



Solely Penile Skin for Neovaginal Construction in Sex Reassignment Surgery

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Background: Gender reassignment surgery due to transsexualism (*International Classification of Diseases*, Tenth Revision: F64.0) is a procedure becoming increasingly common worldwide as a result of a significant increase in diagnostic incidence. Several methods have been described for this complex surgery, but no internationally agreed upon gold standard exists, in particular with regard to which methods allow for creating a sufficient neovaginal depth.

Methods: We use a 2-stage technique using solely penile skin for creating a neovaginal cavity and present the long-term outcome in terms of measured neovaginal depth. Eighty patients were included. Patients' neovaginal depth was measured in a standardized fashion 6 months or more after initial surgery. Results were compared with published data on female anatomy.

Results: The average neovaginal depth achieved was 10.2 cm. Having had a postoperative complication and noncompliance to neovaginal dilatation were both negatively correlated with neovaginal depth, whereas higher body mass index was not. Most patients received a neovaginal depth sufficient for penetrative intercourse and within the range for biological women.

Conclusions: Using solely penile skin for the vaginal lining is a satisfactory surgical method to achieve adequate vaginal depth, provided that the postoperative dilatation regimen is followed. This holds true regardless of age or body mass index. (*Plast Reconstr Surg Glob Open* 2016;4:e767; doi: 10.1097/GOX.0000000000000761; Published online 28 June 2016.)

Transsexualism or sex dysphoria is defined in the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition,¹ and in the *International Classification of Diseases*, Tenth Revision² (F64.X). In many countries, the prevalence of sex dysphoria is rapidly increasing, although numbers have not been reliably established. In the literature, prevalence has been calculated at 1 in 5,000 to 1 in 12,000 or more.³⁻⁵ In Sweden, the diagnosis F64.0 was given to 1,127 patients in 2013, which is twice the number only 3 years earlier and 3 times the number 3 years before that (unpublished data, personal correspondence with the National Board of Health and Welfare, Stockholm, September 30, 2015). Public healthcare systems do not

support the cost of sex reassignment surgery in all countries. However, in Sweden, all inhabitants are eligible to receive such surgery, including any corrections, at no cost to the patient. For the past 30 years, Karolinska University Hospital has been one of Sweden's supraregional centers providing surgical care for transsexual patients. Several variations of the surgical technique for male to female sex reassignment have been described.⁶⁻⁹ Commonly, penile skin is used for lining a part of the neovaginal cavity together with scrotal flaps or skin grafts.^{6,10} Considerable debate exists regarding whether penile skin alone is sufficient to provide lining for the complete vaginal depth needed.

Disadvantages of using skin flaps and/or skin grafts include the creation of intravaginal scars, use of hair-bearing skin, and rougher skin quality compared with the pliable and soft penile skin. At Karolinska University Hospital, we use solely penile skin with a penile inversion technique for nearly all cases. During the past 15 years,

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only 4 patients received a skin flap in addition to penile skin (<1%). Here, we describe this surgical technique and outcome measurements of a large cohort of patients to investigate if penile skin alone is sufficient to create an adequate neovaginal depth.

PATIENTS AND METHODS

Eighty patients who had undergone male to female sex reassignment surgery (primary surgery) using penile skin for the neovaginal lining at Karolinska University Hospital between 2000 and 2014 were included.¹¹ The patients were followed up prospectively and measured for neovaginal depth under general anesthesia during a secondary elective surgical procedure. The indications for a second procedure were planned secondary surgery (see below), breast surgery, or any minor refinement procedure. The time between the primary surgery and the measurements performed at secondary surgery was minimum 6 months to allow for complete healing. Data on patient age, height, weight, and circumcision were collected at baseline. Body mass index (BMI) was calculated. Information on postoperative complications was collected retrospectively. After primary surgery, the patients were prescribed a postoperative self-dilatation regimen. Self-reported compliance with this regimen was noted. The depth of the neovaginal cavity of the patients was measured in the lithotomy position at the end of the surgical procedure using a semirigid silicone vaginal dilator (30×180 mm). All measured neovaginal cavities accepted the dilator with regard to width, but no special attempt to measure the width specifically was made. The dilator was directed horizontally and allowed

to bottom out in the neovaginal cavity, and a marker was used to draw a line parallel to the position of the inner labia (Fig. 1). The distance from the tip of the dilator to the drawn mark was recorded in the patient chart. Measurements were performed according to a written protocol and after a teaching session to assure a comparable measuring technique between surgeons. Measurements of neovaginal depth were compared with the literature on vaginal depth in biological women, including when aroused or nonaroused.¹²⁻¹⁴

