

Construction of Sensitive Labia Minora–Clitoris–Clitoral Hood Complex in Sex Reassignment Surgery in Circumcised Populations

Butterfly Flap

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Introduction: The construction of the labia minora from preputial tissues in uncircumcised patients and the preservation of the sensitivity of the labia minora are not new ideas. However, evidently, this technique is designed for uncircumcised cases.

There is no preputial tissue in the circumcised population. However, this tissue, whose inner and outer layers have different structures and appearances, is critical in the construction of the labia minora. Instead, there is an area of reepithelialization and reinnervation that heals secondarily or is closed primarily, depending on the circumcision. Also, this new skin area is devoid of the natural oily secretions of the prepuce. In addition, the removal of preputial tissue in circumcised individuals may cause uncertainty in terms of vascularity or sensitivity. In this study, we share our clinical experience regarding large labia minora creation (with preserved flap circulation without vaginal reconstruction concerns) and the use of most of the urethra as a mesh graft in the circumcised population.

Materials and Methods: Between 2010 and 2022, 19 cases were operated on with this technique. All cases were primary interventions for male-to-female sex reassignment. Because this design of the sensitive inner surface of the labia minora, which ensured vascular safety, was not found in the literature, the design was named “butterfly flap” because of its shape.

Evaluation of Sensation: The area corresponding to both wings of the butterfly flap was evaluated with the Semmes Weinstein Monofilament test, with the patient's eyes closed, in the preoperative period. Likewise, the sensitivity of the inner surface of the labia minora in the first year of 10 patients who were able to attend follow-up clinical examination was evaluated with the same method.

Results: In our study, a clitoris and a labia minora with sensory innervation were obtained by elevating the superior 180-degree area of the neurovascular bundle surrounding the penis and using the butterfly flap we prepared in the area fed by this bundle. Fourteen cases stated that the sensation of the newly formed labia minora was erogenous and different from the tactile sensation on the body of the penis.

Key Words: sex change surgery, male-to-female sex change, sex reassignment surgery, vagina reconstruction, sensitive labia minora reconstruction, clitoris–labia minora complex reconstruction

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After the first transgender male-to-female sex reassignment operation was performed in 1930, researchers have focused on finding a technique that would allow the safe and effective execution of the procedure. The main concern regarding surgical outcome was the functional and aesthetic status of the external genitalia.^{1–4} Vaginoplasty is the primary surgical problem in male-to-female sex reassignment

surgery. There are many surgical techniques that have been reported, but none of them are ideal.^{4–6} There is also a study in the literature stating that the urethra, which is used in the formation of the neovagina with penile inversion, is the main source of sensation and is responsible for creating orgasm at the base of the vagina.⁵ The clitoris, its prepuce, and the labia minora remain among the most difficult structures to construct. To date, there are no exact guidelines describing how to reconstruct the clitoris, clitoral hood, or labia minora; therefore, the preferred technique depends on the surgeon, which may lead to different outcomes.⁷ The construction of the labia minora from preputial tissues in uncircumcised patients and the preservation of the sensitivity of the labia minora are not new ideas.⁸ In fact, the sensitive area on the inner surface of the labia minora was named as the “Chonburi flap” by Watanyusakul. Again, Watanyusakul^{9,10} stated that an ideal vulva could not be reconstructed aesthetically with penile inversion and explained the necessary aesthetic gains.

However, evidently, this technique is designed for uncircumcised cases. The prepuce has various characteristics, such as denser innervation than the skin of the proximal penis, histologically mucosa-like thickness, and a light pink appearance. These qualities make the prepuce an excellent resource for natural female labia minora reconstruction. In circumcised cases, however, the prepuce is lost to a large extent, and depending on circumcision technique, scars may have formed in the area surrounding the glans. Another problem in sex reassignment surgery in circumcised cases is that if a part of the penile skin is used on the labia minora in the absence of prepuce, there is no material left for penile inversion.

In the present vaginoplasty, the vascularized urethral flap is essential, and therefore, it is of adequate length and is never the limiting factor in vaginoplasty. Using penile disassembly, the corpus spongiosum is completely preserved and ensures an excellent blood supply. Also, the urethral flap allows a wider neovagina, especially the introitus. If the penile skin is insufficient, the creation of the vagina depends on the urethral flap, which also provides moisture and sensitivity to the neovagina.

