flap; ***, Avg of reported outcomes. UL, urethral lengthening; NR, not reported; n/a, not available; RF, radial forearm flap; ALT, anterolateral thigh flap; LOF, length of follow up; mo, months; Avg, average.

Anterolateral thigh flap (ALT)

Three studies reported on ALT, with an average follow up of 36 months and a majority undergoing a single stage procedure (Table 2) (18,19,21). All studies reported rates for STP, average 78% (56% to 100%), glanular meatus, 88% (75% to 100%), urethral stricture 28% (20% to 38%), and fistula 22% (20% to 25%). Flap necrosis was reported by two studies 10% (8% to 13%) (18,21).

Methodologic quality analysis

Table 3 lists the MINORS Criteria scoring for the included studies. Overall scores ranged from 2 to 6 out of 16, with an average score of 4.2.

Discussion

This is the first comprehensive systematic review of urethral

related outcomes following MaPGAS-UL including metoidioplasty and phalloplasty with vaginectomy. All included articles were limited by methodologic quality and the majority were published after 2000, suggesting the 216 relative infancy of the published literature from this surgical field. We found variable, but high rates of STP for metoidioplasty (74%) and phalloplasty (95%). Despite a homogeneous, post-vaginectomy cohort, urethral-related complications remained high, occurring in >25%.

Standing to Pee (STP)

Listed as one of Hage *et al.*'s major criteria for perceived MaPGAS-UL success (2), STP was only reported by half of included studies. Although penis length for metoidioplasty is typically much shorter than phalloplasty, the average rates of STP after metoidioplasty were very high, largely due to the series from Bizic *et al.* reporting 100% STP in 793 cases (27). In contrast, Takamatsu *et al.* found a much

Table 3 Methodologic quality review using the MINORS criteria

Study author	Year	Aims clear	Consecutive patients	Prospective data collection	Appropriate endpoints	Unbiased endpoint assessment	Appropriate follow-up	Loss to follow-up <5%	Prospective study size calculation	Total score
Al-Tamimi	2018	1	0	0	1	1	2	0	0	6
Bizic	2019	2	0	0	1	1	0	0	0	4
Perovic	2003	1	0	0	1	0	1	0	0	3
Takamatsu	2009	1	0	0	1	1	1	0	0	4
Van de Grift	2017	1	0	0	1	1	2	0	0	5
Veerman	2020	2	0	0	1	1	2	0	0	6
Ascha	2018	1	0	0	1	1	1	0	0	4
Garaffa	2010	0	0	0	1	1	1	0	0	3
Fang	1994	0	0	0	1	1	0	0	0	2
D'Arpa	2019	1	0	0	1	0	2	0	0	4
Al-Tamimi	2019	1	0	0	1	1	2	0	0	5

lower rate of STP (less than half of their cohort) (5). This may have been impacted by patient selection (i.e., degree of preoperative clitoral hypertrophy and patient body habitus), surgeon experience, and differing metoidioplasty techniques. For example, an author utilized erectile body (clitoral) suspensory ligament release in addition to extensive chordee release which may have contributed to differences in estimated length (27). It is unclear if length was measured intraoperatively, on or off stretch, before or after penis skin reconstruction.

Although STP, glanular meatus, and penile length were not reported in several of the phalloplasty studies, RF had the highest STP proportions. In contrast, overall ALT STP rates were much lower, perhaps due to lower rates of glanular meatus in the Al-Tamimi study (8), as well as a generally higher rate of urethral complications seen in non-RF phalloplasty (6,19). In contrast, the Al-Tamimi study also had a higher rate of staged phalloplasty, yet a lower rate of STP. This variation may be due to reporting STP at different times and perhaps prior to completion of all the urethral surgical stages.

Urethral stricture and fistula

Urethral stricture and fistula rates were wide ranging and heterogeneous for both metoidioplasty and phalloplasty.

The average rates among the studies included were lowest for metoidioplasty at ~25% (range 1% to 63%). The wide variation amongst reporting studies was likely due to the heterogeneity of surgical technique and lack of standardized follow up. Interestingly, this was similar to the review by Frey *et al.* (13) yielding an average of 27% stricture and fistula rate despite a cohort post vaginectomy. This may be attributed to inherent risks associated with urethral lengthening.