Statistical Analysis

Mean vaginal depth and range were calculated by age category, BMI category, circumcision, postoperative complication, and compliance with the dilatation regime. The Pearson correlation coefficient was used to evaluate the association between vaginal depth and the continuous covariates. Simple linear regression models and a multivariate regression model were used to estimate the effect of all the before-mentioned variables on the primary outcome (vaginal depth). Two-tail *P* values were calculated with a significance level of 0.05.

The study had institutional approval with a register permit from Stockholms Läns Landsting (2010-11-30 and 2015/2225-31).

SURGICAL TECHNIQUE

Primary Surgery

The patient is placed in the lithotomy position under general anesthesia with epidural analgesia. A caudally

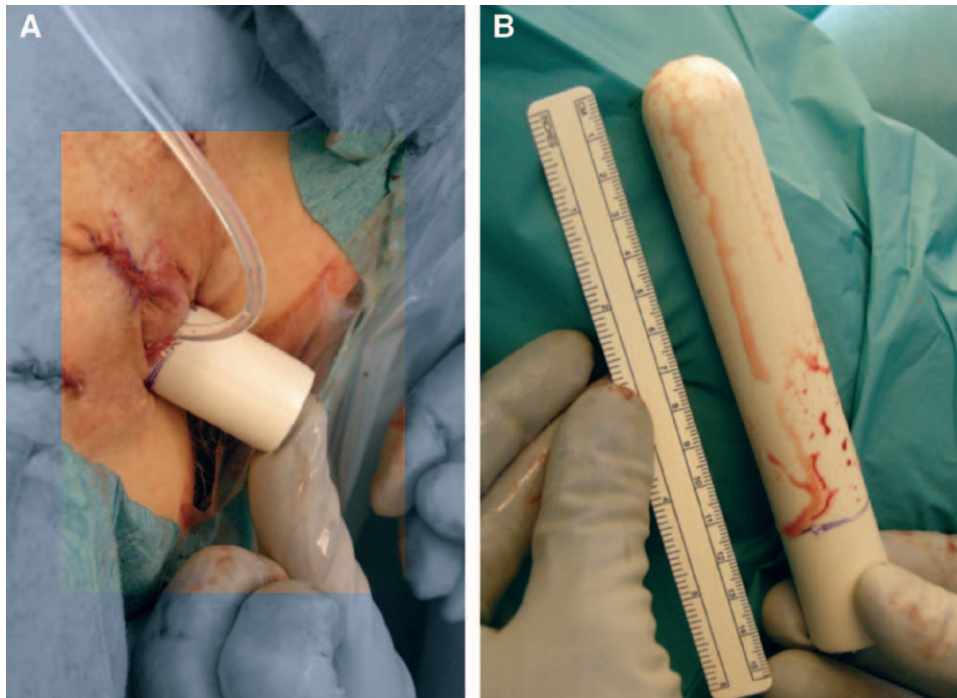


Fig. 1. A, A semirigid 20-mm wide dilator is directed parallel to the operating table and allowed to bottom out in the neovagina. B, The dilator is marked at the position of the inner labia and the distance from tip to the mark is measured.