There is no preputial tissue in the circumcised population. However, this tissue, whose inner and outer layers have different structures and appearances, is critical in the construction of the labia minora. Instead, there is an area of reepithelialization and reinnervation that heals secondarily or is closed primarily, depending on the circumcision. Also, this new skin area is devoid of the natural oily secretions of the prepuce. In addition, the removal of preputial tissue in circumcised individuals may cause uncertainty in terms of vascularity or sensitivity. In this study, we share our clinical experience regarding large labia minora creation (with preserved flap circulation without vaginal reconstruction concerns) and the use of most of the urethra as a mesh graft in the circumcised population.

MATERIALS AND METHODS

Patients

Between 2010 and 2022, 19 cases were operated on with this technique. All cases were primary interventions for male-to-female sex reassignment. The patients were between 25 and 32 years of age.

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All cases were circumcised between the ages of 1 and 9 years and had no complications related to circumcision. The techniques applied for circumcision were unknown. Two cases were hepatitis B carriers, and there were no other comorbidities. Estrogen (estradiolum) and antiandrogen (cyproterone acetate), which they used as hormone replacement therapy, were discontinued 10 days before the operation. In all cases, the proximal part of the penile skin was designed to form the outer surface of the labia minora, and the distal part to form the sensitive inner surface. Because this design of the sensitive inner surface of the labia minora, which ensured vascular safety, was not found in the literature, the design was named “butterfly flap” because of its shape. In all cases, the vaginal wall was created by using the excised urethra as a mesh in addition to the skin materials left over from the scrotum and penile skin. Therefore, there was no need for an extra skin graft donor site.

Surgical Technique

All patients were placed in the lithotomy position. The operative field was prepared from the epigastrium to the thighs, including the genitalia and anus. The incision was started by incising the borders of the butterfly flap shown in Figures 1A and B. The skin, along with the loose superficial fascia just below, was elevated from the border of the butterfly flap to the root of the penis with blunt scissors. The neurovascular bundle was explored. When the dorsal penile vein was considered as the center, the entire neurovascular area (including at least 90 degrees to the left and 90 degrees to the right) was elevated over the corpus cavernosum. In this way, the entire neurovascular bundle and fascia corresponding to the dorsal 180-degree area of the penile circumference were skeletonized as a pedicle. As seen in Figure 1D, the distance from the most distal border of the butterfly flap to this

neurovascular bundle was not more than 1 cm. The 1.5×2 -cm glans at the most distal part of the neurovascular flap was elevated to be a part of the butterfly flap. This part of the glans was prepared for the purpose of forming the neoclitoris as seen in Figure 1E. The fixation of the neoclitoris and labia minora inner surface complex to the symphysis pubis 1 cm above the urethra entrance is seen in Figure 1F.

The scrotum was opened with a straight incision from the ventral-distal part of the penis down the scrotal raphe up to 2.5 cm close to the anus, and the floor for the labia majora was created. Again, starting from the end of this incision close to the anus, the pelvic floor muscles (levator ani) were incised. The incision in the form of an arc of approximately 3 cm in width, made 2 cm away from the anus and parallel to the anal sphincter, as indicated by the red dotted line in Figure 2, and the incision perpendicular to this incision merges inferiorly at 6 o'clock. On the back of the penis, the skin of the penis behind the butterfly flap is cut along the line indicated by the red dot. Here we should not forget that the neurovascular bundle connected to the butterfly flap is preserved. After the skin subcutaneously is passed, at this point, the pelvic floor muscles are cut vertically 3 to 4 cm with electrocautery. This opening will be the starting point of the vagina. The vaginal pouch is opened with the help of blunt soft dissection and finger. The vertical incision in the scrotum continues most distally so that the entire penile skin is completely divided into 2. Afterward, the labia majora will be formed from the skin of the scrotum, and the outer surface of the labia minora will be formed from the skin of the penis. This outer surface will merge with the wings of the butterfly flap (Fig. 2).

Then, using fingers and a sponge, a tunnel was made for the neovagina between the rectum and bladder by blunt dissection. The tunnel depth of 14 cm was sufficient for the silicone inflatable stent we

