

Complications and Patient-reported Outcomes in Transfemale Vaginoplasty: An Updated Systematic Review and Meta-analysis

Samyd S. Bustos, MD*
 Valeria P. Bustos, MD†
 Andres Mascaro, MD‡
 Pedro Ciudad, MD, PhD§
 Antonio J. Forte, MD, PhD¶
 Gabriel Del Corral, MD, FACS||
 Oscar Javier Manrique, MD,
 FACS**

Background: Vaginoplasty aims to create a functional feminine vagina, sensate clitoris, and labia minora and majora with acceptable cosmesis. The upward trend in the number of transfemale vaginoplasties has impacted the number of published articles on this topic. Herein, we conducted an updated systematic review on complications and patient-reported outcomes.

Methods: A update on our previous systematic review was conducted. Several databases including MEDLINE, EMBASE, Cochrane Central Register of Controlled Trials, Cochrane Database of Systematic Reviews, and Scopus were assessed. Random effects meta-analysis and subgroup analyses were performed.

Results: After compiling the results of the update with the previous systematic review, a total of 57 studies pooling 4680 cases were included in the systematic review, and 52 studies were used in the meta-analysis. Overall pooled data including any surgical technique showed rates of 1% [95% confidence interval (CI) <0.1%–2%] of fistula, 11% (95% CI 8%–14%) of stenosis and/or strictures, 4% (95% CI 1%–9%) of tissue necrosis, and 3% (95% CI 1%–4%) of prolapse. Overall satisfaction was 91% (81%–98%). Regret rate was 2% (95% CI <1%–3%). Average neovaginal depth was 9.4cm (7.9–10.9cm) for the penile skin inversion and 15.3cm (13.8–16.7cm) for the intestinal vaginoplasty.

Conclusions: Transfemale vaginoplasty is a key component of the comprehensive surgical treatment of transfemale patients with gender dysphoria. Over time, we will see an increased demand for these procedures, so adequate surgical training, clinical/surgical experience, and research outcomes are required, as we continue to strive to provide the best care possible for a population in need. (*Plast Reconstr Surg Glob Open* 2021;9:e3510; doi: [10.1097/GOX.0000000000003510](https://doi.org/10.1097/GOX.0000000000003510); Published online 19 March 2021.)

From the *Department of Plastic Surgery, University of Pittsburgh, Pittsburgh, Pa.; †Division of Plastic and Reconstructive Surgery, Beth Israel Deaconess Medical Center, Harvard Medical School, Boston, Mass.; ‡Department of Plastic and Reconstructive Surgery, Cleveland Clinic, Weston, Fla.; §Department of Plastic, Reconstructive and Burn Surgery, Arzobispo Loayza National Hospital, Lima, Peru; ¶Division of Plastic and Reconstructive Surgery, Mayo Clinic, Jacksonville, Fla.; ||Department of Plastic and Reconstructive Surgery, MedStar Georgetown University Hospital, Washington, D.C.; and **Division of Plastic and Reconstructive Surgery, University of Rochester Medical Center, Strong Memorial Hospital, Rochester, N.Y.

Received for publication August 7, 2020; accepted January 25, 2021.

This is an invited article for the transgender mini-series.

Copyright © 2021 The Authors. Published by Wolters Kluwer Health, Inc. on behalf of The American Society of Plastic Surgeons. This is an open-access article distributed under the terms of the [Creative Commons Attribution-Non Commercial-No Derivatives License 4.0 \(CCBY-NC-ND\)](https://creativecommons.org/licenses/by-nc-nd/4.0/), where it is permissible to download and share the work provided it is properly cited. The work cannot be changed in any way or used commercially without permission from the journal.

DOI: [10.1097/GOX.0000000000003510](https://doi.org/10.1097/GOX.0000000000003510)

INTRODUCTION

Transgender is a term that includes the many ways that people's gender identities can differ from the sex they were assigned at birth. Unfortunately, the transgender population has largely suffered from transgender-related discrimination in healthcare and employment, and from high rates of mental illness, particularly anxiety and depression, in addition to violence and health-related problems.^{1,2} This population expresses their gender identity in many different ways. Some use their dress or behavior (gender expressions) to live as the gender that feels appropriate for them, and many undergo medical or surgical treatment to change their body, so that it matches their gender identity. Surgical treatment, particularly

Disclosure: The authors have no financial interest to declare in relation to the content of this article. All authors have completed the ICMJE uniform disclosure form.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

genital or bottom surgery, is often the last and most considered step for transgender patients.³ The role of surgery has shown to be essential and medically necessary to alleviate patients' gender dysphoria, which is the distress caused by the discrepancy between a person's gender identity and the sex assigned at birth.⁴⁻¹⁰

For transgender women, genital surgery involves vaginoplasty, which entails the surgical reconstruction of all the anatomical structures of the female external genitalia and the creation of a functional vaginal canal. The Standards of Care from the World Professional Association for Transgender Health clearly defines the criteria for vaginoplasty in transfemale patients, which includes the following: persistent, well-documented gender dysphoria, capacity to make a fully informed decision and to consent for treatment, age of majority, control of significant medical or mental health concerns, 12 continuous months of hormonal therapy as appropriate, and 12 continuous months of living in a gender role that is congruent with their gender identity.³

In general, vaginoplasty aims to create a functional feminine vulva, a deep and wide enough vagina, a hooded sensate clitoris, and labia minora and majora with acceptable cosmesis and sexual sensation. A number of surgical techniques have been described; however, the most commonly used technique is still the penile skin inversion with or without skin graft. Although less common, intestinal-based techniques, including colon or small bowel conduits, have also been reported. These may have specific indications; for instance, patients with micropenis, penile hypoplasia (<8 cm), or poor skin quality or elasticity due to prolonged hormonal treatment may not be suitable for penile skin inversion and other options such as intestinal conduits may be more appropriate.^{11,12}

Although there are still financial and social barriers to healthcare access for this particular population worldwide, the need for surgical gender-affirming care is increasing remarkably. This may be explained due to increased awareness of the needs of transgender and gender-nonbinary (TGNB) patients, and availability and accessibility to gender care centers. In 2015, the US Transgender Surgery sampled over 27,000 TGNB Americans and found that one fourth had undergone one or more gender affirmation surgeries (GAS).^{13,14} A total of 12% of respondents had undergone vaginoplasty and/or labiaplasty, and 54% responded they wanted to have it someday. Therefore, both academic and private centers are facing an increased demand for transfemale vaginoplasty.

The need of a state-of-the-art review on surgical and patient-reported outcomes has been previously addressed by Manrique et al.⁵ However, this upward trend in gender affirmation surgeries has also impacted the number of published articles on this topic over the past years about this surgical procedure. In this study, we aim to conduct an updated, comprehensive systematic review of the literature of papers in transfemale vaginoplasty with meta-analysis of complications and patient-reported outcomes.

METHODS

Search Methodology

Based on the PRISMA guidelines, a comprehensive research of several databases from each database's inception was conducted on July 15, 2020.¹⁵ The databases included PubMed, Ovid MEDLINE Epub Ahead of Print, Ovid Medline In-Process and Other Non-Indexed Citations, Ovid MEDLINE, Ovid EMBASE, Web of Science, and Ovid Cochrane Central Register of Controlled Trials. A comprehensive research strategy using the same strategy from our previous study was conducted.⁵ This was previously designed and conducted by experienced librarians with input from the study's principal investigator. Controlled vocabulary with keywords was conducted to update the previous search and include studies from 2017 to 2020 of vaginoplasty in transgender and nonbinary population who reported our outcomes of interest.

The search terms were formulated using the PICO structure. Participants included transfemale patients. The intervention was vaginoplasty, bottom male-to-female surgery, or transfemale genital surgery. Comparisons addressed the specific technique used. Outcomes included complications, functional or aesthetic patient-reported outcomes. The strategy is available in **Supplemental Digital Content 1. (See pdf, Supplemental Digital Content 1, which displays the search strategies, <http://links.lww.com/PRSGO/B611>.)** All search results were combined in EndNote, a bibliographic management tool, and duplicates were removed.