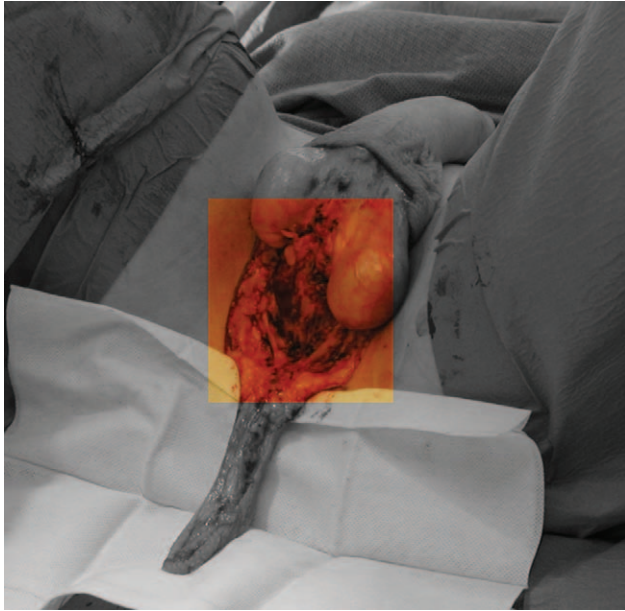


Fig. 2. The neovaginal vault has been dissected through the perineal raphe and the perineal musculature. A plastic prosthesis is inserted to ascertain adequate depth and width. Orchidectomy has not yet been performed.

based scrotal flap is marked and raised for surgical access to the perineal area. The bulbous musculature and the bulb of the urethra are dissected off the proximal corpus spongiosa and discarded. Orchidectomy is done by ligation of the funiculi bilaterally. Creation of a neovaginal vault in the area between the urethra and the rectum fol-

lows by sharp dissection through the perineal musculature and the perineal raphe. Once the contractile musculature has been incised, blunt dissection, under bimanual palpation, directed toward the prostate is performed until sufficient depth and width is reached (Fig. 2A). A penile prosthesis (40 mm diameter × 160 mm length) is inserted to ascertain a sufficient neovaginal space (Fig. 2B). The penile skin is next incised distally along the proximal glans border and separated from the corpora and the spongiosus tissue (Fig. 3A). This skin forms a cranial circumferential skin flap, a “pouch.” The prepuce fold is dissected, and this skin is used to increase the length of the pouch. The distal pouch opening corresponding to the foreskin area is closed by suturing after which the skin pouch is inverted (Fig. 3B). A triangular piece of the proximal dorsal glans penis is drawn out and dissected off the penis, superficial to the tunica albuginea to preserve innervation and vascular supply to the erogenous tissue. Thus, a sensate flap is raised for use as a neoclitoris (Fig. 4). The urethra is dissected completely off the corpora and divided at a suitable length (Fig. 4) before the penile remnants are amputated close to the symphysis at radix penis, and each corpora cavernosa is ligated. The skin of the penis is invaginated into the neovaginal cavity, the scrotal flap is discarded, and the posterior commissure is sutured. This invagination (Fig. 5) causes a significant cranial pull of the skin, which causes the posterior commissure to rise upward to cover a part of the vaginal orifice. The prepelvic skin is likewise stretched, and the anterior commissure is consequently widened (Fig. 5). We do not undermine the prepelvic skin or dissect the lower abdomen to preserve maximum vascularization to the penile skin. The penile skin is not

