# Feasibility and Outcomes After Robot-Assisted Sigmoid Vaginoplasty for Gender Dysphoria

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**OBJECTIVE** To present our technique of robot assisted sigmoid vaginoplasty (RSV) for both primary and in revision cases of vaginoplasty.

**METHODS** Patients were retrospectively evaluated between 2020 and 2024 who underwent either primary or revision RSV. The technique for the surgery is described. Demographics, complications, vaginal depth (VD), and hospital events were analyzed after chart review.

**RESULTS** Thirty-six patients underwent robotic-assisted sigmoid vaginoplasty. Eleven underwent primary RSV and 25 underwent revision vaginoplasty for vaginal stenosis (25) and prostato-vaginal fistula (4). *Mean age was 36.1 years, operative time was 272.9 mins, mean length of stay was 3.7 days*. Mean VD was 17.6 cm (3.7 SD). In patients who underwent revision vaginoplasty for stenosis, preoperative VD was on average 3.4 cm (3.3 SD) and none developed fistulas. *2 developed a sigmoid-skin anastomotic vaginal stricture requiring intervention*. Most patients expressed satisfaction with their surgery and outcomes. None reported a change in bowel habits, vaginitis, or excessive discharge that persisted after 3 months post-op, and none had evidence of diversion neo-vaginal colitis on post-operative vaginoscopy.

**CONCLUSION** RSV is a feasible and safe technique as a primary option for vaginoplasty or as a revision to treat vaginal stenosis. Larger and longer comparative studies are needed to assess the utility and long-term functional outcomes of this technique. UROLOGY 204: 227–233, 2025. Published by Elsevier Inc.

Feminizing genital surgery includes orchiectomy and vaginoplasty for treatment of gender dysphoria. For transgender women, several surgical options exist for vaginoplasty with depth, including penile inversion vaginoplasty, peritoneal flap vaginoplasty, and vaginoplasty with a harvested bowel segment.[1] While there is no consensus on one single method being clinically superior, the most common type of vaginoplasty is penile inversion vaginoplasty (PIV).[1,2] In PIV, the phallic skin is inverted to form the surface of the neovagina, and additional depth is obtained with the use of a skin graft, typically from the scrotum.[3,4] While cosmesis and sexual function is excellent, the disadvantages of this surgery include the lifetime need for dilation to prevent vaginal stenosis and external lubrication with penetrative intercourse or dilation. Additionally, there is not always enough penile and scrotal skin to create a neovagina of adequate depth for painless penetrative intercourse, particularly in patients who hormonally transitioned early in their lives. In patients with vaginal stenosis after PIV, options include harvesting of skin grafts or the use of peritoneal flaps. Both of these options are more difficult if there is little vaginal depth (VD) present. One alternative that has been described is a sigmoid vaginoplasty, which utilizes a sigmoid segment that is intrinsically mucous-producing.[1] However, open sigmoid vaginoplasty is an invasive procedure necessitating an abdominal incision that would otherwise not be present in PIV. The risks and drawbacks of sigmoid vaginoplasty could be minimized by the use of minimally invasive surgical techniques; the robotic approach permits precise pelvic dissection, a smaller scar, decreased pain, and potentially quicker recovery than the open approach. To date, there are few case reports of robot-assisted sigmoid and non-sigmoid vaginoplasty.[5–7] We describe our technique of robot assisted sigmoid vaginoplasty and report our results in a pilot study of patients. We evaluated the feasibility and outcomes of a robot-assisted primary and robot assisted sigmoid vaginoplasty (RSV) in transgender women.

## METHODS

We performed a retrospective cohort study of transgender females undergoing primary or revision RSV at a single-center metropolitan hospital site in 2020-2024.