Study Selection

We conducted a 2-stage screening process with the help of the online software Covidence.¹⁶ Search strategy results were exported from EndNote into XML format and uploaded to Covidence.¹⁶ Two researchers (S.S.B and V.P.B) conducted the first screening by reviewing titles and abstracts, and selected the ones relevant to the research question. Then, the second screening was conducted by the same researchers reviewing the full-text form of the remained articles. The studies included were those that met the inclusion and exclusion criteria. Conflicts in this stage were solved by a third reviewer (O.J.M.), who moderated a discussion and made final decision. Eligible criteria were based on our previous systematic review and meta-analysis by Manrique et al.⁵ Inclusion criteria were all articles that included studies with sample size more than 5 patients, only transfemale vaginoplasty procedures studied, publication year 1985 or more, articles reporting at least 1 outcome measurement, and a follow-up time of at least 1 year. The exclusion criteria were all studies with surgical techniques for partial reconstruction of the vagina or vaginoplasty corrections, surgical techniques only for the creation of neoclitoris or labiaplasty, and unspecified surgical technique, non-English publications, cancer-related publications, trauma-related publications, and congenital-related publications.

Data Extraction and Synthesis

The included studies were analyzed in detail. We extracted information regarding the name of the first

author, year of publication, and follow-ups time (minimum, maximum, and SDs variables). Major complications categorized as fistulas, vaginal and urethral stenosis and strictures, tissue necrosis, and prolapse were

identified. For fistulas outcomes, vaginorectal and vesicovaginal fistulas were included. Stenosis and strictures outcomes included introital, stroma, urethral, and vaginal. Both partial and complete strictures were taken into

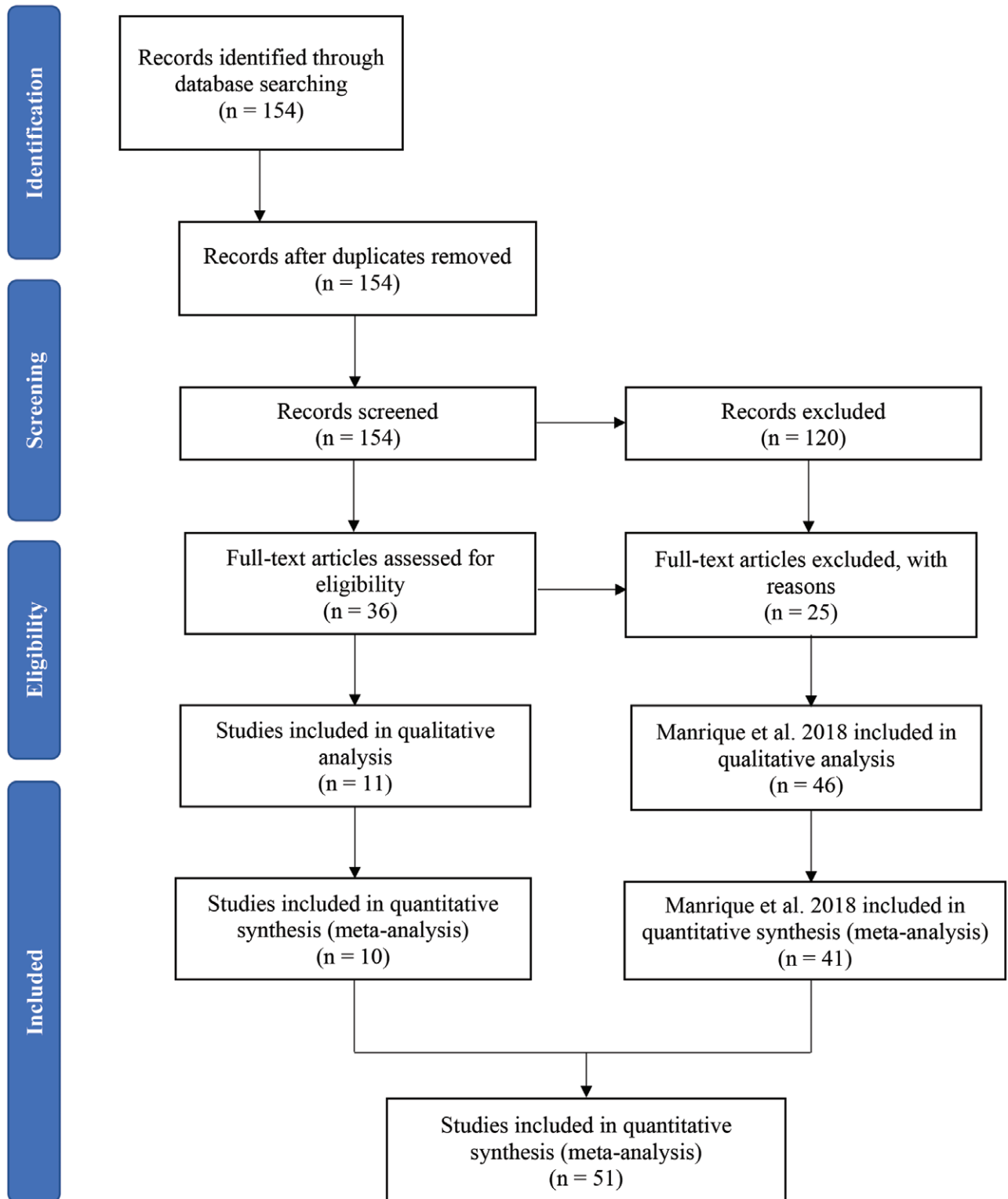


Fig. 1. PRISMA flowchart.

account. The tissue necrosis outcome included necrosis of the urethra, glans, clitoris, and labia. Rectocele, urethral, or mucosal prolapse was included in the prolapse outcome.

Patient-reported outcomes were analyzed as proportions and percentages. Overall results, function, and aesthetic satisfaction outcomes were identified as the number of patients who reported such variables. Aesthetic outcome included perception of vaginal appearance as feminine. Satisfied included “very satisfied” and “mostly satisfied” in the included studies.

The ability to have orgasm, regret rate, and the patient-reported outcomes were analyzed as proportions and percentages. In addition, we extracted information about the vaginal cavity length, its mean, minimum and maximum values, and SD.

Quality Assessment

The Newcastle-Ottawa Scale was used to assess quality of nonrandomized studies in meta-analyses was used to assess the risk of bias in the included studies. A nonrandomized study can be ranked 9 stars on items related to: the selection of the study groups (4 points), comparability of the exposed and unexposed groups (2 points), and the ascertainment of outcomes of interest (3 points).

Statistical Analysis

The data were analyzed, and outcome estimations in this meta-analysis were conducted in Stata Software/IC (version 16.1).¹⁷ We divided the studies in 2 major groups of interest: penile inversion technique and intestinal vaginoplasty. Given the heterogeneity between studies, we conducted a logistic-normal-random-effect model. The study-specific proportions with 95% exact confidence intervals (CIs) and overall pooled estimates with 95% Wald CIs with Freeman–Turkey double arcsine transformation were performed. The effect size and percentage of weight were presented for each individual study. To evaluate heterogeneity, *I*² statistics was used. If *P* value <0.05 or *I*²>50% significant heterogeneity was considered.

RESULTS

Study Selection

A total of 154 articles were identified in the updated search. The first screening process generated 36 articles, and the second screening yielded 11 articles, which were included in the systematic review and meta-analysis. We compiled these data to the one of the previous systematic review and meta-analysis of Manrique et al⁵ as shown in **Figure 1**. A total of 57 studies were included in the systematic review and 52 in the meta-analysis. All included studies were assigned either a low- or moderate-quality design. (See pdf, Supplemental Digital Content 2, which displays the quality assessment of included studies, <http://links.lww.com/PRSGO/B612>.)