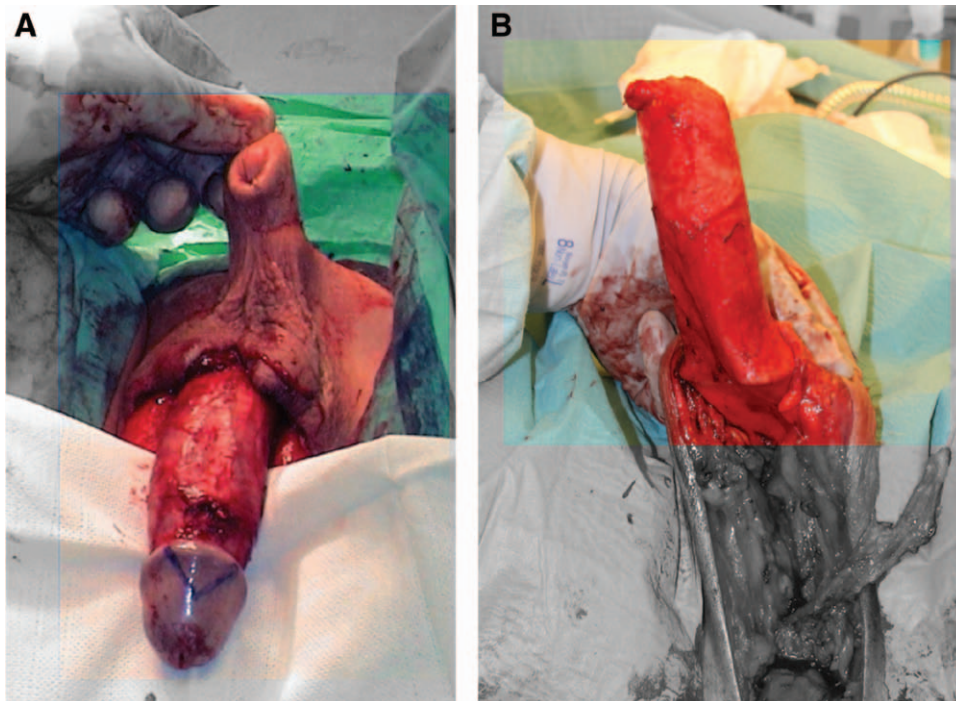


Fig. 3. A, The penile skin has been dissected off the corpora (note the drawing for the neoclitoris flap on the glans penis). B, The skin pouch has been sutured and closed and inverted over a penile prosthesis.

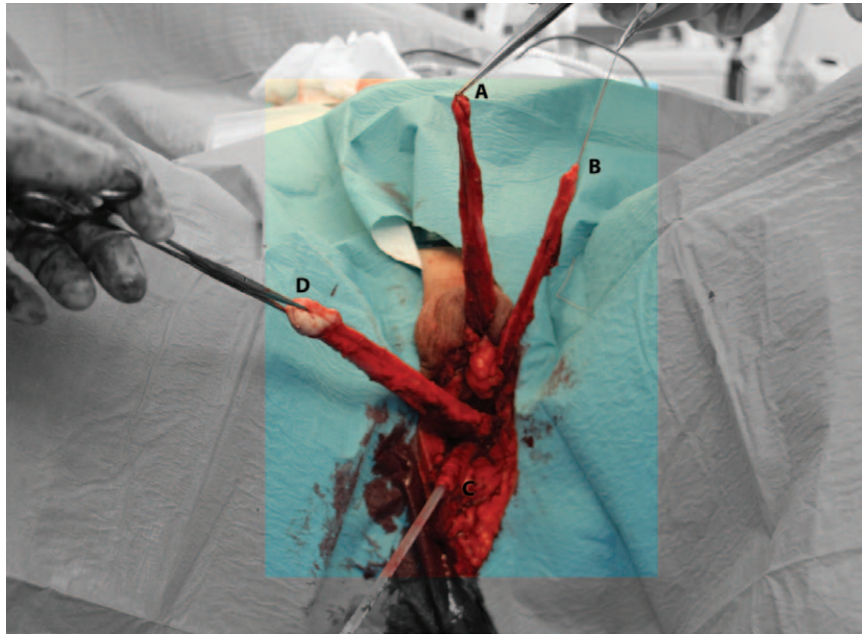


Fig. 4. The penile skin (A), the neoclitoral flap (B), the shortened urethra dissected off the corpora (C), and the penile remnants to be amputated (D).

