Vulvar reconstruction in gynaecological oncology

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ABSTRACT Surgical resection is the mainstay in the management of vulvar cancer and precancer. Following extirpation of large primary or recurrent lesions, especially after radiation therapy, surgical reconstruction of the vulva and groin is of importance in improving tissue healing, reducing morbidity, restoring sexual function and improving the quality of life for the patient. This paper aims to outline the principles of reconstructive surgery, and to describe briefly the techniques used for skin grafting, and for the skin and myocutaneous flaps that are required in vulvar reconstruction.

Key words vulvar reconstruction, skin flaps, myocutaneous flaps

INTRODUCTION The treatment of vulvar cancer can have a major impact on a woman's self esteem, body image, sexual identity and sexual function (1). Modern therapy for the disease should aim at vulvar conservation whenever possible. For early stage disease, radical local excision is as effective as radical vulvectomy (2). For more advanced disease, pre-operative radiation (with or without chemotherapy), may also allow preservation of much of the vulva (3-5). However, with some large primary or recurrent cancers, radical vulvectomy or extended radical vulvectomy will be unavoidable and vulvar reconstruction will be necessary. This is particularly true for recurrent disease following radiation therapy. Reconstructive surgery in these cases requires careful consideration of sexual function, bladder and bowel integrity, in addition to the basic problems of primary tissue healing (6).

In a retrospective comparative study by Landoni et al. (7), patients submitted to radical vulvectomy with reconstruction had a significantly lower rate of wound dehiscence (26% vs. 64%), vaginal introital stenosis (2.8% vs. 10.4%), sexual dysfunction (10% vs. 50%) and urinary stream misdirection (1.4% vs. 6.5%), compared with those having radical vulvectomy without reconstruction.

PRINCIPLES OF VULVAR RECONSTRUCTION Primary wound healing can only be achieved when the edges of a surgical wound are well vascularised and approximated without tension. In general, the simplest means to repair a surgical defect should be used. Small defects can be closed primarily. However, larger tissue defects will require skin grafting, local skin flaps or myocutaneous grafts. Secondary healing by granulation may be a reasonable or even preferred option in certain situations. For example, the perineal area may be left open to granulate, which it will usually do over a period of 6 to 8 weeks (8).

The ideal method of reconstruction following a radical resection of the vulva should provide immediate anatomical restoration and preferably primary healing (9). The new vulva should have as many of the anatomical characteristics of the original vulva as possible. Reconstruction should minimize patient morbidity and pose no life threatening risks. The donor tissue should ideally be expendable and transferrable.

An extensive array of flaps have been described in the literature. The practicing gynaecologic oncologist needs to be familiar with a few flaps of each type so that all eventualities will be covered. A more detailed review of vulvar flaps and reconstructive techniques can be found in "Gynaecologic Cancer Surgery" by Morrow and Curtin (10), and "Reconstructive Surgery in Gynecology" by Knapstein, Friedberg and Sevin (11).

FREE SKIN GRAFTS Skin grafting is useful following extensive superficial excisions or skinning vulvectomy for VIN, particularly VIN 3. For the graft to "take" the raw surface of the skin must remain in contact with the recipient site until a new blood supply is established. These vascular connections are very fragile until about 7 days post-operatively. The graft takes better when thinnner, but if the graft is thicker, it will undergo less contracture, be cosmetically superior, more durable, and have better re-innervation. Success of a skin graft depends on an adequately vascularised recipient site, the absence of infection, good contact between graft and host, and immobilization of the
recipient site until a good vascular hook-up has been established.

There are 2 types of free skin grafts used in gynaecologic oncology split thickness and full thickness.

**SPLIT THICKNESS SKIN GRAFTS**

**PRINCIPLES** Split thickness skin grafts are suitable for covering fresh or healthy granulating superficial defects. The skin graft must be harvested under sterile conditions. The donor site most frequently used to obtain a split thickness skin graft is either the anterior or medial thigh, which is readily accessible with the patient in the low lithotomy position. Alternatively, the graft can be taken from the buttocks with the patient prone, and then repositioned. The buttock donor site has cosmetic advantages, but may be more uncomfortable in the postoperative period. The selection of the donor site should be made preoperatively after discussion with the patient.

A dermatome is used to harvest the skin graft. Several different types of dermatomes are available, including the Brown air-powered, electrically driven dermatome, and the Padgett hand-driven dermatome. The surgeon should select the instrument with which he or she has the greatest facility, as an equally good graft can be harvested with either one.