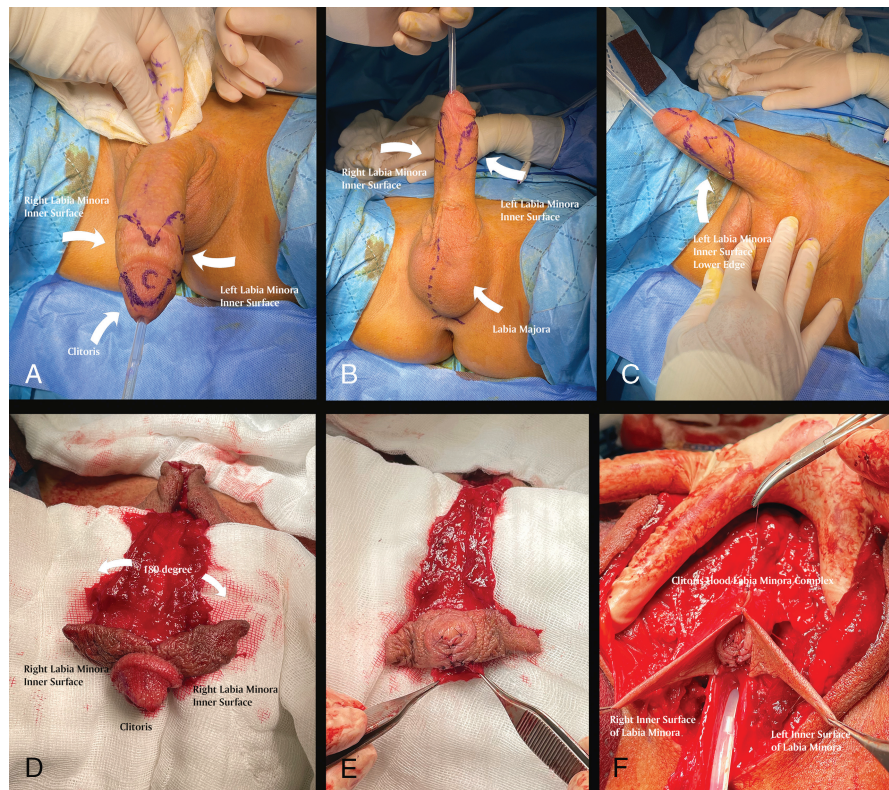


FIGURE 1. Surgical planning and dissection. A, Dorsal view of the butterfly wing design. B, Bottom view of the butterfly wing design. C, Side view of the butterfly flap design. D, Butterfly flap with elevated neurovascular pedicle. E, The glans piece folds over itself to form the clitoris. F, Fixation of the clitoris to the symphysis pubis and the position of the wings. [full color online](#)

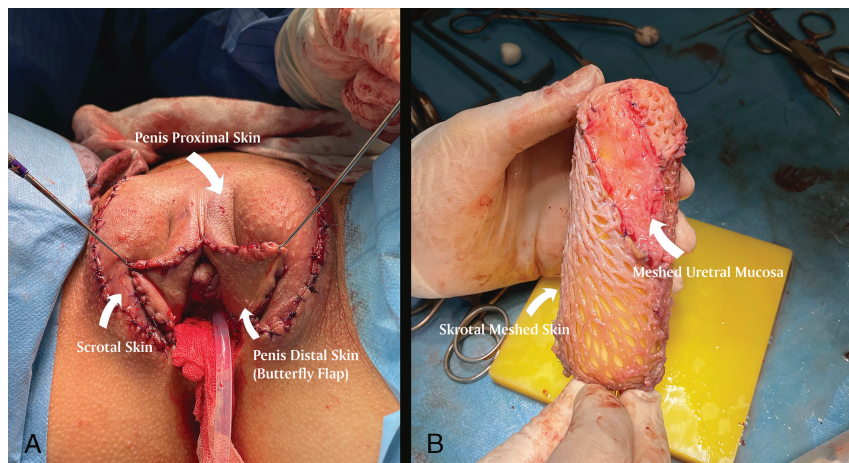


FIGURE 2. A, Final stage of the surgical procedure, labia-clitoris-clitoral hood formation. B, Preparation of vaginal inner surface skin grafts. full color
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used. The vaginal canal was temporarily filled with gauze packing to prevent capillary surface bleeding. Preparation continued up to the inner aspect of the scrotum. The testes were isolated together with fat and the spermatic cord. The spermatic cords were transected and ligated proximally, close to the external inguinal canal. Then all cords and testes were excised. The urethra, together with the corpus spongiosum, was separated from the corpus cavernosum. Because the corpus cavernosum bifurcates on both sides of the symphysis pubis, it was traced to the starting point, and its roots were ligated and then excised (Fig. 1).