Study Characteristics

A total of 4680 cases were represented in this systematic review. A total of 39 (75%) studies used the penile

Table 1. Study Characteristics

Authors	Year of Publication	No. Cases	Mean Follow-up (mo)	Reported Complication Outcomes
Amend	2013	24	41.0	Y
Goddard	2007	233	1.9	Y
Hess	2014	119	62.6	N
Krege	2001	66	NS	Y
Perovic	2000	89	56.0	Y
Reed	2011	250	NS	Y
Rossi	2012	332	24.3	Y
Kim	2003	28	60.8	Y
Djordjevic	2011	27	47.7	Y
Wu	2009	11	14.2	Y
Zhao	2011	19	35.1	Y
Bouman	2016	42	3.2	Y
Lenaghan	1997	59	NS	Y
Morrison	2015	83	2.2	Y
van der Sluis	2016	24	289.6	Y
Rehman	1999	57	0.1	N
Jarolim	2009	134	NS	Y
Hage	1996	60	9.6	Y
van Noort	1993	16	16.6	Y
Huang	1994	121	NS	Y
Bouman	1988	67	NS	Y
Fang	1991	9	NS	Y
Eldh	1993	20	NS	Y
Buncamper	2015	49	49.9	Y
LeBreton	2016	28	14.6	Y
Raigosa	2015	60	24.3	Y
Buncamper	2016	475	94.9	Y
Wangiraniran	2015	395	NS	Y
Sigurjonsson	2016	80	44.6	Y
Papdopulos	2017	47	19.3	N
Manrique	2018	15	146.0	N
Imbimbo	2009	139	NS	N
Namba	2007	7	NS	Y
Siemssen	1997	11	30.6	Y
Wagner	2009	50	36.5	Y
Blanchard	1987	22	53.5	N
Rubin	1993	13	3.5	Y
Small	1987	11	0.7	Y
Zavlin	2017	40	135.6	N
Stein	1990	14	22.1	N
Lindemalm	1986	13	14.1	N
Manrique	2019	40	12.4	Y
DiSumma	2019	38	NS	Y
Mukai	2019	18	NS	N
Ferrando	2020	76	12.0	Y
Levy	2019	240	2.9	Y
Kaushik	2019	386	34.0	Y
Nijhuis	2020	42	13.0	Y
Thalaivirithan	2018	30	18.0	Y
Seyed-Forootan	2018	24	36.0	Y
Gaither	2018	330	3.0	Y
Manero	2018	97	12.6	Y

N, no; NS, not specified; Y, yes.

skin inversion technique with or without scrotal flap^{18–54} and 11 (21.2%) studies used bowel pedicle flaps, of which 7 (13.5%) used sigmoid or rectosigmoid, 3 (5.8%) used ileal, and 1 (1.9%) used transverse colon as conduit.^{55–67} One study (1.9%) reported both techniques,⁶⁸ and another study (1.9%) reported outcomes using amnion grafts with and without fibroblasts.⁶⁹ A total of 3930 (84.0%) cases used the penile skin inversion technique with or without scrotal graft or skin graft, whereas 726 (15.5%) cases used bowel pedicle flaps. One study reported 24 (0.5%) vaginoplasty cases using amnion grafts. The average number of cases per study was 90 with the smallest study including 7 cases and the largest study including 475. **Table 2** shows the differences between the findings of our previous meta-analysis and the current study.

Table 2. Differences between the Previous and Current Metanalysis

		Manrique et al 2018	Current Study	Differences
Complications				
Fistula	Overall	2% (1%–6%)	1% (<0.1%–2%)	-1%
	PSI	1% (0%–4%)	1% (<0.1%–2%)	=
	IBV	6% (0%–20%)	2% (<0.1%–9%)	-4%
Stenosis and strictures	Overall	14 (10%–18%)	11% (8%–14%)	-3%
	PSI	13% (9%–18%)	10% (8%–14%)	-3%
	IBV	17% (10%–29%)	14% (5%–26%)	-3%
Tissue necrosis	Overall	1% (0%–6%)	4% (1%–9%)	+3%
	PSI	1% (0%–6%)	5% (1%–10%)	+4%
	IBV	NR	1% (<0.1%–9%)	—
Prolapse	Overall	4% (2%–10%)	3% (1%–4%)	-1%
	PSI	3% (1%–8%)	2% (1%–4%)	-1%
	IBV	8% (2%–43%)	6% (1%–14%)	-2%
Patient-reported outcomes				
Overall results	Overall	93% (79%–100%)	91% (81%–98%)	-2%
	PSI	91% (75%–100%)	87% (78%–94%)	-4%
	IBV	100% (96%–100%)	99% (97%–100%)	-1%
Function outcome	Overall	87% (75%–96%)	87% (77%–94%)	=
	PSI	88% (71%–99%)	87% (74%–96%)	-1%
	IBV	86% (75%–95%)	86% (75%–95%)	=
Aesthetic outcome	Overall	90% (79%–98%)	90% (84%–94%)	=
	PSI	91% (78%–99%)	90% (84%–95%)	-1%
	IBV	86% (69%–94%)	86% (69%–94%)	=
Ability to have an orgasm	Overall	70% (54%–84%)	76% (64%–86%)	+6%
	PSI	68% (52%–83%)	73% (60%–84%)	+5%
	IBV	89% (72%–96%)	95% (88%–99%)	+6%
Regrets	Overall	1% (<1%–3%)	2% (<1%–3%)	+1%
	PSI	2% (<1%–4%)	2% (<1%–4%)	=
	IBV	0%	0% (<1%–20%)	=
Vaginal cavity length				
	Overall	12.2 cm (10.2–14.2 cm)	10.9 cm (9.2–12.8)	-1.3 cm
	PSI	10.7 cm (8.8–12.5 cm)	9.4 cm (7.9–10.9)	-1.3 cm
	IBV	15.3 cm (14.3–16.4 cm)	15.3 cm (13.8–16.7 cm)	=

Data shown as pooled value and 95% confidence interval.

IBV, intestinal-based vaginoplasty; PSI, penile skin inversion; =, no change.

Complications

Overall pooled data including both surgical techniques showed the following complication rates: 1% (95% CI <0.1%–2%, $I^2 = 65.8%$) of fistula, 11% (95% CI 8%–14%, $I^2 = 87.3%$) of stenosis and/or strictures, 4% (95% CI 1%–9%, $I^2 = 94.3%$) of tissue necrosis, and 3% (95% CI 1%–4%, $I^2 = 77.2%$) of prolapse (Fig. 2).

Subgroup meta-analysis showed the following outcome complications for the penile skin inversion technique with or with our scrotal flaps: 1% (<0.1%–2%, $I^2 = 57.5%$) of fistula, 10% (8%–14%, $I^2 = 85.5%$) of stenosis and strictures, 5% (1%–10%, $I^2 = 93.9%$) of tissue necrosis, and 2% (1%–4%, $I^2 = 78.1%$) of prolapse. Complications for intestinal vaginoplasty were as follows: 2% (<0.1%–9%, $I^2 = 83.3%$) of fistula, 14% (5%–26%, $I^2 = 91.7%$) of stenosis and strictures, 1% (<0.1%–2%) of tissue necrosis in 1 study, and 6% (1%–14%, $I^2 = 76.4%$) for prolapse. Complications reported for the 2 surgical techniques had an I^2 value greater than 50% representing considerable heterogeneity.

Patient-reported Outcomes

Satisfaction rates were 91% (81%–98%, $I^2 = 94.8%$), 87% (77%–94%, $I^2 = 88.6%$), and 90% (84%–94%, $I^2 = 69.4%$) for overall, functional, and aesthetic outcomes, respectively (Fig. 3). For the penile skin inversion technique, patient-reported outcomes showed a satisfaction rate of 87% (78%–94%, $I^2 = 88.3%$) for overall satisfaction, 87% (74%–96%, $I^2 = 90.9%$) for functional outcomes, and 90% (84%–95%, $I^2 = 71.0%$) for aesthetic outcomes. For

the intestinal vaginoplasty technique, patient-reported outcomes showed a satisfaction rate of 99% (97%–100%) for overall satisfaction, 86% (75%–95%, $I^2 = 55.3%$) for functional outcomes, and 86% (69%–94%) for aesthetic outcomes.