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*Submitted: January 20, 2025, accepted (with revisions): June 4, 2025*

Published by Elsevier Inc.

https://doi.org/10.1016/j.urology.2025.06.003



0090-4295

Revision RSV was defined as RSV in patients who have had a previous form of vaginoplasty that required revision due to stenosis, fistula, or inadequate depth. Data was obtained via chart review of patients, and descriptive statistics of mean and standard deviation were reported. Variables evaluated included operative time (OT), estimated blood loss (EBL), length of hospital stay (LOS), surgical complications, hospital course, post-discharge events, pre-op (in revision cases) and healed VD, measured with a dilator at 3-6 months post-op or after any additional procedures, presence of gastrointestinal symptoms post-operatively, including excessive discharge, diversion colitis, or neovaginal inflammation at 3 or more months post-op (GI), and presence of persistent lower urinary tract symptoms at 3 or more months post-op (LUTS). Additionally, it was noted if patients reported continued pain with dilation, expressed satisfaction or regret with undergoing the procedure or the outcome, or had disclosed to a provider that they engaged in painful or painless penetrative sexual activity. Satisfaction was assessed during follow-up visits using yes/no metric. Summary statistics were performed using Stata 16 (StataCorp, College Station, TX).

## Surgical Technique

**Preoperative Evaluation and Preparation.** Patients presented for either primary or RSV for gender dysphoria. Primary sigmoid vaginoplasty was performed in cases with a lack of available penile skin due to radical circumcision or lichen sclerosis. Revision surgery was performed after failed PIV or peritoneal flap vaginoplasty. In these revision cases, vaginoscopy was performed to measure the depth and quality of the vaginal canal as well to rule out urethrovaginal fistula. Four patients were found to have a prostato-neovaginal fistula with vaginal stenosis, which was corrected at the same time as the RSV procedure.

**Surgical Technique.** Our technique of RSV includes a two-team approach. The surgery was performed simultaneously by surgeons who were both urologists, one was a urologic oncologist facile with robotic bowel surgery and the other a reconstructive urologist. A five-port technique is used with a 12 mm assistant port, three 8 mm robot instrument ports, and one 8 mm camera port (Fig. 1). The DaVinci Xi robot was docked to the patient's left side. In primary and revision cases, robotic harvesting of a 15 cm sigmoid segment is performed by first taking down the lateral and inferior attachments of the sigmoid and then dissecting the posterior peritoneum to gain access to the sigmoid mesentery. One key to success is the harvesting of sigmoid vessels medial to the sigmoid down to its root at the inferior mesenteric artery. Vascular redundancy in the sigmoid permits sacrificing superior components of the vasculature to aid in inferior mobilization of the sigmoid if necessary. Both of these techniques aim to create adequate tension-free inferior mobilization. Prior to superior and inferior transection of the sigmoid segment with the 60 mm endoGIA stapler, the mobility of the segment is assessed. After harvesting the sigmoid, the proximal colonic and distal sigmoid