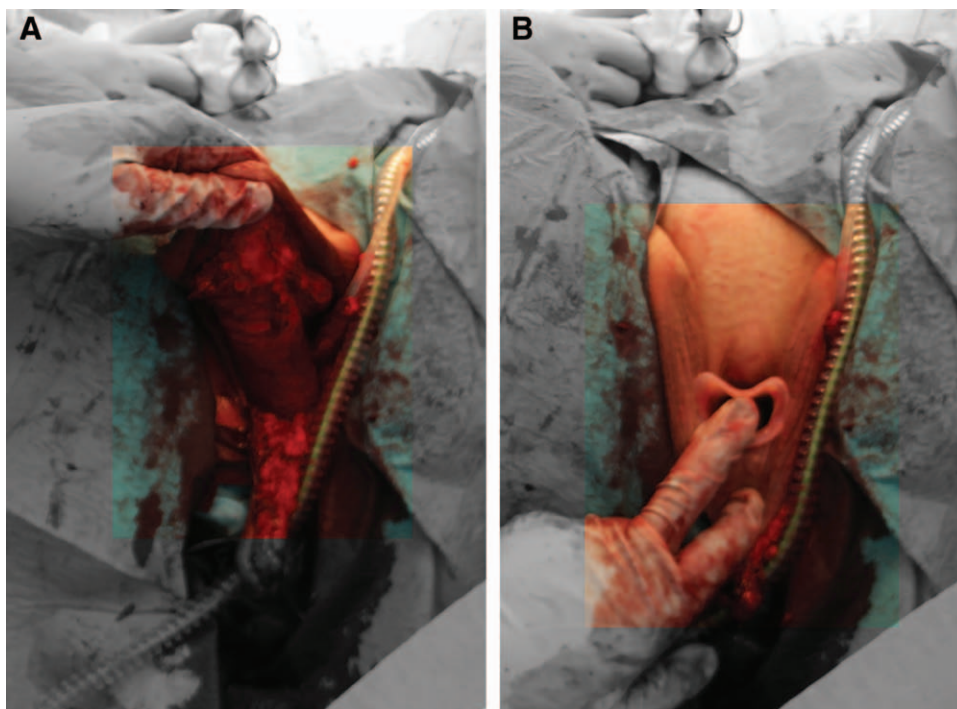


Fig. 5. The penile skin draped over a plastic penile prosthesis (A) has been invaginated into the neovaginal cavity (B).

anchored into the neovaginal space by suturing. This pull of the skin is the cause of the mandatory secondary procedure as described below. Next, semicircular and rhomboid incisions cranial to the neovagina are performed, and the neoclitoral flap and the urethra, respectively, are sutured into place. The lateral incisions are closed by suturing, and the neovaginal cavity is packed with vaseline gauze

before bandaging. In case of bleeding or fecal contamination, the surgical area is inspected, but otherwise, the bandages are kept until the fourth postoperative day when the dressings are changed and the urethral catheter is removed. Mobilization is allowed at days 3 to 5.

Vaginal dilatation is started on the fourth postoperative day and continues for minimum 1 year. The dilatation

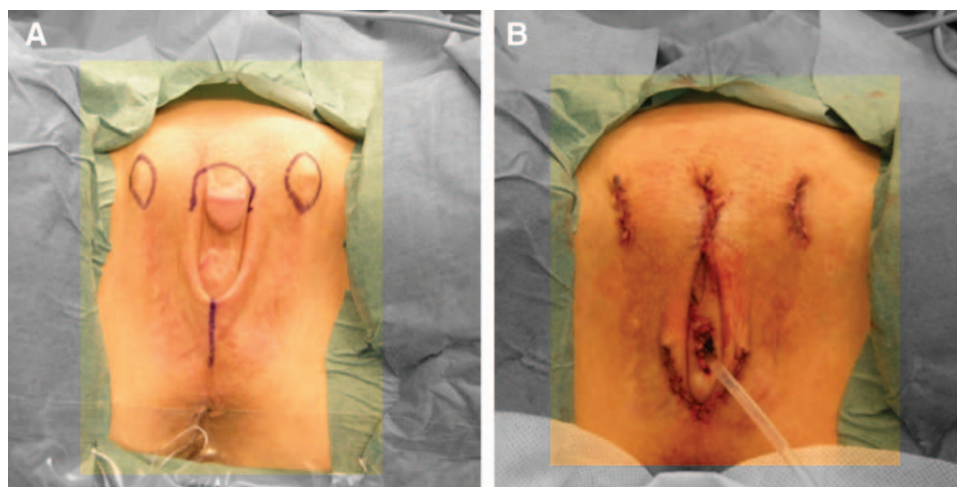


Fig. 6. A, Before secondary surgery: the posterior commissure will be opened vertically, the anterior commissure narrowed, and a clitoral hood created by turnover flaps. Small dog-ears will be excised bilaterally. B, After secondary surgery.

regimen consists of initial dilatation with a 25-mm-wide semirigid silicon dilator for 20 minutes 2 to 3 times per day. After 3 weeks, the patient uses a rigid plastic dilator with a width of 35 mm.

Secondary Surgery

Secondary surgery is performed no earlier than 6 months after the primary surgery to allow for complete healing and stretching of the tissues. A vulvoplasty is conducted with a vertical incision in the caudal vaginal orifice (posterior commissure) to deepen the commissure (Fig. 6). Inner labia may be created by repositioning of the commissure skin anteriorly or by creation of a skin fold us-

ing the extra skin available at the posterior commissure. Coverage of the neoclitoris and narrowing of the anterior commissure are achieved by using a skin flap enveloped from each side (Fig. 6). No procedures to stretch or widen the neovaginal space are performed at secondary surgery.

