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Vaginoplasty with a Pudendal-groin Flap in Male-to-female Transsexuals

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Many vaginoplasty techniques have been introduced to improve the outcomes of sex reassignment surgery for male-to-female transsexuals. Some vaginoplasty patients still require additional skin grafts, making dilation mandatory to overcome shrinkage. We developed a new vaginoplasty method (called the "pudendal-groin flap") that uses pudendal-groin flaps. One of this procedure's advantages is that skin grafts are unnecessary, even for patients with small penises and scrotums. We introduce the procedure here and describe our evaluation of its utility. We retrospectively analyzed the cases of the 15 patients who underwent vaginoplasty using pudendal-groin flaps from May 2010 to January 2016 at our institution. We compared the complications as well as the functional and aesthetic outcomes with those of previous studies. The most common complication was bleeding, which occurred at the corpus spongiosum or while creating a new vaginal cavity. Bleeding can be reduced with more careful hemostasis and dissection. Aside from inadequate vaginal depth in one patient, the incidence of other complications, sexual intercourse, and aesthetic outcomes were acceptable. The pudendal-groin flap is thin and pliable and can create sufficient vaginal depth without skin grafts. The resulting scar is inconspicuous. Our findings suggest that vaginoplasty using the pudendal-groin flap method is feasible.

Key words: vaginoplasty, male-to-female transsexuals, pudendal-groin flap

For transsexuals, sex reassignment surgery (SRS) is an important treatment on the path to becoming their chosen gender, as are psychiatric counseling and hormone therapy. The core procedures for male-to-female (MTF) SRSs are divided into roughly five steps: orchidectomy, clitoroplasty, penectomy, labiaplasty, and vaginoplasty [1]. Although many operative techniques for vaginoplasty have been reported [2-6], the ideal vaginoplasty procedure remains a matter of debate because of the several drawbacks of each method.

For example, both penile skin flaps and penile-scrotal flaps are widely used and are sufficient to create a vagina with sufficient depth in many cases. However, in individuals with a short penis, skin grafts are neces-

sary, and if performed, continuous dilation is essential to prevent contracture. To overcome this downside, Namba *et al.* reported a vaginoplasty procedure using M-shaped pudendo-scrotal flaps, which are not completely reliant on the length of the penis [5] (Fig. 1). Nevertheless, the depth of the new vagina is still limited by the size of the scrotum, and skin grafts are required for patients with small scrotums.

We recently developed a new technique that we named the "pudendal-groin flap" technique, which provides for the construction of a vagina with adequate depth without the need for skin grafts, even for individuals with short penises and/or small scrotums.

We explain our new post-vaginoplasty surgical technique in detail herein, and we describe our study con-

ducted to determine the effectiveness of pudendal groin flap use including our investigation of perioperative complications in a comparison with the results of previous studies.

Patients and Methods

We retrospectively analyzed the cases of the 15 MTF
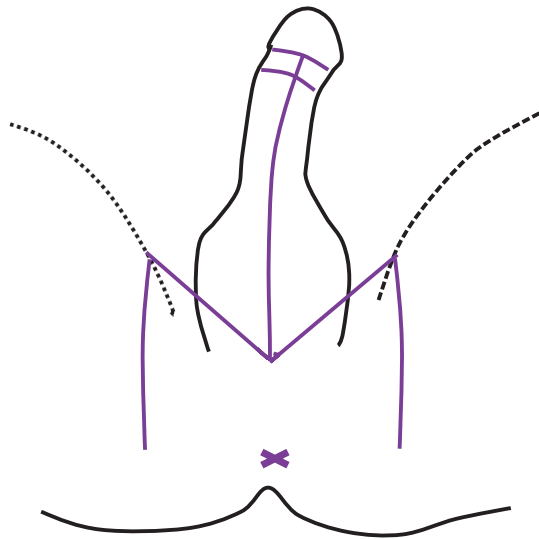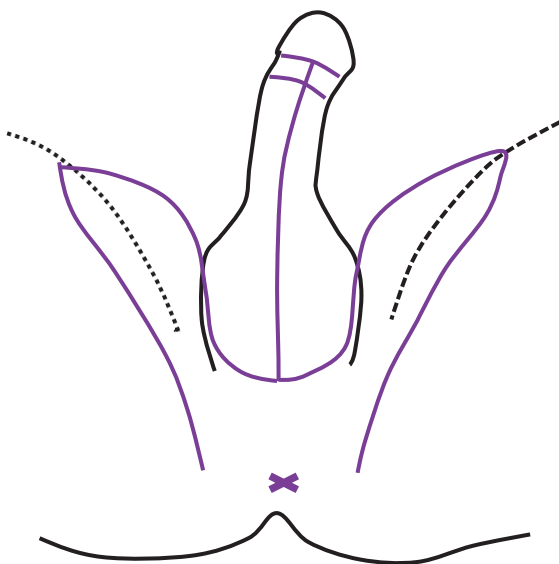