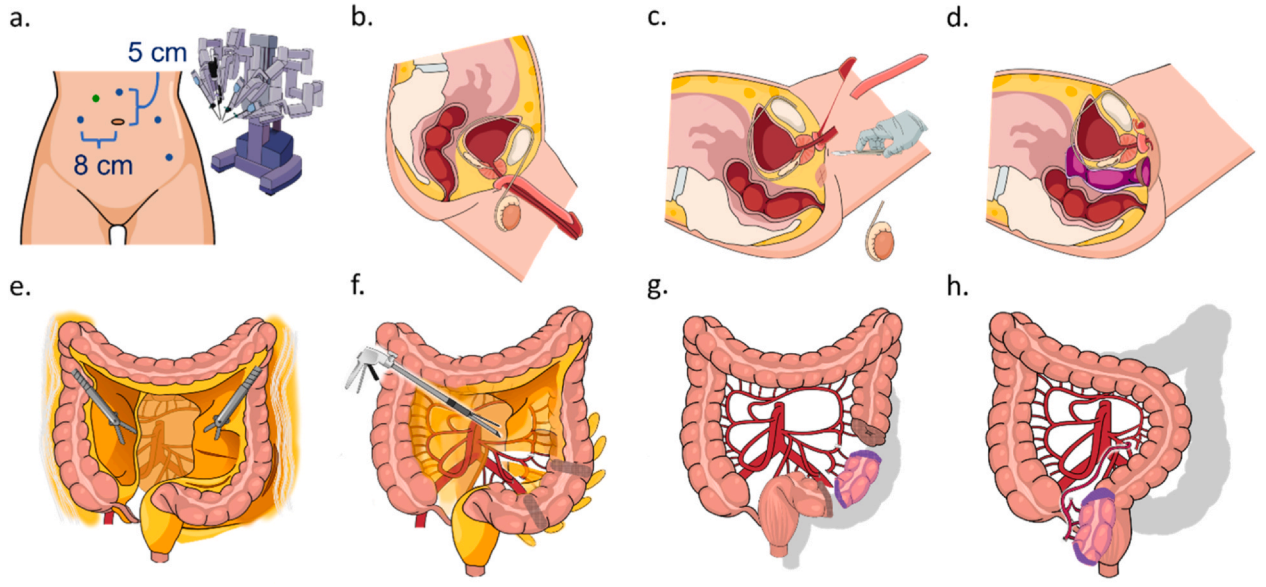


**Figure 1.** (**a**) Trocar placement. 4 8-mm ports (blue) are placed; 3 robot ports are placed at 8 cm laterally on either side of the umbilicus and just above the anterior superior iliac spine. The camera port is placed 5 cm superior to the umbilicus. A 12-mm assistant port (green) is placed between the superior and right lateral robot ports. (**b-d**) The surgeon from below completes the orchiectomy, clitoroplasty, and vulvaplasty in primary cases, and in secondary cases, incises the vaginal remnant and excises scar tissue. Care is taken to anastomose the skin to the sigmoid above the introitus to maintain optimal cosmesis. (**e-h**) Robotic sigmoid harvesting is performed by dissecting the mesentery to the root of the IMA, creating a medial pedicle, and bringing the tension-free sigmoid into the Pouch of Douglass. IMA, inferior mesenteric artery.

segments is re-anastomosed with a circular stapler from below.

Concurrently, a PIV is performed without scrotal graft in the standard fashion in patients undergoing primary vaginoplasty.[3] For patients undergoing a revision procedure, a cruciate incision at the apex of the vaginal remnant permits a wide anastomosis to the sigmoid. Additionally, in revision cases, labiaplasty, urethroplasty, and/or monsplasty is performed as needed.

After the proximal and distal colonic segments are anastomosed with a circular stapler, the phallic skin flap or neovaginal remnant is anastomosed robotically or manually from below to the harvested sigmoid segment. Precise dissection avoids injury to the rectum, anus, bladder, and urethra. Importantly, we avoid bringing the sigmoid to skin level because, in our opinion, it results in poor cosmetic outcomes. The neovagina is packed with gauze, and robotic ports were closed in standard fashion.

**Post-Operative Care and Follow-Up.** Vaginal dilation begins using just the patient's finger to keep the junction between the skin and the sigmoid open and transitioned to silicone dilators provided to patients, and graduated dilation is taught in clinic and encouraged at home, based on introital appearance and patient comfort. All patients were recommended to dilate daily. We use the Soul Source vaginal dilators. Patients are instructed to use the smallest (purple) dilator 2-3x per day by advancing the dilator and holding it in place for 20 minutes. During the first month, patients were instructed to use Metronidazole gel as lubricant during dilation. During months 2-6 they were instructed to use water-based lubricant. And after the 6 months patients reported natural lubrication from the neovagina therefore, no external lubrication was needed. Patients were discouraged from penetrative sexual activity before the 6 month post-operative timepoint. Post-op follow-up visits are scheduled to be at 1 week, 1 month, 3 months, 6 months, and 12 months after surgery, or more frequently as needed.