Overall, the ability to achieve orgasm was 76% (64%–86%, $I^2 = 93.1%$). In the subgroup analysis, the ability to achieve orgasm was 73% (60%–84%, $I^2 = 92.8$) for the penile skin inversion technique and 95% (88%–99%) for intestinal vaginoplasty (Fig. 4).

The overall regret rate was 2% (95% CI <1%–3%, $I^2 = 0%$). The regret rate was 2% (95% CI <1%–4%, $I^2 = 0%$) for the penile inversion technique and <1% (95% CI <1%–20%) for the intestinal-based vaginoplasty group (Fig. 5).

Vaginal Cavity Dimensions

Fifteen studies reported vaginal cavity length (Fig. 6). The average neovaginal length for both surgical techniques was 10.9 cm (9.2–12.8 cm, $I^2 = 93.5%$). In the subgroup analysis, the average length was 9.4 cm (7.9–10.9 cm, $I^2 = 84.6%$) for the penile skin inversion technique and 15.3 cm (13.8–16.7 cm, $I^2 = 0.0%$) for the intestinal vaginoplasty group.

DISCUSSION

The gender confirmation process involves a comprehensive treatment program including endocrine therapy, psychological treatment, breast surgery, facial surgery, and

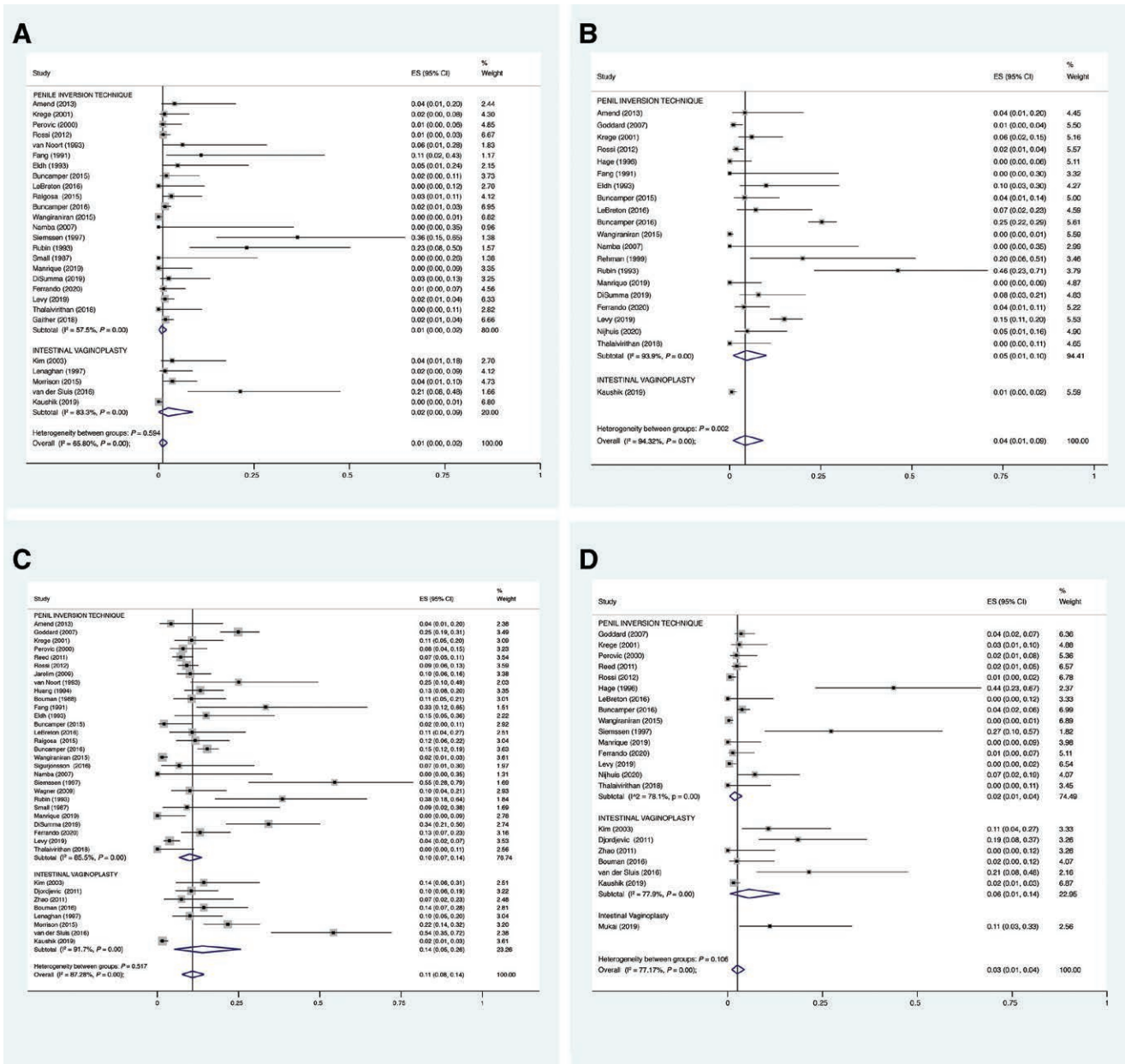


Fig. 2. Meta-analyses of different types of complications. Fistula (A), tissue necrosis (B), stenosis and strictures (C), and prolapse (D) are depicted.

genital confirmation surgery.⁵ Of all treatment modalities, genital surgery is generally the final stage of the gender confirmation process and is associated with significant improvement in both mental and sexual quality of life.⁵

Various techniques have been described for trans-female vaginoplasty; most of these techniques have been adapted from procedures designed to treat vaginal agenesis.⁷⁰ An optimal or ideal technique has not yet been determined due to the lack of sufficiently large comparative studies. However, penile inversion using a pedicle penoscrotal skin flap seems to be the first-line approach, as it is technically less complex and invasive when compared to other techniques while providing great cosmetic and functional results. Nevertheless, patients with penile hypoplasia

(penile shaft less than 8 cm) pose a challenge to the surgeon, as they usually do not have sufficient penile skin to create the neovaginal cavity. In such cases, skin grafts from the lower abdomen or thighs are necessary. Additionally, intestinal transposition vaginoplasty emerges as a reasonable option, in which rectosigmoid or ileal segments are isolated (through open or minimally invasive approach) and transferred into the neovaginal space. The advantage of using an intestinal conduit is its length, texture, lubrication, and appearance similar to a natural vagina. However, it should be noted that an abdominal surgery is required, and there is a risk of colitis, peritonitis, intestinal obstruction, junctional neuroma, introital stenosis, mucocele, and constipation.⁷¹ Furthermore, colonic mucosa is more