Fig. 1   Design of the M-shaped pudendo-scrotal flap. In this design, the majority of the new vagina is made from the scrotal skin; therefore, the depth of the new vagina is affected by the scrotal size.

patients who underwent vaginoplasty using pudendal-groin flaps at Okayama University Hospital Gender Center in the approx. 5.5-year period from May 2010 to January 2016. This study was approved (No. 1704-002) by the local Ethical Committee Board, and all procedures were carried out with the adequate understanding and consent of each patient. We conducted a retrospective review using patient demographics and surgical data.

The patient demographics analyzed in this study were age at surgery, body mass index (BMI), smoking history, past medical and surgical histories, and the use of medication. The surgical parameters were the operative time, amount of bleeding, length of hospitalization, and intra- and post-operative complications. The details of the pudendal-groin flap surgical technique are provided next.

Surgical technique.   Prior to the operation, the patient undergoes pudendal hair removal with the use of a laser. The surgery is performed under general anesthesia with the patient in the lithotomy position. The flap design (Fig. 2) is achieved by elevating the pudendal-groin and penile scrotal skin flaps. While elevating both flaps, the surgeon should attach a thin layer of fat to the flaps and ensure blood flow by avoiding damage to the feeding vessels in the flaps. For the penile scrotal flap, the dorsal part of the penis skin with superficial fascia is dissected down to the suspensory ligament of the penis, whereas the ventral part is dis-
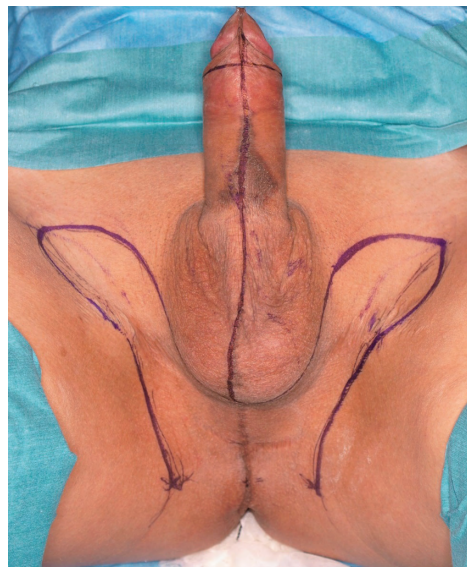

Fig. 2   Design of the pudendal-groin flap. The axis of the flap is extended to the inguinal region.
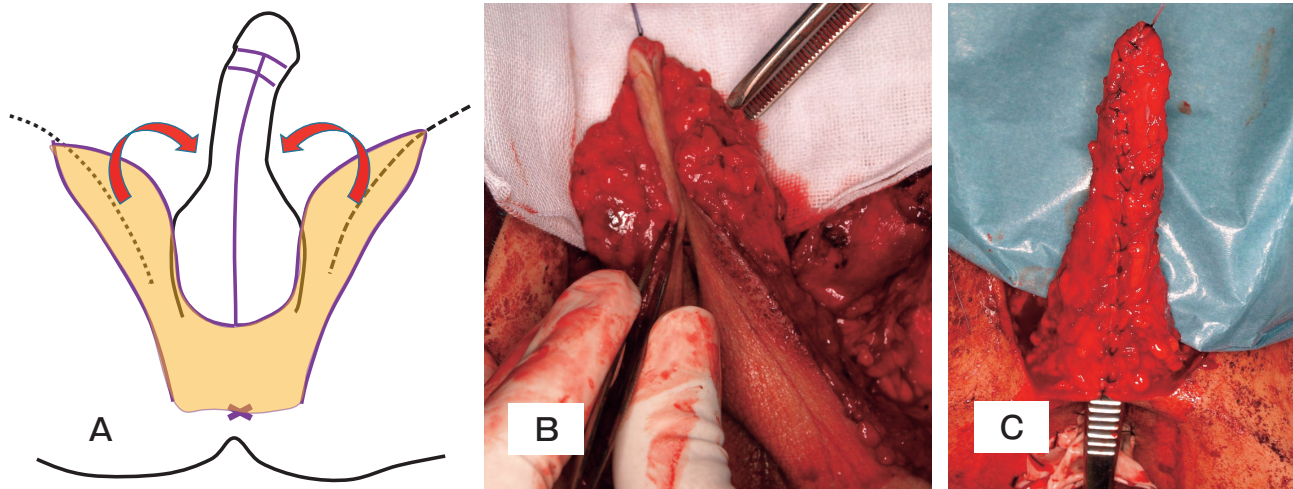
Fig. 3   Creation of the sac lining the new vaginal cavity. **A**, The pudendal-groin flaps are elevated to make a vaginal sac (colored yellow); **B**, Both edges of the flaps are sutured; **C**, The length of the resulting sac was approx. 13 cm for this patient.