## RESULTS

Operative variables, hospital course, and post-discharge events are reported in Table 1. Thirty-six transgender females underwent RSV, of which 25 were revision and 11 were primary procedures, with a mean of 36.1 years

**Table 1.** Variables evaluated.

| Baseline Demographics | | | |
|---|---|---|---|
| Variable | Mean (SD) | | |
| Age | 36.1 (11.3) y | | |
| Operative Time | 272.9 (118.3) mins | | |
| Estimated Blood Loss (EBL) | 174.1 (143.4) mL | | |
| EBL Primary RSV | 306.4 (179.3) mL | | |
| EBL Revision RSV | 113.5 (64.9) mL | | |
| Length of stay (LOS) | 3.7 (1.3) d | | |
| Vaginal Depth | 17.6 (3.7) cm | | |
| Follow-Up Period | 9.8 (9.4) mos | | |
| Time to revision or additional procedure | 222 (208) d | | |
| *RSV Type* | *Number of Patients* | | |
| Primary RSV | 11 | | |
| Revision RSV (due to stenosis) | 25 | | |
| With prostatovaginal fistula | 4 | | |
| *Hospital Course* | | | |
| | *Primary RSV (N = 11)* | *Revision RSV (N = 25)* | *Total (N = 36)* |
| Clavien-Dindo Score of 1 | 2 | 4 | 6 |
| Patients requiring extended hospital stay due to hyperemesis | 1 | 0 | 1 |
| Clavien-Dindo Score of 2 | 1 | 2 | 3 |
| Post-op transfusion | | | |
| Surgical complications | 0 | 0 | 0 |
| *Post-Discharge Events* | | | |
| *Event* | *Primary RSV (N = 11)* | *Revision RSV (N = 25)* | *Total (N = 36)* |
| 30-day re-admission, surgical site infection, or wound dehiscence | 0 | 1 | 1 |
| Change in bowel habits | 0 | 1 | 1 |
| No further procedures/surgeries | 7 | 23 | 30 |
| Sigmoid-skin anastomotic stricture revision | 1 | 1 | 2 |
| *Satisfaction* | | | |
| | *Primary RSV (N = 11)* | *Revision RSV (N = 25)* | *Total (N = 36)* |
| *Satisfied* | 81.8% (9/11) | 94.2% (16/18) | 89.3% (25/28) |
| *Not Satisfied* | 18.2% (2/11) | 5.8% (1/18) | 10.7% (3/28) |
| *Not Reported* | 0 | 32% (8) | 22.2% (8) |

RSV, robot assisted sigmoid vaginoplasty.

(range 22-60, SD 11.3) at the time of the procedure. The primary indication for a revision RSV was vaginal stenosis and introital scarring; 23 of 25 patients undergoing revision RSV had complete or near-complete stenosis with a pre-op VD of 0-2.5 cm. For patients undergoing revision RSV, concurrent procedures included urethroplasty for either regression of the urethra or a prostate-neovaginal fistula (4), labiaplasty (21), clitoroplasty (18) perineoplasty (2), and monsplasty (2). For patients undergoing primary RSV, concurrent procedures included orchiectomy if not done previously (3), penile inversion, consisting of urethroplasty and clitoroplasty (6), and monsplasty (4). Mean OT was 272.9 +/- 118.3 minutes; revision RSV OT was on average 189 minutes shorter than primary RSV OT as no penile inversion needed to be performed. EBL was on average 174.1 (143.4) mL, and LOS ranged between 2 and 8 days (3.7 (1.3) days). Return of bowel function occurred between post-op days 1-3 (day 2.1 +/- 0.57). Most patients had an uneventful hospital course; 2 patients experienced hyperemesis, one of them requiring nasogastric tube placement and IV fluids, and as a result had a prolonged hospital stay. Two patients were transfused with pRBC postoperatively for symptomatic anemia. Seven patients had a Clavien-Dindo score of 1, and 2 patients had a score of 2.