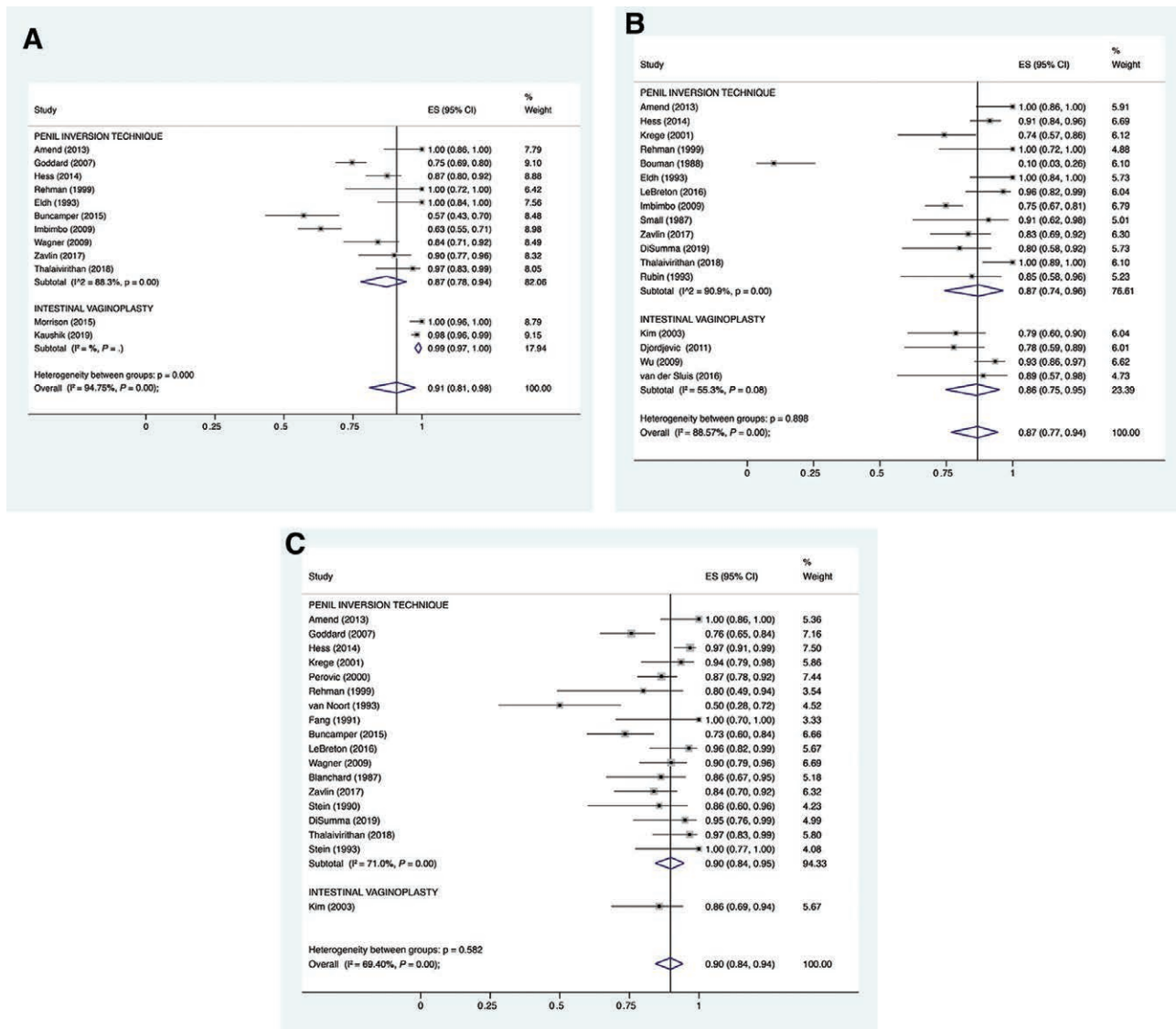


Fig. 3. Meta-analyses of different types of patient-reported outcomes. Overall satisfaction (A), functional outcomes (B), and aesthetic outcomes (C) are depicted.

vulnerable to sexually transmitted diseases and further screening for colon cancer is required.^{71,72}

Various grafts such as pedicle genital or nongenital skin flaps have also been described.^{11,12,70,72–74} Skin graft vaginoplasty is not limited by a vascular pedicle. This ensures that there can be significantly more skin harvested if required to line the neovaginal cavity. Nonetheless, a circumferential skin graft tends to scar and contract leading to neovaginal stenosis in 33%–45% of cases, representing a real disadvantage of this technique.^{72,73} In addition, undesirable scarring and hypopigmentation of donor sites are also major drawbacks. Hence, this approach is less likely to be utilized in current surgical practice. However, skin grafting may be used as an adjunct of other approaches, for instance when there is not enough tissue for the creation of the neovagina from penile skin alone.⁷⁰ Other options for reconstructing a neovagina are emerging, and

include, but are not limited to the use of buccal mucosa, amnion grafts, or decellularized tissue.¹¹

In our analysis, the vast majority of studies included penile skin inversion with or without scrotal flaps. However, with the updated search, we included 2 studies reporting intestinal-based vaginoplasties, one of which was the largest retrospective study among this group including a total of 386 sigma-lead rectosigmoid colon vaginoplasties in India.⁶⁷ Only 1 study with amnion grafts was identified but not included in the meta-analysis. In general, quality of the studies was either low or moderate. Most of them were retrospective studies with no control group.

The largest study within the intestinal-based vaginoplasty group was conducted by Kaushik et al⁶⁷ in India and included a total of 386 sigma-lead rectosigmoid vaginoplasty. They reported a 20.2% complication rate of which the majority were minor complications (97.4%). A total of 11.4% required

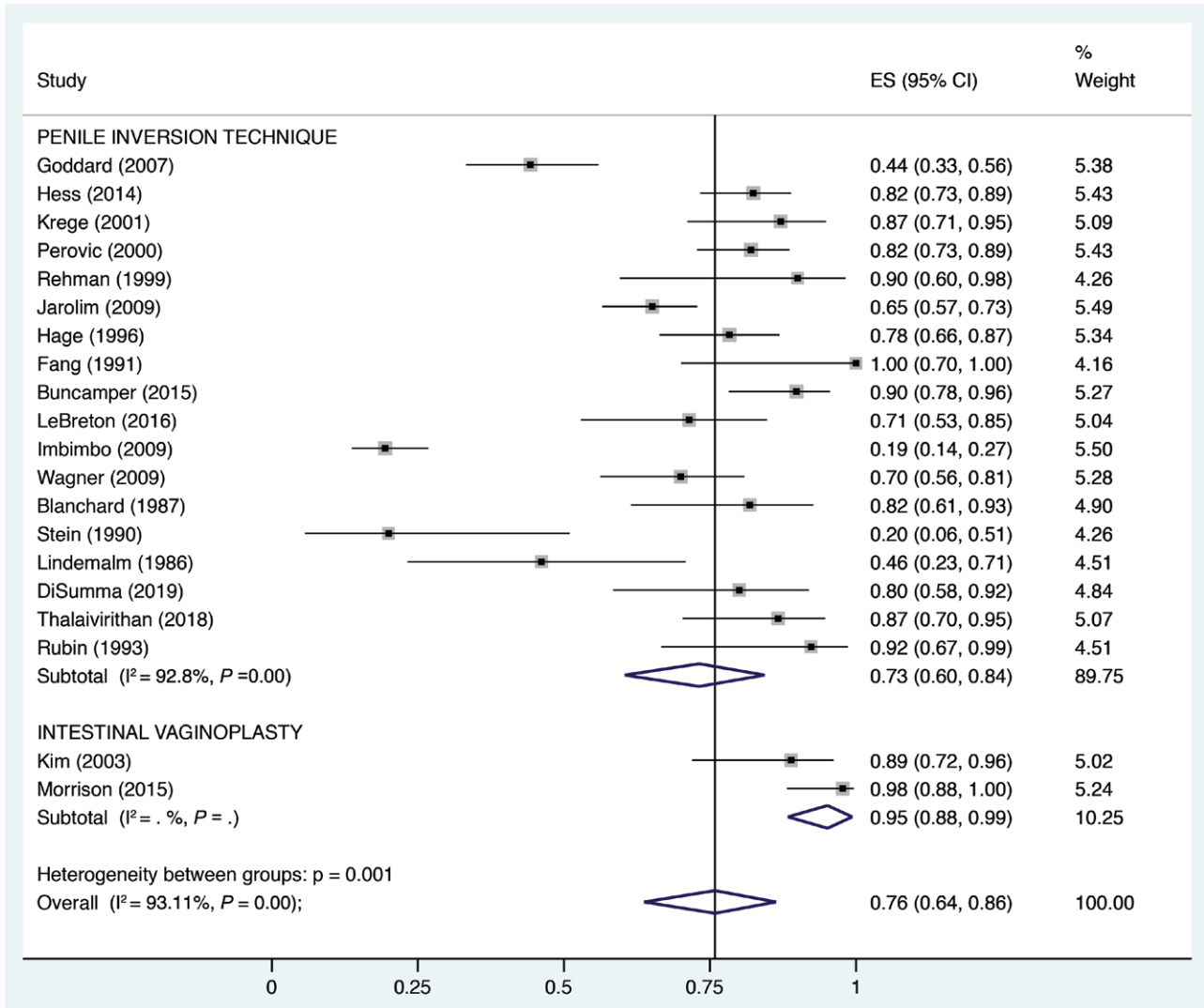


Fig. 4. Meta-analysis of ability to achieve orgasm.

reoperations: 2.6% due to introital stricture and mucosal prolapse and 8.8% for elective minor aesthetic enhancement. Satisfaction was reported as 4.7 over a 5-point scale.