sected to just above the bulbospongiosus muscle.

Orchiectomy.   The urologist is responsible for performing the orchiectomy. The spermatic cord is divided into the ductus deferens and testicular vessels, and these are resected at the level of the deep inguinal ring.

Clitoroplasty.   The plastic surgeon performs the clitoroplasty. A new clitoris is created from part of the glans penis with a dorsal neurovascular bundle. The neurovascular bundle is carefully dissected from the corpora cavernosa, and one stump of the glans is attached to the other using buried suture. The new clitoris is then attached to the lower pubic symphysis.

Penectomy.   After a urethral catheter is inserted into the urethra, the corpora cavernosa is separated from the corpus spongiosum down to the crusa of the penis. The corpora cavernosa is then amputated at the level of the crusa. To prevent postoperative pain, the stumps from both corpora cavernosa are sutured and the corpus spongiosum is subsequently shortened to a quarter of the original length of the penis.

Vaginoplasty.   The central tendon is dissected and the rectourethralis and levator ani muscles are transversely divided by the urologist. The Denonvilliers' fascia is then exposed, and a cavity for the new vagina is created in the midst of the adipose tissue between the rectum and the Denonvilliers' fascia. There are 2 important points for this procedure.

First, blunt finger dissection is the most reliable method to prevent bleeding. Second, 2 fingers are used simultaneously: one index finger is used to create a cavity, while the other is inserted into the rectum to confirm the distance to the rectum and to avoid rectal injury. Subsequently, the plastic surgeon thins the pudendal groin flap, paying careful attention to the blood flow, and sutures both edges of the flap together to form a sac lining the new vaginal cavity (Fig. 3). The top of the sac is fixed to the bottom of the adipose tissue in the cavity using anchor sutures (Fig. 4).

Labiaplasty.   After an urethroplasty, both sides of the scrotal flap are pulled down and sutured in order to create a new labia major. The remaining part of the penile flap is used to form the labia minor. This section is divided into 2 sections, folded, and then sutured at the labia major. Gauze is placed inside the new vagina to prevent a prolapse after surgery (Fig. 5).

Results

The 15 patients' demographics are summarized in Table 1. The average age ± standard deviation (SD) was 34.2 ± 4.0 years, and the average BMI ± SD was 24.8 ± 1.8 kg/m^2. The median follow-up period was 29 months (range 1-71 months). Though cross-sex hormone therapy was initiated prior to surgery for all patients, the therapy was stopped in all cases before surgery and restarted after surgery in order to avoid the risk of thrombosis.

Some of the patients had a history of depression or asthma, but none of these conditions required treat-

ment with internal medicine before the surgery. One patient who suffered from ulcerative colitis required oral treatment at the time of the surgery. Evidence of a previous right orchidectomy caused by testicular torsion and atrophy of the right testis was discovered in one patient during surgery. The mean operative time and estimated median blood loss were 437 min (range 359-

500 min) and 610 ml (range 90-2,000 ml), respectively. The average hospital stay was 13 days (12-16 days).

Table 2 shows the perioperative complications encountered. During the follow-up period, neither perioperative surgical site infection nor thrombosis was observed. The most common intraoperative complication was bleeding, necessitating postoperative blood transfusion in 4 patients (27%). Another intraoperative complication, urethral laceration, occurred in one patient (7%) and was treated with oversewing and temporary placement of a urethral catheter. Although a ureterocutaneous fistula developed after the surgery, it healed with conservative treatment and there was no need to extend the hospitalization period due to the complication.