Following discharge, patients are seen in the clinic at approximately the 1 week, 1 month, 3 months, 6 months, and 1 year post-op marks, or more frequently as needed. Mean follow-up length was 9.8 months (9.4 SD). 30-day readmission was 2.7%. Only one patient was re-admitted due to constipation. No patients developed surgical site infection, abnormal bleeding, or uncontrolled pain after discharge. 1 patient developed wound dehiscence within the first week postoperatively; she received wound care and closure at bedside. Three patients reported abnormal or excessive vaginal discharge. One patient reported bowel complaints after 1 month post-operatively. Eight patients reported initial pain on dilation post-operatively, which later improved; 4/8 later underwent vaginal dilation under anesthesia due to anxiety and low pain threshold. These patients who underwent dilation under anesthesia was for the management of mild/moderate stenosis. If the patient had a more severe stenosis, surgical management was offered. Eight out of 36 patients underwent additional procedures unrelated to the sigmoid harvesting, including vaginal introitus dilation under anesthesia (4), clitoroplasty for cosmesis or hypersensitivity (4), laser surgery of scar tissue (1), urethroplasty (4), monsplasty (1), and revision introitoplasty due to stenosis (4). All four patients who had revision of the introitus had revision RSV and had the additional revision performed due to extensive scar tissue development at the introitus or in the distal neovagina. Finally, there were two patients who required revision of the sigmoid-skin anastomosis due to re-stenosis.

Mean VD, recorded at the healed timepoint of 3-6 months, or 3 months after dilation under anesthesia, was 18.0 cm (2.6 cm SD). In patients who underwent revision vaginoplasty for stenosis, preoperative VD was on average 3.4 cm (3.3 cm SD), with improvement to 17.6 cm (3.7 cm). Although routine vaginoscopy is not part of our post-operative protocol, patients with complaints of abnormal vaginal discharge or bleeding, pain with dilation, or any other symptom were offered vaginoscopy. Eleven patients in our cohort had vaginoscopy done after 1 year post-op (Fig. 2), and none developed fistulas. To date, no patients report excessive bothersome