RESULTS

Eighty ($n = 80$) patients who had been operated on for sex reassignment surgery were measured for vaginal depth at the time of a secondary surgical procedure. At least 6 months had passed after the primary operation with a median time of 44 months. As we prescribe a strict dilatation scheme for the first year only, we examined statistically if measurements at 6 months were adequate to indicate a stable result. Patients measured between 6 months and 1 year compared with patients measured between 1 and 2 years (when dilatation frequency is up to the patient) showed no statistical difference in terms of depth (10.7 versus 10.5 cm; $P = 0.808$; confidence interval, -2.385351 to 1.863782). The average vaginal depth was 10.2 cm with a median value of 10.4 cm and a range between 1 and 16 cm (Table 1 and Fig. 7). Of the 80 participants, 11 (13.7%) experienced 1 or more postoperative complications, whereas 69 (86.3%) experienced none (Table 1). A majority of the participants adhered to the dilatation regime (68 participants; 85.0%), 11 (13.8%) did not, and 1 participant (1.2%) did not report this. The Pearson's correlation coefficient did not indicate a statistically significant association between vaginal depth and BMI (Pearson correlation coefficient, 0.007; $P = 0.95$) or age (Pearson correlation coefficient, 0.089; $P = 0.43$).

A multiple regression model was used to estimate the effect of different covariates on vaginal depth. In a multivariate analysis, noncompliance with dilatation regime and having had any postoperative complication were found to be associated with the outcome (Table 2). Neither circumcision nor age did statistically affect vaginal depth. We found no association between vaginal depth

Table 1. Vaginal Depth by Covariates

| | Study Participants (80) | Mean Vaginal Depth (Range), cm |
|--|-------------------------|--------------------------------|
| Age, median (range), y, n (%) | 30.5 (18–63) | |
| 18–29 | 39 (48.8) | 9.9 (1.0–13.8) |
| 30–59 | 38 (47.5) | 10.4 (2.9–16.0) |
| 60–69 | 3 (3.7) | 11.2 (9.0–13.4) |
| Body mass index, median (range), kg, n (%) | 23 (17–34) | |
| <19 | 14 (17.5) | 9.3 (1.0–13.2) |
| 19–25 | 39 (48.8) | 10.4 (2.9–13.4) |
| >25 | 27 (33.7) | 10.2 (4.0–16.0) |
| Circumcised, n (%) | | |
| Yes | 7 (8.8) | 9.2 (7.2–11.0) |
| No | 73 (91.2) | 10.3 (1.0–16.0) |
| Complications to first surgery, n (%) | | |
| No complication | 69 (86.3) | 10.5 (1.0–16.0) |
| Bleeding | 6 (7.5) | 8.7 (4.0–13.4) |
| Urinary tract infection | 0 (0.0) | ... |
| Deep infection | 1 (1.2) | 6.0 (NA) |
| Wound rupture | 2 (2.5) | 8.9 (7.2–10.6) |
| Rectal injury | 1 (1.2) | 2.9 (NA) |
| >1 complication | 1 (1.2) | 12.8 (NA) |
| Compliance, n (%) | | |
| Yes | 68 (85.0) | 10.9 (7.0–16.0) |
| No | 11 (13.8) | 6.0 (1.0–10.5) |
| Missing value | 1 (1.2) | 8.0 (NA) |

NA, not available.

