Perforator Flaps for Perineal Reconstructions

Niri S. Niranjana, M.S., F.R.C.S. (Plast)¹

ABSTRACT

Whenever there is soft tissue loss from the perineum there are many options for reconstruction. These include allowing the wound to heal by secondary intention and the use of local random or axial pattern flaps, regional flaps, or free flaps. The axial skin flap can be defined as a flap based on known constant vessels of the subcutaneous tissue and its vena comitantes. The perforator flap on the other hand is a randomly selected perforator consisting of an artery with vena comitantes, which perforate the deep fascia to supply the subcutaneous vascular networks. The perineum has a rich blood supply with multiple perforating vessels, and the vascular network of the perineum is similar to that of the head and neck. Anatomically, there exist circles of anastomosis around any orifice or joint. The perineum has two outlets: the urogenital and the anal. The arterial network of the perineum is supplied by the vessels of the lower abdomen, medial thigh, and gluteal region. Knowledge of the rich blood supply of the perineum can be applied to harvest the various types of perforator flaps in perineal reconstruction.

KEYWORDS: Skin flap, perforator flaps, perineal reconstruction

The first ever skin flap known in the field of reconstructive surgery for nasal reconstruction was an axial pattern flap in 600 BC.¹ Almost a thousand years later the flap used for the same purpose was a random pattern flap from the arm.² Even though the blood supply of the skin was extensively studied and reported by Manchot in 1889 and Salmon in 1936,³ this information was not applied by the reconstructing surgeons until a similar study was performed by Taylor and Palmer⁴ in 1987, which identified an average of 374 cutaneous perforators in the body. We now have many free and pedicled perforator flaps in almost all parts of the body.

The perineal region has excretory and sexual components. Malfunction or dysfunction of any one of these can affect the whole body. Nature has provided a very rich blood supply to this area, fed by the femoral

and iliac arteries (similar to the face with the external and internal carotid vessels). Branches from these vessels anastomose with each other around the urogenital and anal orifices and this enables reconstructing surgeons to use skin flaps based on perforators from these vessels.

Soft tissue reconstruction is challenging. To achieve the best outcome in terms of maintaining the normal function and the cosmetic appearance, local flaps based on perforators are the best as they replace like tissues.

ANATOMY OF THE BLOOD SUPPLY OF THE PERINEUM

In 1889 Manchot⁵ divided the cutaneous area of the perineum into anterior and posterior regions. They

¹Department of Plastic and Reconstructive Surgery, St. Andrews Centre, Broomfield Hospital, Chelmsford, Essex, United Kingdom.

Address for correspondence and reprint requests: Niri S. Niranjana, M.S., F.R.C.S. (Plast), P.O. Box 9520, Chelmsford CM1 9DF, Essex, United Kingdom.

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Figure 1 Vascular anatomy and perforators of perineum. SCIA, superficial circumflex iliac artery; SIEA, superficial inferior epigastric artery; SEPA, superficial external pudendal artery; DEPA, deep external pudendal artery; OA, obturator artery; PA, perineal artery; IPA, internal pudendal artery.

also described the blood supply of the perineum in great detail. The rich vascular network of the perineum is formed by branches of the femoral and internal iliac arteries. The anterior region is supplied by the superficial and deep external pudendal arteries. The internal pudendal artery and branches of the inferior gluteal artery supply the posterior half of the perineum (Fig. 1).

The internal pudendal artery gives out two terminal branches: the penile or clitoral branch and the perineal artery. The perineal artery supplies the

labia/scrotal part of the perineum by terminal branches that anastomose with their counterparts from the opposite side. The other branches of the perineal artery are medial and lateral branches. The medial branch supplies the perianal region and the lateral branch supplies an area of the posterior surface of the upper thigh. All these branches anastomose with a counterpart from the opposite side and hence form a rich vascular anastomosis around the orifice. This vascular network provides the basis of our perforator flaps.

Figure 2 Areas of perineum. RU, right upper; RL, right lower; LU, left upper; LL, left lower; CA, central anterior; CP, central posterior.

Figure 3 Flaps for the perineum. (A) Lotus petal flap. (B) Transposition. (C) V-Y flaps.

Figure 4 (A,B) Flaps from labia minora to correct the stenotic introitus (ritual circumcision).

Figure 5 Unilateral vulval reconstruction by gluteal fold perforator island flap. (A) Defect. (B) Gluteal fold flap rotated to the defect. (C) Flap inset—secondary defect closed directly. (D) Postoperative result. (E) Donor site.