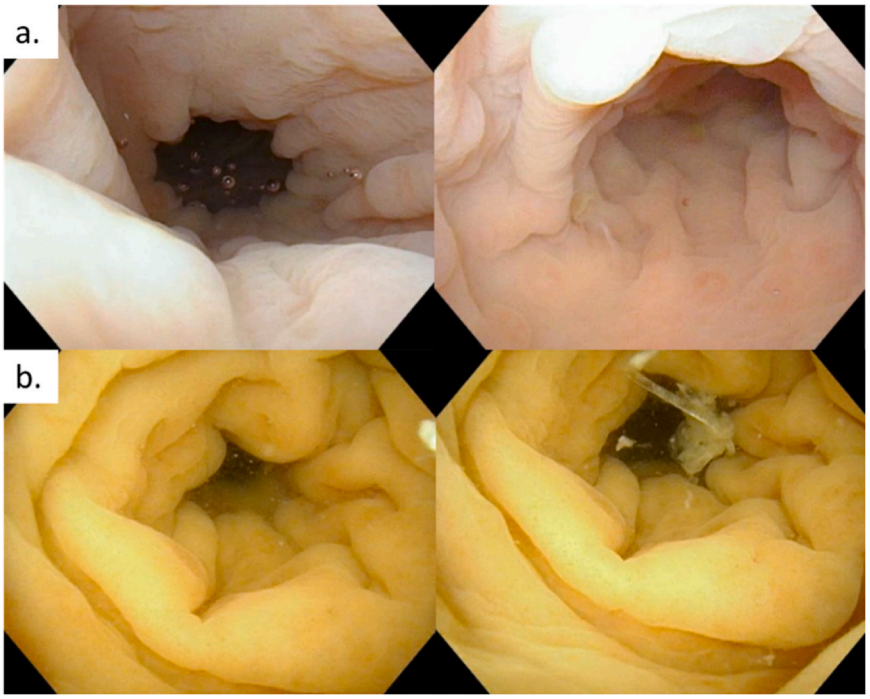


**Figure 2.** Vaginoscopy of two patients (**a** and **b**), showing healthy mucosa with minimal mucous production.

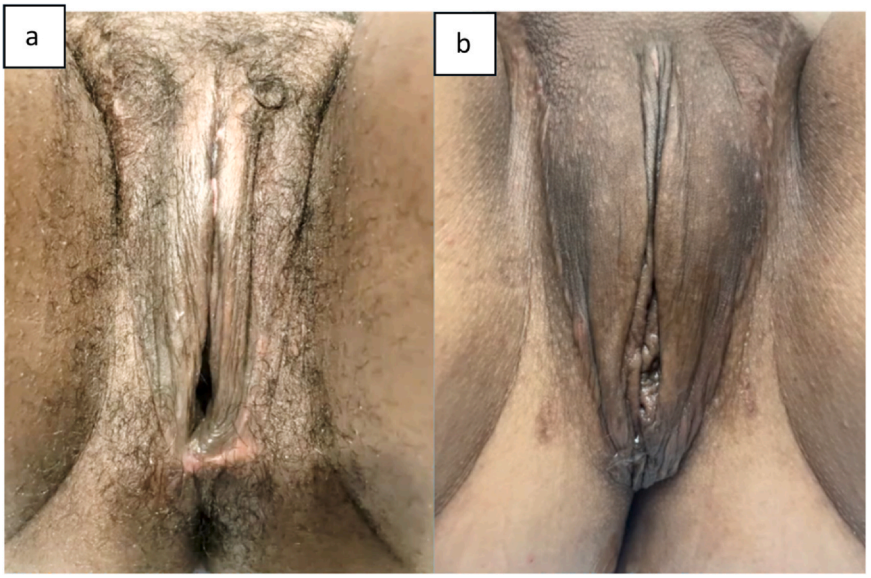


**Figure 3.** The final external appearance of the perineum, neo-vulva, and neovagina (not visualized externally) is shown with the final healed appearance of two patients (**a** and **b**).

LUTS, prolapse, or chronic pain. All patients reported being satisfied with the surgery and both cosmetic and functional outcomes, even despite undergoing additional procedures. Final healed appearance of the genitalia is shown in Figure 3.

## DISCUSSION

PIV is often considered the gold standard for primary gender-affirming vaginoplasty in transgender women because of preserved sexual function and excellent cosmetic outcomes.[8,9] In PIV, the penile or scrotal skin provides an acceptable level of sensation of the neovagina, while the penile glans forms the neoclitoris, and the prostate serves as an erogenous zone at the anterior wall of the neovagina.[4,10] However, PIV does have several drawbacks. If the skin is not completely hairless after laser hair removal hair may regrow in the vagina. Pre-operative hair removal via electrolysis or laser procedures often delays surgery but is necessary, as residual hair may retain secretions, douches/soap, ejaculate, and serve as a nidus of infection.[11] Additionally, cutaneous flaps from the phallus in PIV do not provide a significant natural source of lubrication for the patient and alone are usually inadequate for depth. Lack of lubrication and discomfort with the neovagina are common contributors to sexual dysfunction in transwomen.[8] The addition of scrotal grafts provides additional depth to the neovagina but increases the risk of stenosis and requires lifelong dilation. The incidence of genital hypoplasia in transgender females has increased, making PIV more technically challenging. In particular, the period from 2000 to 2015 saw an uptick of patients taking GnRH antagonists at or before reaching Tanner Stage 3, primarily to delay puberty and decrease gender dysphoria. As a result, many of these trans women experienced phallic and scrotal hypoplasia and were not good candidates for PIV, if the goal was to create a neovagina of adequate depth for penetrative sexual intercourse.[2,12]