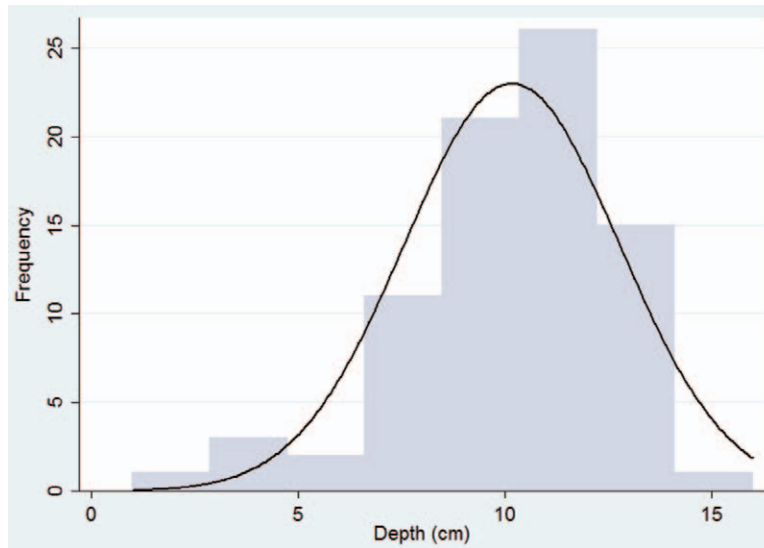


Fig. 7. Distribution curve of neovaginal depth measurements.

Table 2. Estimates of Coefficients from Simple Linear and Multivariate Regression

| Covariate | Linear Regression | | | Multivariate Regression | | |
|-------------------------|-------------------|-------|-----------------|-------------------------|--------|----------------|
| | Coefficient | P | 95% CI | Coefficient | P | 95% CI |
| Age category (y) | | | | | | |
| 18–29 | Ref. | | | Ref. | | |
| 30–59 | 0.45 | 0.46 | –0.74 to 1.63 | 0.14 | 0.78 | –0.84 to 1.12 |
| 60–69 | 1.29 | 0.41 | –1.83 to 4.41 | 1.10 | 0.48 | –1.97 to 4.18 |
| BMI category | | | | | | |
| <19 | –1.15 | 0.16 | –2.76 to 0.46 | –0.78 | 0.30 | –2.27 to 0.71 |
| 19–25 | Ref. | | | Ref. | | |
| >25 | –2.11 | 0.75 | –1.51 to 1.08 | –0.40 | 0.43 | –1.40 to 0.60 |
| Circumcised | | | | | | |
| No | Ref. | | | Ref. | | |
| Yes | –1.11 | 0.28 | –3.15 to 0.94 | –0.65 | 0.41 | –2.20 to 0.90 |
| Complications | | | | | | |
| No complication | Ref. | | | Ref. | | |
| Bleeding | –1.74 | 0.10 | –3.80 to 0.31 | | | |
| Urinary tract infection | ... | | | | | |
| Deep infection | –4.46 | 0.07 | –9.33 to 0.41 | | | |
| Wound rupture | –1.56 | 0.37 | –5.03 to 1.91 | | | |
| Rectal injury | –7.56 | <0.01 | –12.43 to –2.69 | | | |
| >1 complication | 2.34 | 0.34 | –2.53 to 7.21 | | | |
| Any complication | –2.11 | 0.01 | –3.74 to –0.49 | –1.47 | 0.06 | –3.01 to 0.07 |
| Compliance | | | | | | |
| Yes | Ref. | | | Ref. | | |
| No | –4.85 | <0.01 | –6.14 to –3.56 | –4.27 | <0.001 | –6.11 to –2.43 |
| Missing value | ... | | | ... | | |

CI, confidence interval; Ref., reference.

and BMI, neither as a continuous variable nor as a categorical variable. Vaginal depth in biological women as published from magnetic resonance imaging scans was 6.3 cm (range, 4.1–9.5),¹⁴ the cast measured 6.9 to 14.8 cm,¹³ and the aroused versus nonaroused averages were 7 to 8 versus 11 to 12 cm.¹² The depth measured after neovaginal reconstruction was thus within the range of normal for biological women for all published measurement modalities (Table 3).