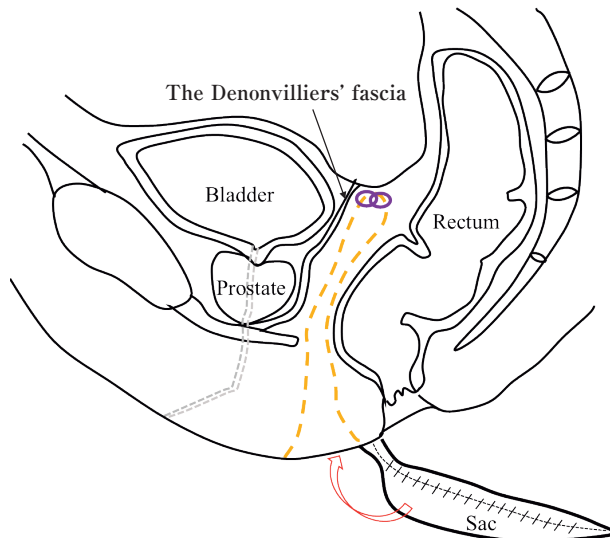With regard to postoperative complications, 1

Fig. 4   Schema of the relationship between the sac and the new vaginal cavity. The sac was fixed to the top of the vaginal cavity (yellow dotted line) using anchor sutures (purple circles).
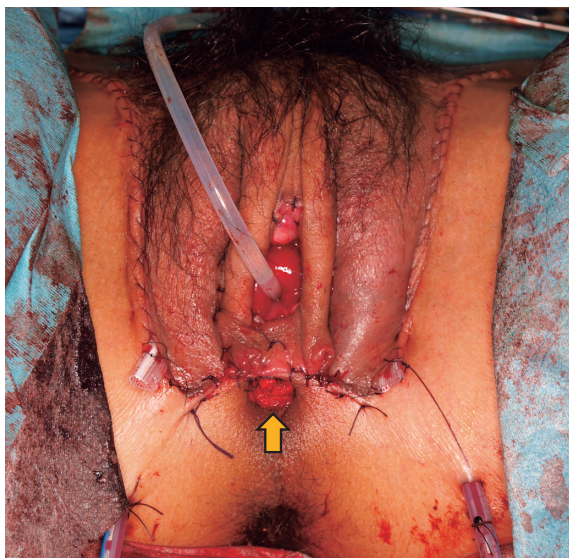

Fig. 5   Just after surgery. The labia major and minor are created from the penile scrotal flap. The new vaginal introitus is indicated (↑).

Table 1   Patient demographics

Variables	Mean ± SD	no. (%), (n = 15)
Age, year	34.2 ± 4.0	
Mean BMI kg/m^2	24.8 ± 1.8	
Smoking		1 (7)
Medical History		
Depression		1 (7)
Asthma		2 (13)
Ulcerative colitis		1 (7)
Surgical History		
Breast augmentation surgery		1 (7)
Inguinal hernia repair		1 (7)
Sterilization		2 (13)
Orchidectomy due to testicular torsion		3 (7)
Fracture reduction of lower leg		4 (7)
Cervical ganglion removal		5 (7)

SD, standard deviation; BMI, body mass index.

Table 2   Intraoperative and postoperative complications

Complication	no. (%), (n = 15)
Intraoperative	
Surgical bleeding requiring transfusion	4 (27)
Urethral laceration	1 (7)
Postoperative	
Prolapse of new vagina	1 (7)
Partial flap necrosis (penile-scrotal flap)	2 (13)
Vaginal stenosis	2 (13)
Persistent neoclitoral hyperesthesia	1 (7)
Secondary postopearative corrections	1 (7)

patient (7%) reported painful prolapse of the new vagina starting on the 6th postoperative day and persisting until the present day. As she expressed reluctance to undergo a second surgery, we continue to monitor this patient through routine follow-up. Partial necrosis of the penile scrotal skin flap occurred in 2 patients (13%), and was managed successfully with outpatient treatment for partial debridement. Impaired circulation of the pudendal-groin flap was not observed. Two patients (13%) developed mild to moderate vaginal stenosis, which was treated with dilation. Other complications consisted of new clitoral hyperesthesia after surgery in 1 patient (7%) and the need for secondary clitoral hood correction in another patient (7%), who experienced pain due to the exposed new clitoris.

The depth of the new vagina for most of the patients was over 8 cm. Although precise measurement was not possible, the depth for all patients except one was sufficient to have sexual intercourse. The patient who had a shorter vaginal depth, approx. 5-6 cm, complained of discomfort during sexual activity. No incidents of abnormal urinary stream that required revision surgery occurred.