Sigmoid vaginoplasty has been described as an alternative option, with good depth and a natural source of lubrication.[1,13] The sigmoid neovagina has excellent vascularity, is significantly less prone to stenosis and shrinkage, and has the mucosal and tactile properties of a natal vagina; the thicker wall of the sigmoid additionally can sustain more mechanical forces, which makes sexual activity more comfortable and less prone to bleeding.[1] Complications of sigmoid vaginoplasty (SV) that have been reported include diversion colitis, incidence of cancer in the neovagina, excessive and bothersome mucous discharge, as well as expected complications of the surgery including anastomotic leak, rectal and bladder or urethral injury, ileus and bowel obstruction due to adhesions.[14–19] Laparoscopic SV has also been performed, though intraoperative and post-operative risks seem similar to open approaches.[13,20–22]

The largest published independent series reported to date consisted of 86 laparoscopic SV patients with follow-up periods of 8-114 months showed that 90% of patients achieved good aesthetic results, and 80% had satisfactory sexual function. No patients experienced surgery-related complications such as abscess formation, dehiscence, or intraoperative urologic or rectal injury, and none reported excessive mucous production nor developed diversion colitis or vaginal pain.[23] Studies like these describe outcomes with the laparoscopic approach, but our study is the first of its kind to present results using a robotic approach for SV.

In addition to sigmoid, the use of other colonic segments for vaginal canal creation have been reported. Garcia et al[24] described the advantage of using right colon due to the consistency of its vascular pedicle as well a potentially reduced risk of a bowel leak, which is reported in the

literature to be 1%-2% versus 5%-7% in colorectal anastomosis when the sigmoid is used. Nonetheless, our cohort had a leak rate of 0%. This group assessed other outcomes, such as return to bowel function (2.7 vs 2.1 days) and length of stay (5 vs 3 days), which are comparable to our results. The group had five patients with some degree of prolapse, which could be explained by the length of the right colon. No mucosal or full-thickness prolapse was seen within our cohort of patients utilizing sigmoid colon. We believe the low risk of prolapse is in part due to a comparatively small segment of bowel that was harvested. Nonetheless, literature shows that there is a risk of prolapse with sigmoid vaginoplasties. Djordjevic et al[23] reported up to 8.13% incidence of prolapse.

Additionally, a meta-analysis performed by Bouman et al consisting of 894 total patients undergoing intestinal vaginoplasty for any indication, of which 726 were sigmoid, has been published.[21] The rate of moderate and severe early and late postoperative complications, consisting of abscess formation, fistulas, anastomotic leak, mechanical ileus, necrosis, etc, in SV was reported as 6.4%; 4.23% were early complications, and 0.58% of cases had severe complications; there were no intraoperative complications reported. Likewise, Bouman et al found no incidence of diversion colitis resulting from the SV, and bothersome discharge was found in 0.7% of patients. Expert consensus states that excessive mucous production should not be an issue if the length of sigmoid harvested is appropriate (8-15 cm), and for most patients, mucous production sharply decreases in the first 3-6 months post-op.[1,13,23,25,26] Persistent bothersome, malodorous, or excess mucous production after SV has been reported to occur between 0% and 10% of the time; in our cohort, no patients presented with these complaints, and none experienced any GI symptoms.[21–23,27]

By the same token, a meta-analysis comparing PIV to both open and laparoscopic SV by Horbach et al showed similar rates of surgical and post-operative complications between both techniques, with substantial inter-technique variability in cosmetic, sexual function, and patient satisfaction outcomes, likely in part due to significant heterogeneity in surgical technique, patient population, difference in measurement of outcomes, and follow-up periods. The preferred technique by surgeons operating after 2000 has been PIV, but no evidence exists that SV is inferior.[28] Introital stenosis was by far the most common complication in both PIV and SV, with estimates of stenosis at 12% and 8.6%, respectively.[21,28] In both techniques, stenosis is associated with decreased frequency of dilation; in SV, stenosis frequently occurs at the introitus, where the colonic segment meets the skin flaps, which allows for easier correction compared to stenosis in multiple potential locations in the vaginal canal after PIV. No patient in our cohort developed prolapse of the sigmoid segment or bothersome excessive discharge, in our opinion, this was because the segment of sigmoid harvested is only 15 cm.