Similarly, the average stricture and fistula rates for phalloplasty were wide ranging however were lower at around 30% as compared to a combined average of 51% in the Frey *et al.* study (13). Perhaps this relates to inclusion of only post vaginectomy cohorts. Not surprisingly, urethral complications were lower for the metoidioplasty cohort. Likely due to the use of smaller local tissue flaps that do not rely on blood supply from vascular anastomoses, as in the case of phalloplasty (6,7). Notably, the definition, diagnosis, severity, and treatment of strictures and fistulas were not apparent in the majority of included studies nor was management strategy, therefore, the reported rates may be underestimated within these cohorts.

Wound complications

There were more frequent and varied wound complications

reported in the metoidioplasty studies (~63%) than in phalloplasty (~12%). This may have been due to wider inclusion of both operative and non-operative wound complications for metoidioplasty and differing follow up rates. Mucocele rates were primarily reported by the metoidioplasty studies (12%), though there was a lack of standard follow up and clarity of modality for mucocele diagnosis. Despite varying inherent ischemia risk (6,19), as well as varying stricture and fistula rates, the average proportion of phalloplasty necrosis reported was similar amongst the RF and ALT studies (~10%). Further refinement in definition of ischemia is required since partial and total flap necrosis were often not differentiated and inconsistently reported.

Limitations in study design and outcomes reporting

Designing a prospective, comparative study for MaPGAS is difficult due to the nature of reconstructive surgical procedures, limited volumes, and lack of surgical equipoise (28). This inherently limits the methodologic quality of the small number of heterogenous studies evaluated in this review—as reflected in the uniformly low MINORS scores (*Table 1*). Although the number of MaPGAS surgeries continues to increase (1), they are primarily performed at a handful of established centers which allows for surgeon- and site-related bias. For example, in the metoidioplasty data there were in total 870 unique patients identified and 793 (91%) were from a single center (*Table 1*). These limitations are likely related to the relatively recent emergence of wide-spread access to and funding for MaPGAS with small cohorts and evolving surgical technique throughout study periods. Follow-up times were variable and short in many of the studies, and in those with longer follow-up there was limited clarity about true loss to follow-up. Further, it is unclear if rates of complications changed based on surgeon experience in these large single center series.

A major limitation for MaPGAS is the lack of standardized outcomes definitions. For example, one could theoretically define STP simply as not sitting on a toilet. This definition would thus include leaning or squatting over a toilet undressed or using a hand assisted device, either of which could be accomplished with the natal female urethra. The mechanism for urethral stricture diagnosis was not included in the majority of studies (e.g., patient report,

uroflowmetry, endoscopy, imaging). Additionally, the location and length of the stricture or what management was required were not described. As such, urethral strictures that did not require operative, subspecialty care at the reporting institution may not have been included. Similarly, wound complications were infrequently defined and perhaps not reported if they did not require operative interventions. Taken together, perhaps the most accurate assessment of post vaginectomy MaPGAS-UL complications is that they are “common,” but uncommonly reported.

Future directions

With increasing demand for MaPGAS, and a relatively small community of surgeons to provide these services, surgeon and community stakeholder cooperation is imperative. Efforts must be directed to understanding what patients perceive are the aesthetic and functional characteristics of the “ideal” penis sought through MaPGAS to develop relevant patient reported outcomes. Incorporating these measures along with dissemination of this data will help to improve surgical outcomes, patient experience, and shared decision making. Until a more standardized follow-up and defined outcomes metrics are available, it is necessary to accept that MaPGAS carry high complication rates that are likely underreported. An open discussion between providers and patients on our limited knowledge of the true MaPGAS outcomes will help support and inform patients in their decision making.

Conclusions

Urethral complications in MaPGAS-UL in a cohort with prior vaginectomy are common and variably reported. This review highlights the limitations of currently published data for MaPGAS outcomes, strengthening the call for a standardized method of evaluation and a continued open exchange of technical skill and outcomes information. Patient centered outcome measures as well as clearly defined outcome metrics created in partnership with community members are needed as the field of MaPGAS continues to expand and evolve.

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Footnote

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Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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