FLAP ANATOMY

The ideal flap for any perineal defect should be like tissue, not bulky but reliable and robust and should have protective sensation to maintain normal function and cosmesis. It should also have minimal donor-site morbidity. The perineum can be divided into six areas by a midline and a horizontal line drawn between the

ischial tuberosity at the level of perineal body into right upper and lower, left upper and lower, and central areas; the central area can again be divided into an anterior half containing urogenital organs and a posterior half containing the anal orifice (Fig. 2). The plastic surgeon is called upon by resecting surgeons, and in the majority of the cases the defect is created

Figure 6 Case with recurrent SCC of the vulva post-gluteal fold flap reconstruction. (A) Recurrent SCC of vulva. (B) V-Y island flap raised. (C) Mid thigh island perforator flap elevated. (D) Flap inset to the defect. (E) Postoperative result. (F) Donor site.

in the central area, for example, in vulvar/vaginal or anal neoplasia. Other situations where flap reconstruction is used include congenital malformations and severe debilitating infections (like hidradenitis suppurativa). Traumatic defects requiring local flaps are uncommon. For defects in the upper quadrant, the donor for skin flaps can come from the groin and/or mons area; for the lower quadrant, the donor can be from the gluteal fold and/or the gluteal area. The mid thigh can also provide a flap for these situations. For the central area of the perineum, the donor can be

selected from any of the above. The selection depends on the site and size of the defect. There are three ways of moving the local perforator flaps: rotation (lotus petal flaps) (Fig. 3A), transposition (pudendal, mons pubis flaps) (Fig. 3B), and V-Y advancement flaps (Fig. 3C).

Preoperatively the patient should be informed about the flap reconstruction and the postoperative regimen. As these flaps are perforator-based, patients should be advised to refrain from smoking. Extra care should be taken in patients who are obese or diabetic.

Figure 7 (A) Defect of the perineal body. (B) Bilateral V-Y flap planned. (C) Flap sutured by advancing the V-Y flap.

OPERATIVE TECHNIQUE

The surgery can be performed under either general or regional anesthesia. The patient is placed in Lloyd Davies' position and can be maneuvered further to suit while the resection and reconstruction are performed. A urethral catheter is inserted. Prophylactic antibiotics should be given at the time of induction and for 48 hours postoperatively. The defect is created by resecting surgeons as for either cancer or infection, or the wound is debrided if traumatized. Once the dimension of the defect is studied, the required flap is planned over the donor area. The flap is planned in a reverse manner by using a swab. The success of perforator flap reconstruction depends mainly on the selection of the perforator vessel at or around the base of the selected flap. Before the operation, perforator vessels are mapped using a hand-held Doppler ultrasound probe at the base of the planned skin flap. The surgery should be performed using loupe magnification. An exploring incision is made along one

edge of this flap down to the muscle. The flap is elevated including the deep fascia. The perforating vessel is reassessed.

In rotation or transposition flaps, the perforators should be selected closer to the defect. However, for V-Y advancement flaps, perforators can be anywhere in and around the midaxis of the V-Y flap. Once the perforator is identified and in an axial flap, the subcutaneous vessels should be identified. Only then can the flap be islanded. The advantage of islanding is that there is better mobility of the flap and avoidance of dog-ears at the pivot point. The main disadvantage of island flaps is venous congestion, and this can be avoided by preserving some amount of subcutaneous tissue at the pivot point. The flap can then be transposed, rotated, or advanced to the defect and sutured with absorbable sutures. The donor site is almost always closed directly. A suction drain should be inserted for the donor site and recipient site. A

Figure 8 (A) Gluteal fold flap with partial loss on the left side. (B) Midhigh perforator flap reconstruction. (C) Postoperative result.

bulky Gamgee dressing is applied for protection and also to keep the flap warm.

Patient-controlled analgesia is often required for the first 3 days. The thighs are kept abducted and the knees slightly flexed. Most patients can be mobilized after 24 hours. Patients who have had gluteal fold flaps feel uncomfortable sitting for a few weeks and they should be advised to use soft cushions. The catheter is removed within 3 to 5 days and the patients are discharged after a week to 10 days, depending on the extent of reconstruction.

Complications in perineal reconstructions are uncommon and are mostly infective. Complete loss is very rare and partial loss is usually as a result of venous outflow problems. This can be rectified by either using leeches or removing sutures. This type of complication occurs mostly in patients who have had radiotherapy or patients who are obese, smokers, or diabetics. Small defects following partial loss are allowed to heal by secondary intention. In some situations where there is partial loss with infection, the wounds may have broken down and the flap tends to contract. In these situations the flap is debrided and secondary perforator flaps can be used.