Slight changes were identified in this updated meta-analysis as compared with the previous meta-analysis. The differences between studies in complication rates and in patient-reported outcomes including overall, functional, and aesthetic outcomes, ranged from 1 to 4 percentage points. This reflects a stable prevalence among these outcomes, which may be translated as neither an improvement nor a decline in surgical quality standards. From all the complications of interest, fistula had the lowest rate with only 1% (<0.1%–2%), whereas stenosis and strictures had the highest rate with 11% (8%–14%). For stenosis and strictures, intestinal-based vaginoplasty had the highest complication rate with 14% (5%–26%) compared with the penile skin inversion technique with 10% (8%–14%). However, stenosis rates were lower compared with the previous meta-analysis.

Interestingly, the ability to achieve orgasm after both vaginoplasty techniques increased compared with the

previous meta-analysis: from 70% (54%–84%) to 76% (64%–86%), respectively. The intestinal-based vaginoplasty technique reported the highest ability to achieve orgasm with 95% (88%–99%) compared with the penile skin inversion technique with 73% (60%–84%). This may be translated as an improvement in surgical techniques in preserving genital sensation.

Very low regret rates have been a common denominator among transfemale patients who undergo vaginoplasty. The prevalence of regret was almost the same as our previous meta-analysis, with only 1 point of difference: 1% (<1%–3%) and 2% (<1%–3%), respectively. For vaginal length, there was a 1.3 cm of difference compared with our previous report. Hence, no important changes were presented with regard to these 2 outcomes.

Gender confirmation surgery, and genital surgery particularly, does not fall within a single specialty's scope of practice.⁷⁴ A multidisciplinary approach is typically required, involving endocrinology and psychology. It is essential to integrate mental health professionals, who

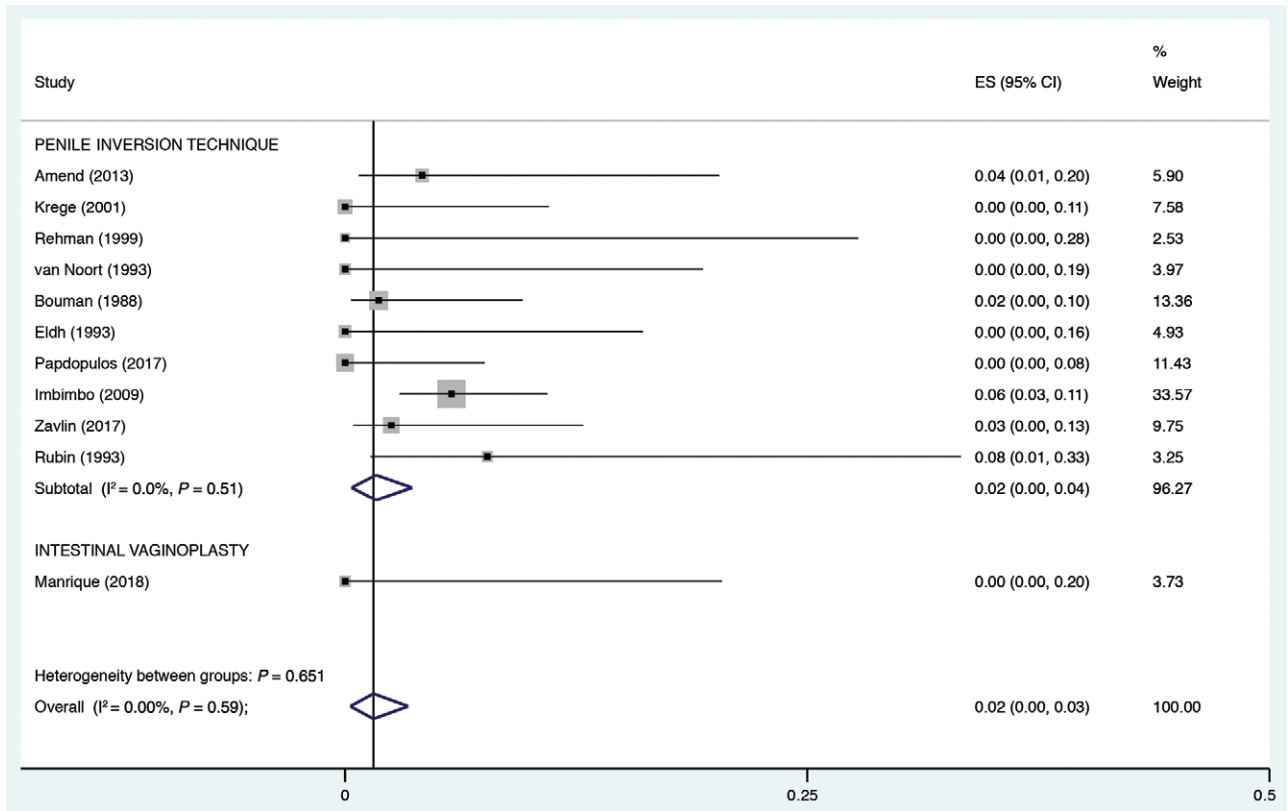


Fig. 5. Meta-analysis of regret rates.

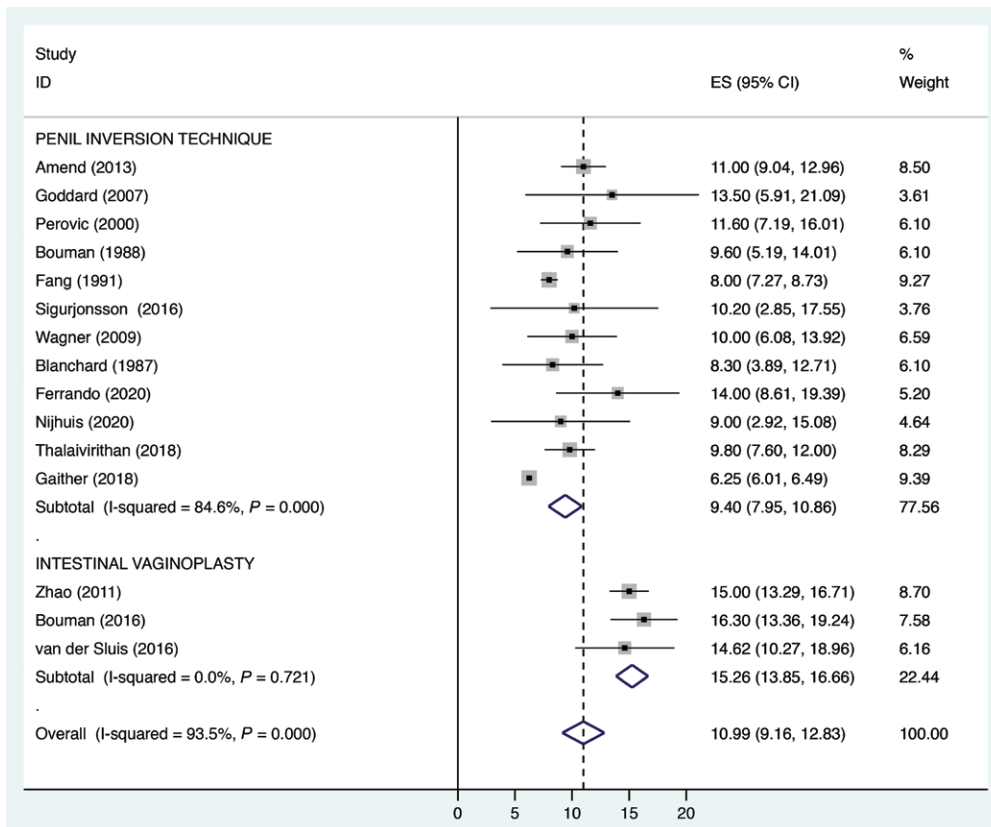


Fig. 6. Meta-analysis of depth of neovagina. Weights are from random effects analysis.

are knowledgeable about the assessment and treatment of gender dysphoria and physical and sexual health in the preoperative and postoperative setting. The overall focus is to help maximize the patient's psychological and physical state to improve quality of life.^{3,75}

CONCLUSIONS

Transfemale vaginoplasty is a key component of the comprehensive surgical treatment of TGNB patients with gender dysphoria. To improve quality of care, a multidisciplinary approach is always necessary. Over the next several years, we will see an increase demand for these procedures, so adequate surgical training, clinical/surgical experience and research outcomes are very much needed, as we continue to strive to provide the best care possible for a population in need.