Discussion

SRS is the final stage of treatment for transsexual patients to assume their desired gender. MTF SRS involves the creation of a new vagina with satisfactory sexual function and appearance. Many surgical methods for vaginoplasty have been reported [2-6]. These surgical techniques can be divided into 3 main categories according to the origin of the donor tissue: (1) skin grafts, (2) penile-scrotal skin flaps, and (3) pedicled small or large bowel transplants [7].

Vaginoplasty with split skin grafts for transsexuals was first reported by Laum and Fick in 1974 [2]. More recently, Hage and Karim published a report on full-thickness skin grafts (FTGs) obtained from the lower abdomen of six MTF patients for secondary vaginoplasty [8]. As demonstrated in those reports, techniques utilizing skin grafts have several advantages such as a simple one-stage surgical procedure, the ability to create a deep, wide, and hairless new vagina, and a low risk of severe complications. However, there are also several disadvantages including the need for daily dilation due to shrinkage of the skin graft, the presence of a conspicuous scar at the donor site, and the lack of nat-ural lubrication.

To overcome these limitations, new techniques using genital flaps were developed. Gillies and Millard reported vaginoplasty using penile skin flaps with satisfactory results in MTF transsexuals [3]. Van Noort and Nicolai also reported a different technique using penile-scrotal skin flaps [4]. Several modifications to these techniques were later introduced [9,10]. Genital flaps such as penile skin flaps and penile-scrotal skin flaps are widely used because they have a lower tendency to contract compared to skin grafts, and local innervation can be provided.

However, genital flaps present a problem if the patient has a short penis. FTGs are necessary for these patients to obtain enough skin to create a deep and wide vaginal cavity. Namba *et al.* reported the use of M-shaped pudendo-scrotal flaps, which is a breakthrough technique as the vaginal depth is unaffected by the penile length [5] (Fig. 1). However, there is still a drawback in that skin grafts are essential for patients with small scrotums.

Several recent studies of the use of pedicled bowel segments have been published [6,11-13]. With this technique, excessive transient discharge occurs over approx. 3 months, although many advantages are also present. For example, there is no shrinkage or need for postoperative dilation, and the abdominal scar hardly stands out (due to the use of laparoscopy). In addition, the appearance, texture, and lubrication are natural. For the above reasons, use of the pedicled bowel segments method is expected to increase in the future.

Nevertheless, some patients are not suitable for bowel transplants, such as those who have undergone intestinal surgery, those who suffer from bowel diseases such as ulcerative colitis, patients who are opposed to the use of the intestine, and for other reasons. For these patients, skin flap techniques remain the first choice for vaginoplasty, and improvements to eliminate the drawbacks of using a flap are necessary.

The surgical techniques for vaginoplasty have undergone various transitions to date, but no consensus exists regarding the ideal surgical method to create a new vagina. Due to the above historical reasons, we devised a novel technique that we refer to as the pudendal-groin flap technique. This technique can be used to create a vagina with sufficient depth that is not influenced by the size of the penis and scrotum by extending the major axis of the flap to the inguinal region. The

flap is pliable and thin and can maintain the shape of the new vaginal cavity well enough for sexual intercourse. The length of the flap harvested is approx. 13 cm, and the donor site scar is inconspicuous because the incision line is parallel to the relaxed skin tension line (Fig. 6).

We evaluated the complications observed in our study population and compared them with those in previous studies involving genital flaps. The previously reported complications for penile skin flaps, penile-scrotal skin flaps, and M-shaped perineo-scrotal flaps are as follows: Amend *et al*. reported intraoperative bleeding in 8.3% of 24 patients [14]. Reed *et al*. reported both bleeding that required blood transfusion and new vaginal prolapse in 2.4% of 250 patients, respectively [15]. Rossi *et al*. reported that urethral laceration was present in 0.3% of 332 cases [16]. Namba *et al*. reported that partial necrosis of M-shaped perineoscrotal flaps occurred in 2 of 6 patients [5]. Wagner reported vaginal shrinkage as the most frequent complication, occurring in 10% of their patients [17].