Case 1. Stenosis of the Introitus Postcircumcision (Fig. 4)

Case 2. Pagets of Right Vulva (Fig. 5)

Case 3. Recurrent Squamous Cell Carcinoma (SCC) following Bilateral Vulvar Reconstruction with Gluteal Fold Flap (Fig. 6)

Case 4. SCC of the Perineal Body (Fig. 7)

Case 5. Partial Loss of Gluteal Fold Flap and Reconstruction by Perforator Midhigh Flap (Fig. 8)

Case 6. Vaginal Reconstruction, Post-Cervical Cancer Resection (Fig. 9)

Case 7. Malignant Melanoma of Left Side of Anal Region (Fig. 10)

Case 8. Severe Hydradenitis Suppurativa Perianal Region (Fig. 11)

DISCUSSION

Plastic surgeons nowadays are involved in reconstructive surgery as part of a multidisciplinary team. Cases referred to plastic surgeons for perineal defect reconstruction come from gynecologists, dermatologists,

Figure 9 (A) Vaginal reconstruction with gluteal fold flap. (B) Post-cervical cancer resection and radiotherapy—flap marked. (C) Vaginal reconstruction flap inset. (D) Postoperative result. (E) Donor site.

urologists, and coloproctologists. The reconstruction is challenging, as one has to maintain the important excretory and sexual functions. There are several options for reconstruction for perineal defects, which include closing the wound directly or allowing the wound to heal by secondary intention. In these two steps of the reconstructive ladder, patients are left with significant morbidity. The next step of the ladder is flap reconstruction with local, regional, or distant flaps. Horton et al in 1973⁶ reported local random pattern flaps designed around the genital area. Other skin flaps used during the 1970s and 1980s were mostly myocutaneous types of flaps, including the gracilis,⁷ tensor fascia lata,^{8,9} and rectus abdominis.¹⁰ These flaps were obviously bulky and

there was also considerably donor-site morbidity. The fasciocutaneous flap emerged in the early 1980s, and in 1987 Wang et al¹¹ advocated medial thigh fasciocutaneous flaps and Wee and Joseph in 1989¹² described a neurovascular pudendal thigh flap for vaginal reconstruction. The same flap was modified by Woods et al in 1992.¹³ Similar axial pattern skin flaps based on the superficial external pudendal artery¹⁴ and superficial circumflex iliac artery (groin flap)¹⁵ were also used for perineal defects, but when a radical vulvectomy was performed for cancer, bilateral inguinal block dissection was also performed, rendering the femoral vessels unusable. However, the gluteal area can be an ideal donor area for reconstruction for vulvar/vaginal and anal regions, as it is away from the lymphatics of the urogenital and anal

Figure 10 (A) Wide excision of malignant melanoma on left side of anal orifice. (B) Defect and potential flaps drawn. (C) V-Y flap advanced and sutured.

region. Trelford and Silverton in 1979,¹⁶ Knapstein and Friedberg in 1990,¹⁷ and Davison et al in 1996¹⁸ used the transposition skin flap based around the anal orifice for vulvar reconstruction.

I got involved as part of a multidisciplinary team in the management of vulvar-vaginal reconstruction. Since 1993 I have applied the perforator concept and used skin flaps based on perforators in the vulvoperineal region. When we reviewed our experience we noticed that the pattern of skin flaps that were used in vulvar-vaginal reconstruction resembled the petals of the lotus flower and we reported the lotus petal flap based on perforators of internal-pudendal vessels.¹⁹ Anatomically there are multiple perforators and subcutaneous vessels arising from the superficial external pudendal artery, deep external pudendal artery, and internal pudendal arteries with accompanying veins. Since 1994 the gluteal fold flap has become a work-

horse for vulvar-vaginal reconstruction and we now have used this flap in 52 patients. The majority of cases were following radical vulvectomies. We have also used the gluteal fold flap for anal cancer and extensive hidradenitis suppurativa.²⁰ In December 2001 Hashimoto et al²¹ confirmed our experience of perforator-based gluteal fold flaps with their anatomical study. This gluteal fold flap has become a workhorse for perineal defects as it has the major advantages of being away from the pathway of lymphatic spread and radiotherapy. It can also give a large thin flap raised in the gluteal fold and leaves very minimal donor-site scars. These flaps are robust and have been used in obese patients in all age groups with only partial loss in five patients. We have used other perforator flaps from the medial thigh and the gluteal region in patients who have had recurrence or partial loss of the gluteal fold flaps.

Figure 11 (A) Severe hidradenitis suppurativa perianal region. (B) Large defect. (C) Reconstruction by V-Y gluteal flap (left) and gluteal fold flap (right).

CONCLUSION

The lotus petal flap and V-Y perforator flaps have become workhorses in perineal reconstruction. The role of free perforator flaps (anteriolateral thigh [ALT] and thoracodorsal artery perforator [TAP] flaps) and myocutaneous flaps are considered when a local option is not available or when the defect is too large. The gluteal fold flap is the main flap in the majority of cases as it is situated away from the lymphatics of the vulvar-vaginal region and from the effects of irradiation. It also leaves very minimal donor-site scars.

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