Oscar Javier Manrique, MD, FACS

Division of Plastic and Reconstructive Surgery
University of Rochester Medical Center
Strong Memorial Hospital
160 Sawgrass Drive, Suite 120
Rochester, NY 14620
E-mail: oscarj.manrique@gmail.com

ACKNOWLEDGMENT

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.

REFERENCES

- Bradford J, Reisner SL, Honnold JA, et al. Experiences of transgender-related discrimination and implications for health: results from the Virginia Transgender Health Initiative Study. *Am J Public Health.* 2013;103:1820–1829.
- Puckett JA, Matsuno E, Dyar C, et al. Mental health and resilience in transgender individuals: what type of support makes a difference? *J Fam Psychol.* 2019;33:954–964.
- Coleman E, Bockting W, Botzer M, et al. Standards of care for the health of transsexual, transgender, and gender-nonconforming people, version 7. *Int J Transgenderism.* 2012;13:165–232.
- Oliver JD, Alsubaie SA, Vyas KS, et al. “creation” rather than “reconstruction” in gender-affirming surgery. *Plast Reconstr Surg.* 2019;144:341e–342e.
- Manrique OJ, Adabi K, Martinez-Jorge J, et al. Complications and patient-reported outcomes in male-to-female vaginoplasty—where we are today: a systematic review and meta-analysis. *Ann Plast Surg.* 2018;80:684–691.
- Bustos SS, Kapoor T, Schechter LS, et al. Impact of social media presence on online reviews among plastic surgeons who perform gender confirming surgeries. *J Plast Reconstr Aesthet Surg.* 2020;73:783–808.
- Black CK, Fan KL, Economides JM, et al. Analysis of chest masculinization surgery results in female-to-male transgender patients. *Plast Reconstr Surg - Glob Open.* 2020;8:e2356.
- Bluebond-Langner R, Berli JU, Sabino J, et al. Top surgery in transgender men: how far can you push the envelope? *Plast Reconstr Surg.* 2017;139:873e–882e.
- Agarwal CA, Scheefr MF, Wright LN, et al. Quality of life improvement after chest wall masculinization in female-to-male transgender patients: a prospective study using the BREAST-Q and Body Uneasiness Test. *J Plast Reconstr Aesthet Surg.* 2018;71:651–657.

- Poudrier G, Nolan IT, Cook TE, et al. Assessing quality of life and patient-reported satisfaction with masculinizing top surgery: a mixed-methods descriptive survey study. *Plast Reconstr Surg.* 2019;143:272–279.
- Salim A, Poh M. Gender-affirming penile inversion vaginoplasty. *Clin Plast Surg.* 2018;45:343–350.
- Bouman MB, van Zeijl MC, Buncamper ME, et al. Intestinal vaginoplasty revisited: a review of surgical techniques, complications, and sexual function. *J Sex Med.* 2014;11:1835–1847.
- Meerwijk EL, Sevelius JM. Transgender population size in the United States: a meta-regression of population-based probability samples. *Am J Public Health.* 2017;107:e1–e8.
- James SE, Herman JL, Rankin S, et al. The Report of the 2015 U.S. Transgender Survey. Washington, DC: National Center for Transgender Equality; 2016: 297. Available at: <https://www.transequality.org/sites/default/files/docs/USTS-Full-Report-FINAL.PDF>. Accessed May 5, 2020.
- Liberati A, Altman DG, Tetzlaff J, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *PLoS Med.* 2009;6:e1000100.
- Covidence. Better systematic review management. Available at: <https://www.covidence.org/home>. Accessed May 28, 2020.
- Nyaga VN, Arbyn M, Aerts M. Metaprop: a Stata command to perform meta-analysis of binomial data. *Arch Public Health.* 2014;72:39.
- Amend B, Seibold J, Toomey P, et al. Surgical reconstruction for male-to-female sex reassignment. *Eur Urol.* 2013;64:141–149.
- Goddard JC, Vickery RM, Qureshi A, et al. Feminizing genitoplasty in adult transsexuals: early and long-term surgical results. *BJU Int.* 2007;100:607–613.
- van Noort DE, Nicolai JP. Comparison of two methods of vagina construction in transsexuals. *Plast Reconstr Surg.* 1993;91:1308–1315.
- Huang TT. Twenty years of experience in managing gender dysphoric patients: I. Surgical management of male transsexuals. *Plast Reconstr Surg.* 1995;96:921–930.
- Bouman FG. Sex reassignment surgery in male to female transsexuals. *Ann Plast Surg.* 1988;21:526–531.
- Fang RH, Chen CF, Ma S. A new method for clitoroplasty in male-to-female sex reassignment surgery. *Plast Reconstr Surg.* 1992;89:679–682.
- Eldh J. Construction of a neovagina with preservation of the glans penis as a clitoris in male transsexuals. *Plast Reconstr Surg.* 1993;91:895–900.
- Buncamper ME, Honselaar JS, Bouman MB, et al. Aesthetic and functional outcomes of neovaginoplasty using penile skin in male to female transsexuals. *J Sex Med.* 2015;12:1626–1634.
- LeBreton M, Courtois F, Journel NM, et al. Genital sensory detection thresholds and patient satisfaction with vaginoplasty in male-to-female transgender women. *J Sex Med.* 2017;14:274–281.
- Raigosa M, Avvedimento S, Yoon TS, et al. Male-to-female genital reassignment surgery: a retrospective review of surgical technique and complications in 60 patients. *J Sex Med.* 2015;12:1837–1845.
- Buncamper ME, van der Sluis WB, van der Pas RSD, et al. Surgical outcome after penile inversion vaginoplasty: a retrospective study of 475 transgender women. *Plast Reconstr Surg.* 2016;138:999–1007.
- Wangjiraniran B, Selvaggi G, Chokrungravanont P, et al. Male-to-female vaginoplasty: Preecha's surgical technique. *J Plast Surg Hand Surg.* 2015;49:153–159.
- Hess J, Rossi Neto R, Panic L, et al. Satisfaction with male-to-female gender reassignment surgery. *Dtsch Arztebl Int.* 2014;111:795–801.
- Imbimbo C, Verze P, Palmieri A, et al. A report from a single institute's 14-year experience in treatment of male-to-female transsexuals. *J Sex Med.* 2009;6:2736–2745.