The penile skin remaining on the proximal part was cut in half to the point where it would form the clitoral hood. Then, both parts were fixed on both sides of the neovaginal pouch. These would form the outer surfaces of the labia minora. These outer surfaces were brought together at this point with the inner surface of the labia minora that we created at the beginning of the procedure, and their edges were sutured to one another. Thus, the labia minora was completed (Fig. 3A). The labia majora consisted only of the skin of the scrotum. Of course, the spongy soft tissue under the skin and the fascia were preserved. These would provide volume to the labia majora. The skin sections remaining from the scrotum and penis and the excised urethra were prepared as mesh and adapted on the Inflatable Vaginal Stent (Silimed Industria de Implantes Ltda) with the contact surface on the subcutaneous side. At this point, it is crucial to ensure that the implant should be fully inflated by 190 cc with saline (Fig. 3B). This preparation was then deflated, placed in the neovaginal pouch, and reinflated inside. This maneuver is performed to prevent the rupture of the grafts. The graft does not need to be sutured at the base or bottom of the vaginal pouch. It is important for safety to fix the stent from the wash tubes in the neck to the pelvic floor with sutures so that it does not come off.

Evaluation of Sensation

The area corresponding to both wings of the butterfly flap was evaluated with the Semmes Weinstein Monofilament test, with the patient's eyes closed, in the preoperative period. Likewise, the sensitivity of the inner surface of the labia minora in the first year of 10 patients who were able to attend follow-up clinical examination was evaluated with the same method (Fig. 4; Video 1, Supplemental Video File, <http://links.lww.com/SAP/A846>).

POSTOPERATIVE CARE

In general, a 5-day hospital stay was deemed appropriate for the patients. Even if postoperative early mobilization was allowed, restriction

of movement and pedaling in the bed were recommended. Nutrition was allowed with regimens 1 to 2. Washing was done daily with a mixture of rifampicin and saline through the vaginal stent and left to free drainage. A urinary catheter was in place for 5 days. Before removing it with the stent, patients performed bladder exercises. Parenteral antibiotics were continued for 5 days. At the end of the fifth day, the vaginal stent was deflated and gently removed from the vagina. It was observed that more than 90% of the grafts attached to the vaginal wall, even lower rates would be sufficient for subsequent epithelialization. Then, a condom was put on a custom-made, soft surface, fixed stent with a diameter less than the stent, which was then placed in the

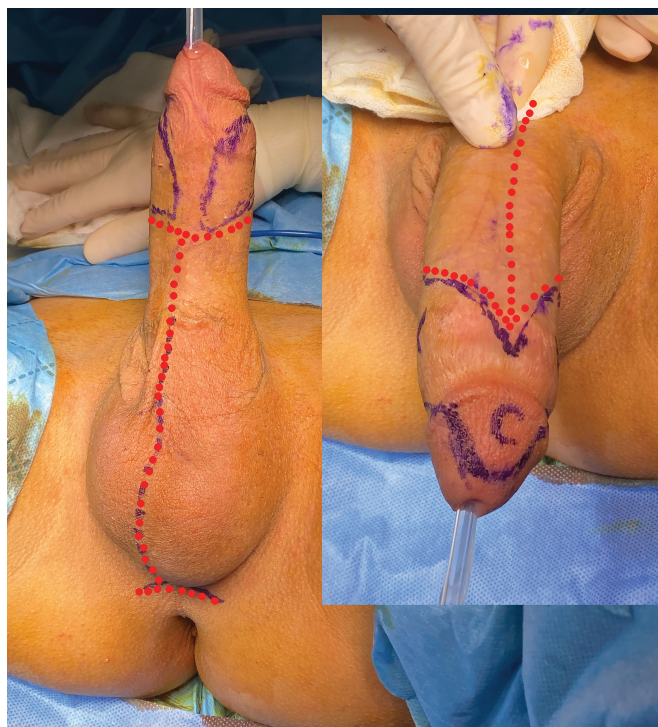


FIGURE 3. With a pencil, straight lines indicate the boundaries of the clitoris-labia flap. The line of dots indicates the incision to form the outer surface flap of the labia minora. full color
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FIGURE 4. Different phases of the healing process. full color
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neovagina. On the first month, the use of a soft silicone vaginal dildo for a year was recommended (Fig. 5).

RESULTS

The patients were followed up closely for the first 3 weeks of recovery, and their further follow-up continued by remote inquiry or invitation to the clinic, depending on availability. Follow-up times ranged from 0.5 to 7 years. During the follow-up period, the status of 10 patients was determined by examination, and the status of 9 patients was obtained by questioning their sexual activities and genital sensitivities with a telephone questionnaire.

In one patient, resuturation was performed because of a 1×0.5 -cm superficial necrosis in the distal part of the labia minora, and the patient recovered without any sequelae in the follow-up. Urethral stricture did not occur in any of the patients.

In the face-to-face examination and questionnaire, the state of having an orgasm, vaginal moistness, orgasm points, clitoral sensitivity, and labia minora sensitivity were evaluated. All patients stated that they

could have an orgasm during sexual intercourse, the vaginal moistness was sufficient, and the labia minora was sensitive to touch.