Genital pain and secondary postoperative correction after vaginoplasty have also been reported in 9% and 54.2% of patients, respectively [14,18]. Other complications such as deep venous thrombosis, incontinence, meatal stenosis, and rectal injury have been reported, but did not occur in our study population [15,19-21]. Even taking into account the relatively low number of cases in our study (n = 15), compared with the above results, our patients had a slightly higher incidence of bleeding. Our review revealed that bleeding occurred at the corpus spongiosum after penectomy or the creation of the new vaginal cavity. The cause of the bleeding at the corpus spongiosum was oozing, because the bleeding site was unclear during surgery. On the other hand, the cause of the bleeding from the new vaginal cavity was damage to the venous plexus. Bleeding at both locations occurred at an early stage when we were still unfamiliar with the procedure. The amount of bleeding has been better managed in recent years. Overall, our rate of complications can be considered acceptable.

All but one of the patients had boyfriends who attempted vaginal sexual intercourse. One patient requested secondary postoperative correction, which was performed. Our patients' sexual activity and aesthetic outcomes after surgery are considered to be not inferior to those of previous results (Fig. 6).

However, this study has several limitations. It was a retrospective review with a small number of cases, and the extent of patient satisfaction is not completely clear. Although the disruption of blood circulation in the pudendal-groin flap did not occur in this patient series, the method used to determine the flap survival area was not objective. Because blood flow at the flap apex followed very thin capillary vessels, we determined the
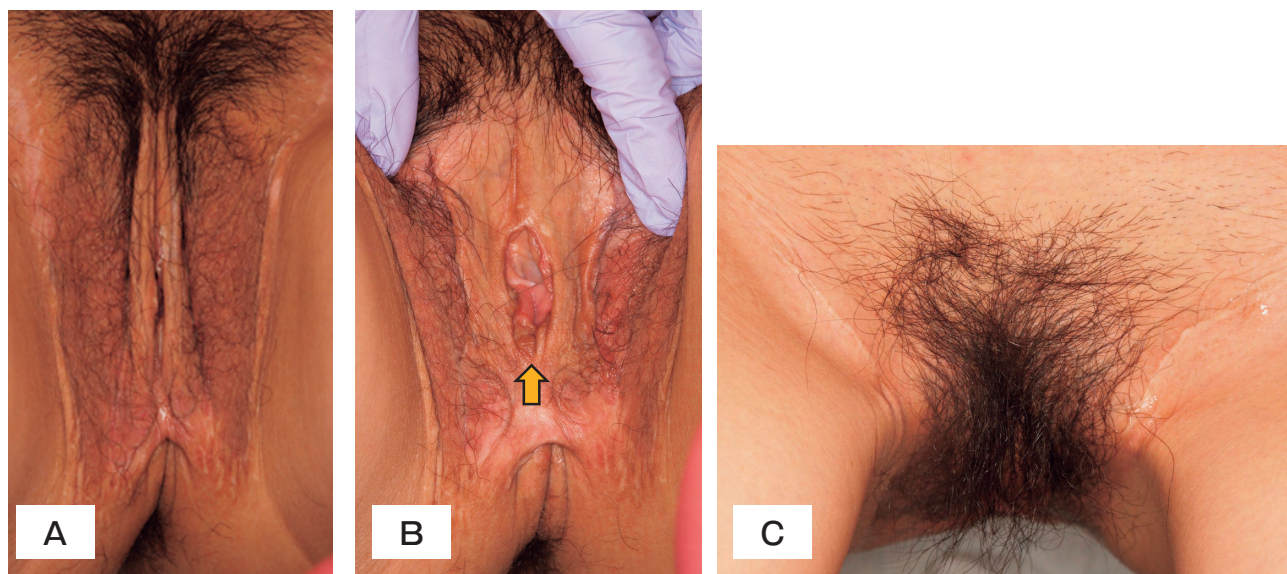

Fig. 6　Aesthetic results after surgery. **A**, View of the genital region at 18 months post-surgery. After the swelling subsided, the new vaginal introitus was invisible within the labia minor. The patient was satisfied with the surgical outcome; **B**, The new vaginal introitus is indicated (↑); **C**, This is another patient. Frontal view of donor site approx. 4 years after surgery. The scar is unremarkable.

area based only on bleeding from the flap margin during surgery.

There is a need for prospective studies with larger patient groups and longer follow-up periods, including a patient-reported outcome measure [22-24] to better evaluate the outcomes of SRS. In addition, issues regarding the evaluation of the blood supply can be solved through intraoperative visualization using indocyanine green imaging. Using this imaging method, the flap survival area can be determined easily and objectively [25-27].

We have reported herein the outcomes of vaginoplasty using pudendal-groin flaps, a method that eliminates the drawbacks of using genital flaps. Based on the results of our analysis, this method provides a valuable option for SRS.

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