32. Namba Y, Sugiyama N, Yamashita S, et al. Vaginoplasty with an M-shaped perineo- scrotal flap in a male-to-female transsexual. *Acta Med Okayama*. 2007;61:355–360.
33. Siemssen PA, Matzen SH. Neovaginal construction in vaginal aplasia and sex-reassignment surgery. *Scand J Plast Reconstr Surg Hand Surg*. 1997;31:47–50.
34. Wagner S, Greco F, Hoda MR, et al. Male-to-female transsexualism: technique, results and 3-year follow-up in 50 patients. *Urol Int*. 2010;84:330–333.
35. Blanchard R, Legault S, Lindsay WR. Vaginoplasty outcome in male-to-female transsexuals. *J Sex Marital Ther*. 1987;13:265–275.
36. Rubin SO. Sex-reassignment surgery male-to-female. Review, own results and report of a new technique using the glans penis as a pseudoclitoris. *Scand J Urol Nephrol Suppl*. 1993;154:1–28.
37. Small MR. Penile and scrotal inversion vaginoplasty for male to female transsexuals. *Urology*. 1987;29:593–597.
38. Zavlin D, Schaff J, Lellé JD, et al. Male-to-female sex reassignment surgery using the combined vaginoplasty technique: satisfaction of transgender patients with aesthetic, functional, and sexual outcomes. *Aesthetic Plast Surg*. 2018;42:178–187.
39. Stein M, Tiefer L, Melman A. Followup observations of operated male-to-female transsexuals. *J Urol*. 1990;143:1188–1192.
40. Lindemalm G, Körlin D, Uddenberg N. Long-term follow-up of “sex change” in 13 male-to-female transsexuals. *Arch Sex Behav*. 1986;15:187–210.
41. Krege S, Bex A, Lümmer G, et al. Male-to-female transsexualism: a technique, results and long-term follow-up in 66 patients. *BJU Int*. 2001;88:396–402.
42. Manrique OJ, Adabi K, Huang TC, et al. Assessment of pelvic floor anatomy for male-to-female vaginoplasty and the role of physical therapy on functional and patient-reported outcomes. *Ann Plast Surg*. 2019;82:661–666.
43. di Summa PG, Watfa W, Krähnenbühl S, et al. Colic-based transplant in sexual reassignment surgery: functional outcomes and complications in 43 consecutive patients. *J Sex Med*. 2019;16:2030–2037.
44. Ferrando CA. Adverse events associated with gender affirming vaginoplasty surgery. *Am J Obstet Gynecol*. 2020;223:267.e1–267.e6.
45. Levy JA, Edwards DC, Cutruzzola-Dreher P, et al. Male-to-female gender reassignment surgery: an institutional analysis of outcomes, short-term complications, and risk factors for 240 patients undergoing penile-inversion vaginoplasty. *Urology*. 2019;131:228–233.
46. Nijhuis THJ, Özer M, van der Sluis WB, et al. The bilateral pedicled epilated scrotal flap: a powerful adjunctive for creation of more neovaginal depth in penile inversion vaginoplasty. *J Sex Med*. 2020;17:1033–1040.
47. Thalaivirithan BM, Sethu M, Ramachandran DK, et al. Application of embryonic equivalents in male-to-female sex reassignment surgery. *Indian J Plast Surg*. 2018;51:155–166.
48. Gäthner TW, Awad MA, Osterberg EC, et al. Postoperative complications following primary penile inversion vaginoplasty among 330 male-to-female transgender patients. *J Urol*. 2018;199:760–765.
49. Perovic SV, Stanojevic DS, Djordjevic ML. Vaginoplasty in male transsexuals using penile skin and a urethral flap. *BJU Int*. 2000;86:843–850.
50. Reed HM. Aesthetic and functional male to female genital and perineal surgery: feminizing vaginoplasty. *Semin Plast Surg*. 2011;25:163–174.
51. Rossi Neto R, Hintz F, Krege S, et al. Gender reassignment surgery—a 13 year review of surgical outcomes. *Int Braz J Urol*. 2012;38:97–107.
52. Rehman J, Melman A. Formation of neoclitoris from glans penis by reduction glansplasty with preservation of neurovascular bundle in male-to-female gender surgery: functional and cosmetic outcome. *J Urol*. 1999;161:200–206.
53. Jarolím L, Šedý J, Schmidt M, et al. Gender reassignment surgery in male-to-female transsexualism: a retrospective 3-month follow-up study with anatomical remarks. *J Sex Med*. 2009;6:1635–1644.
54. Hage JJ, Karim RB. Sensate pedicled neoclitoroplasty for male transsexuals: Amsterdam experience in the first 60 patients. *Ann Plast Surg*. 1996;36:621–624.
55. Kwun Kim S, Hoon Park J, Cheol Lee K, et al. Long-term results in patients after rectosigmoid vaginoplasty. *Plast Reconstr Surg*. 2003;112:143–151.
56. Djordjevic ML, Stanojevic DS, Bizic MR. Rectosigmoid vaginoplasty: clinical experience and outcomes in 86 cases. *J Sex Med*. 2011;8:3487–3494.
57. Wu JX, Li B, Li WZ, et al. Laparoscopic vaginal reconstruction using an ileal segment. *Int J Gynaecol Obstet*. 2009;107:258–261.
58. Zhao YZ, Jiang H, Liu AT, et al. Laparoscope-assisted creation of a neovagina using pedicled ileum segment transfer. *World J Surg*. 2011;35:2315–2322.
59. Bouman MB, van der Sluis WB, Buncamper ME, et al. Primary total laparoscopic sigmoid vaginoplasty in transgender women with penoscrotal hypoplasia: a prospective cohort study of surgical outcomes and follow-up of 42 patients. *Plast Reconstr Surg*. 2016;138:614e–623e.
60. Lenaghan R, Wilson N, Lucas CE, et al. The role of rectosigmoid neocolporrhaphy. *Surgery*. 1997;122:856–860.
61. Morrison SD, Satterwhite T, Grant DW, et al. Long-term outcomes of rectosigmoid neocolporrhaphy in male-to-female gender reassignment surgery. *Plast Reconstr Surg*. 2015;136:386–394.
62. van der Sluis WB, Bouman MB, de Boer NK, et al. Long-term follow-up of transgender women after secondary intestinal vaginoplasty. *J Sex Med*. 2016;13:702–710.
63. Manrique OJ, Sabbagh MD, Ciudad P, et al. Gender-confirmation surgery using the pedicle transverse colon flap for vaginal reconstruction: a clinical outcome and sexual function evaluation study. *Plast Reconstr Surg*. 2018;141:767–771.
64. Sigurjonsson H, Rinder J, Möllermark C, et al. Male to female gender reassignment surgery: surgical outcomes of consecutive patients during 14 years. *JPRAS Open*. 2015;6:69–73.
65. Papadopulos NA, Lellé JD, Zavlin D, et al. Quality of life and patient satisfaction following male-to-female sex reassignment surgery. *J Sex Med*. 2017;14:721–730.
66. Mukai Y, Sakurai T, Watanabe T, et al. Laparoscopic rectosigmoid colon vaginoplasty in male-to-female transsexuals: experience in Japan. *Acta Med Okayama*. 2019;73:205–211.
67. Kaushik N, Jindal O, Bhardwaj DK. Sigma-lead male-to-female gender affirmation surgery: blending cosmesis with functionality. *Plast Reconstr Surg Glob Open*. 2019;7:e2169.
68. Mañero Vazquez I, García-Senosiain O, Labanca T, et al. Aesthetic refinement in the creation of the clitoris, its preputial hood, and labia minora in male-to-female transsexual patients. *Ann Plast Surg*. 2018;81:398–401.
69. Seyed-Forootan K, Karimi H, Seyed-Forootan NS. Autologous fibroblast-seeded amnion for reconstruction of neo-vagina in male-to-female reassignment surgery. *Aesthetic Plast Surg*. 2018;42:491–497.
70. Schechter L. Surgery for gender identity disorder. In: Neligan PC, ed. *Song DH's Plastic Surgery*. 3rd ed. Philadelphia, Pa: Elsevier; 2013:336–351.
71. Hage JJ, Karim RB, Asscheman H, et al. Unfavorable long-term results of rectosigmoid neocolpopoiesis. *Plast Reconstr Surg*. 1995;95:842–848.
72. Horbach SERR, Bouman M-BB, Smit JM, et al. Outcome of vaginoplasty in male-to-female transgenders: a systematic review of surgical techniques. *J Sex Med*. 2015;12:1499–1512.
73. Selvaggi G, Ceulemans P, De Cuyper G, et al. Gender identity disorder: general overview and surgical treatment for vaginoplasty in male-to-female transsexuals. *Plast Reconstr Surg*. 2005;116:135e–145e.
74. Hadj-Moussa M, Agarwal S, Ohl DA, et al. Masculinizing genital gender confirmation surgery. *Sex Med Rev*. 2019;7:141–155.
75. Hadj-Moussa M, Ohl DA, Kuzon WM Jr. Evaluation and treatment of gender dysphoria to prepare for gender confirmation surgery. *Sex Med Rev*. 2018;6:607–617.