SV is also an excellent option for patients seeking revision procedures for vaginal stenosis, and prior to 2000 was almost exclusively performed for revision vaginoplasties. One advantage of this technique is that a second skin graft does not need to be harvested, while there is an abundance of sigmoid that can be used as a graft—making it an attractive procedure for patients who do not have adequate tissue for a vaginoplasty using skin flaps but still desire sufficient depth of the neovagina for penetrative intercourse.[22] In our cohort of revision RSV patients, we found the technique to be technically feasible and safe, yielding good cosmetic outcome and highly satisfied patients without the drawbacks of open surgery. Long-term, other studies have found that patients who had undergone primary or revision SV were satisfied with the surgical/cosmetic outcome and had similar rates of sexual dysfunction, LUTS, and pelvic floor issues compared to both cisgender women and transgender women who had undergone PIV.[16,29]

### Limitations

Our study was not specifically designed to evaluate long-term risks that have been previously reported with SV, including diversion colitis and changes in bowel habits, cancer of the neovagina, and late-developing stenosis. However, with short term follow-up, we found RSV to be one alternative to PIV, and especially an attractive option for treatment of vaginal stenosis, even in severe cases. A validated questionnaire to assess patient satisfaction was not used. Patients self-reported using yes/no metric their satisfaction during follow-up visit. Additional studies with longer term follow-up and increased sample size are needed to assess the long-term safety and feasibility of this technique compared to open and laparoscopic SV and PIV, as well as whether it can or should replace open SV as an option for transgender females seeking primary and/or revision feminizing genital surgery. Furthermore, there have been no randomized clinical trials comparing PIV to SV, so patient preference, comorbidities, and risk profiles should be taken into consideration during surgical planning; in patients not desiring penetrative sexual intercourse, PIV without neovaginal depth or with vulvoplasty alone may be a more attractive option that cosmetically appears no different from full-depth neo vaginas.[30,31] After genital gender-affirming surgery, quality of life measures, depression scales, and measures of gender dysphoria show improvement; however, further studies are needed to parse out the benefit to patients relative to the risks of sexual dysfunction and reoperation in order to better compare the different vaginoplasty techniques.

## CONCLUSION

We describe our technique and initial experience for RSV, which is an option for transgender women seeking a primary vaginoplasty or revision vaginoplasty. In our experience, primary RSV creates a lubricating neovagina with good VD, a lack of bothersome discharge, and an

acceptable risk of complications. RSV is a viable option for patients seeking revision vaginoplasty for vaginal stenosis.

## Ethical Declaration

All procedures were performed in compliance with relevant laws and institutional guidelines of the Institutional Review Board (IRB).

## Disclosures

None.

## CRediT Authorship Contribution Statement

**Michaela Sljivich:** Writing – original draft, Supervision, Data curation, Conceptualization. **Camille Torres:** Writing – review and editing, Supervision, Data curation, Conceptualization. **Derek Chen:** Writing – review and editing, Software, Data curation. **Tatyana Yatsenko:** Writing – original draft, Methodology, Conceptualization. **Peter Wiklund:** Writing – review and editing, Supervision, Conceptualization. **Miroslav Djordjevic:** Supervision, Conceptualization. **Rajveer S. Purohit:** Writing – review and editing, Writing – original draft, Visualization, Supervision, Conceptualization.

## Declaration of Competing Interest

All authors declare that they have no known competing financial interest or personal relationship that could influence the work reported in this paper.

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