When the Semmes Weinstein Monofilament sensory test results of 10 cases with clinical postoperative long-term follow-up were compared, it was determined that the sensitivity of 8 cases was higher than in the preoperative period. In all patients, the sensitivity of the neoclitoris was positive at level 1.65 with 0.008 g force. Although labia minora sensitivity was observed to be 100% at level 3.84 with 0.6 g force in all patients, 7 cases reported being sensitive at level 3.22 with 0.16 g force, and 4 cases reported sensitivity at level 1.65 with 0.008 g force. Six of these patients with long-term follow-up and 5 of those followed remotely by survey stated that labia minora sensitivity increased in the first year, making orgasm easier. Fourteen cases stated that the sensation of the newly formed labia minora was erogenous and different from the tactile sensation on the body of the penis.

A serious complication developed in 1 patient (rectovaginal fistula), the patient underwent reoperation 1 year later, and sufficient correction was carried out. Skin grafts obtained during abdominoplasty were used in the repair. Figure 6 shows examples of other results and



FIGURE 5. Postoperative results. full color
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minor complications. Ecchymosis and superficial dermal injuries healed spontaneously.

DISCUSSION

Many vaginoplasty methods have been described in the literature for male-to-female sex reassignment surgeries. The focus of these techniques is to allow vaginal penetration, which is only one of the functions attributed to the vagina, and to achieve vaginal moistness that facilitates penetration. Because of technical difficulties, neural innervations and sensory flaps required for a real orgasm have been of secondary importance. With the reconstruction of the clitoris from a part of the glans penis, a new threshold has been reached in sex reassignment surgeries.³ Perovic et al⁵ even put the urethral flap at the center of neovaginal sensitivity and orgasm, but this approach is not entirely accurate either. In our own experience, we observed that the urethral flap was not directly associated with erogenous sensation, and that the urethral flap experiences an avascular process in the distal region, finally forming a graft. For this reason, as the graft, we began to use the part of the urethra beginning after the proximal 5 cm by creating a mesh without thinning it. In this way, the urethra contributed to vaginal moistness. The proximal 5-cm urethral flap is only a precaution against urethral stricture. No urethral stricture was observed in our study. There was no erogenous stimulation in this part. Because we were not dependent on penis size in the creation of the neovagina, there was no problem with depth or hair growth in the vaginal pouch.

In our study, a clitoris and a labia minora with sensory innervation were obtained by elevating the superior 180-degree area of the neurovascular bundle surrounding the penis and using the butterfly flap we prepared in the area fed by this bundle. Of course, the type

of innervations obtained from the clitoris and the wings of the butterfly flap that will form the labia minora are different. It was expected that orgasm would be triggered by the erogenous tactile neural stimulus obtained from the glans part in the center of the butterfly flap, and only the tactile sensation would be perceived from the wings of the flap. It is clear that the distal penile shaft, from which the wings of the flap originate, has no role in erogenous stimuli. On the other hand, in the Semmes Weinstein Monofilament test, quantitative characteristics of contact on the inner surfaces of the labia minora were determined, and furthermore, we identified qualitative erogenicity—both of which demonstrated significance. It has been reported in many studies that axonal sprouting does not occur in a single direction after neuronal injuries, but throughout the entire nerve sheath.^{11,12} The clinical observation we obtained from these studies led us to the conclusion that the neural endings in the excised glans penis can expand the erogenous tactile stimulation area by moving in the direction of the flap wings that were also excised and elevated from the inferior-proximal. Although this neural activation requires further studies and evidence, clinical observations are significant.

In light of all these assessments, our study has shown that, with the butterfly flap technique, female genitalia can be created with an aesthetically natural appearance. Also, the labia minora can be reconstructed in addition to the clitoris, and furthermore, this labia minora-clitoris-clitoral hood complex can allow erogenous tactile sensations, thereby promoting orgasm. To express these findings in the context of our circumcised population, which constituted our study group, the method we have put forth can be used in circumcised men very safely. The reason why the uncircumcised population is particularly emphasized has multiple reasons, including the fact that, although many circumcision techniques have been described, it is unclear what kind of



FIGURE 6. Performing the sensory test with monofilaments. full color online

long-term vascular structures develop after these interventions in the peri-glans region, what kind of innervations they have, and what should

be the approach for safe flap elevation. Although the method was planned for use in the circumcised population, we have the preliminary belief that this method will be successful in the uncircumcised population as well. Nevertheless, we would like to point out that this subject may require further clinical studies.

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