DISCUSSION

Determining the optimal surgical procedure for a complex (re)construction, such as gender reassignment,

cannot be done for all patients as a group. Vaginal depth is the most common area of discussion among patients and surgeons within this field. We compared our data on 80 patients with the literature on biological women and found that the long-term result after sex reassignment surgery using the above-described technique is well within the range of measures in biological women.^{13,14} Possibly, the width of the dilator could affect measurements, which is an inherent shortcoming of a study protocol as described here. We have, however, not experienced that the 30-mm wide dilator was difficult to use in any patient. Although we do not know what percentage of our patients do have heterosexual intercourse, our results indicate that it should

Table 3. Vaginal Depth, Comparison to Biological Vagina

| | Depth (cm) |
|---|---------------|
| Vaginal depth in the present study, depth (range) | 10.2 (1–16) |
| Vaginal depth in biological women | |
| Barnhart et al, ¹⁴ MRI scans (28 women), depth (range) | 6.3 (4.1–9.5) |
| Pendergrass et al, ¹³ cast measurement (39 women), range | 6.9–14.8 |
| Masters et al ¹² (range) | 7–8 vs 11–12 |

MRI, magnetic resonance imaging.

indeed be anatomically possible. Buncamper et al¹⁵ have recently shown that transsexual women operated on using a similar neovaginoplasty technique using penile skin are generally satisfied in terms of functional and aesthetic outcome as determined by questionnaires (Female Sexual Function Index), which is in concordance with our experience.

Using solely penile skin for neovaginal construction is efficient in terms of procedural time consumption with a low rate of major complications.¹¹ Penile skin is supple and non-hair bearing.^{15,16} Furthermore, no intravaginal scarring or donor-site morbidity is inflicted. The secondary surgery, necessitated by the pronounced stretching of the skin in the prepubic area, is a minor 20-minute procedure performed as an outpatient case and has the advantage of also giving the surgeon a late “second look” with a chance to refine untoward scarring or dog-ears, and it may be combined with ancillary procedures, such as breast augmentation. Although small skin flaps, such as perineal flaps, could be used to widen the posterior fornix, we do not use these because the secondary surgery is scheduled anyway, and therefore, such corrections are handled then. The cosmetic outcome can thus be well controlled (**Supplemental Figs. 1–4**, <http://links.lww.com/PRSGO/A224>). In our study, patients who had extremely limited usable penile skin, that is, because of circumcision or of malformations or scarring, were not included as they would have received primary surgery using another technique. However, during the past 15 years, only 4 patients were operated on with another technique (2 were circumcised and had a short penis, 1 had a congenital micropenis, and 1 patient had a previous injury to the penis). Consequently, our experience is that nearly all patients will have sufficient skin if all skin is used for the vaginal lining and that occurrences with insufficient penile skin are very few. The surgeon’s discretion will have to guide whether circumcized patients have enough skin for this technique. Furthermore, it should be noted that penile measurements have not been performed and that other geographical populations may have less available skin. We prescribe a vaginal dilatation protocol for at least 1 year after surgery where the patient uses a dilator to prevent contracture of the vaginal vault (20 minutes 2–3 times daily). Patients who admitted to not having adhered to the prescribed postoperative dilatation regimen had, as expected, a significantly reduced average vaginal depth with almost 4 cm. Empirically, dilatation has limited effect in increasing depth but is necessary to prevent reduction of the vaginal space or, in worst case, even collapse and protrusion.^{18,19} In comparison to surgical techniques using scrotal flaps or skin grafts, our postoperative dilatation protocol is not significantly different.²⁰

The use of pedicled intestinal tissue^{7,21} may limit the need for postoperative dilatation but impose possible long-term risks of colitis²² and a perceived increased morbidity by operating intraabdominally. Age at primary surgery was not correlated with vaginal depth, and the mean difference in centimeters between age groups was within 1.3 cm. Having had any complication was associated with lesser neovaginal depth. Nonetheless, because this group was small, the presence of 2 patients with a major complication (rectal injury and deep bleeding, respectively) and a resultant very shallow depth makes the overall effect of less serious complications difficult to interpret. In contrast, bodily habitus as approximated by BMI, which could be expected to lessen the vaginal depth because of intraabdominal downward pressure, did not affect the outcome negatively. This indicates that this technique is also suitable for heavier patients, and such parameters should not be the basis for diverting the surgeon toward other techniques.

CONCLUSIONS

Benefits of using solely penile skin for creating a neovagina in transsexual patients include reduced scarring, avoidance of intravaginal scar contracture, and vaginal lining without hair-bearing skin. In conclusion, these results support the use of solely penile skin for neovaginal construction to accomplish an anatomically adequate neovaginal depth in the vast majority of patients, provided that the postoperative dilatation protocol is adhered to.

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