**TECHNIQUE** The graft width and thickness can be determined by adjusting the settings of the dermatome. In reconstructing the vulva, a graft thickness of 0.016 to 0.020 inch is recommended (10). When using the dermatome, the surgeon must apply firm steady pressure in order to harvest a graft of uniform thickness. To minimize friction, mineral oil is applied to the skin over which the dermatome is to be passed. The skin to be taken is stretched and flattened by the surgical assistant with the aid of a tongue depressor. A second assistant picks up the leading edge of the graft as it is being harvested. The graft is kept moist in saline solution while the recipient site is being prepared.

After complete haemostasis of the recipient site, the graft is placed on the defect without tension or wrinkles, cut to leave a slight overlap at the edges of the defect, and attached with interrupted vicryl sutures. The graft may be pie-crusting by making small incisions on the surface (Figure 1). This maximizes the dimensions of the graft while permitting the escape of fluid that might otherwise accumulate between the graft and the recipient site. Extensive pie crusting may result in contracure.

A dressing of cotton wool is applied to the graft with light pressure to ensure that the graft conforms to the contour of the recipient site. Sutures are then tied snugly over this dressing to keep it in place. Excessive pressure between graft and host is potentially harmful. The donor site is covered with an Opsite film dressing and a pressure dressing is applied for 24 to 48 hours. The donor site heals spontaneously from an outgrowth of epithelium within the residual islands of epidermis, sweat or sebaceous gland ducts and hair follicles.

The graft and recipient site are immobilized for 5 days to prevent disruption of the vascular connections by shearing forces. The dressing is removed on the 6th postoperative day.

**FULL THICKNESS SKIN GRAFTS** These incorporate the epidermis and dermis, and are most suitable for filling small defects in the vulva. They should be applied to a fresh clean defect rather than a granulating wound. The graft may be taken from the inguinal region or the upper inner thigh and an ellipse of skin is removed with a scalpel to facilitate primary closure of the defect. Any fat is trimmed away to expose the underlying dermis. The graft is sutured to the recipient site as described for split thickness grafts.

**SKIN FLAPS**

**CLASSIFICATION** Skin flaps may be classified as follows:

1. transposition flaps, when the flap is passed over a portion of normal tissue to reach the defect e.g. rhomboid flap, perineal thigh flap, mons pubis flap;
2. rotation flaps, when the flap is turned in an arc to reach the defect;
3. advancement flaps, when the flap is moved in along a straight axis to reach the defect, e.g. V-Y flap.

Skin flaps may also be classified according to blood supply:

1. random pattern flaps - vascularised by a subdermal plexus of small blood vessels (most local skin flaps) e.g. rhomboid flap, perineal thigh flap;
2. axial pattern flaps - vascularised by a single anatomically constant subcutaneous artery e.g. mons pubis flap.
Random pattern flaps are limited with respect to their shape, because ischaemia and necrosis will occur if the length is more than 2 times the width of the base, whereas the axial pattern flap can be as long as the axial artery on which it is based. A flap is designated an island flap, when the flap of skin raised remains attached only by the vascular pedicle or muscle.

**PRINCIPLES** In principle, the suitability of a flap depends on its ability to cover the defect and also allow primary closure of the donor site. Poor micro-circulation due to prior irradiation, previous incision, vascular disease and cigarette smoking can all compromise the suitability of the skin for use as a flap. Postoperatively, bed rest for 5 days will reduce flap edema, while stress on suture lines, tension, pressure and creases on the flap must all be avoided.

**TRANSPOSITION FLAPS**

**RHOMBOID FLAP**

**PRINCIPLES** The most commonly used transposition flap in gynecologic oncology surgery is the rhomboid flap. This is a variation of the Z plasty (12-16) and its primary application is in closing perineal defects between the vagina and anus. It can also be used in the anterior and lateral vulva. Bilateral flaps are most appropriate for perineal repair, both for cosmetic symmetry and because of limitation of the adjacent tissue mobility. Its height and base are equal in length and because of this, flap necrosis almost never occurs.

**TECHNIQUE** A rhomboid is visualized over the defect. A line is drawn transversely as an equidistant continuation of the transverse diameter of the defect onto the adjacent skin. A line forming a 60 degree angle and also equidistant with this transverse line is then drawn upward or downward depending on the condition of the adjacent tissue and its mobility (*Figure 2*). It is useful to place the origin of the transverse incision slightly more posteriorly and also to maintain as wide a V as possible to enhance the blood supply to the tip of the flap (17).

Bilateral flaps are recommended for defects larger than 4x4 cm. In such situations, a rhomboid figure is superimposed on each half of the defect and 2 smaller flaps (mirror images of each other) sutured together in the mid-line provide superior coverage to a single large flap, and maintain symmetry to the end result. Designing the flaps 0.5 cm larger than the defect will also allow for trimming the flap edges to fit the defect and permit closure with minimal tension.

The skin and subcutaneous tissue are incised along the transverse and vertical lines and the flap elevated. The flap is then transposed onto the defect (*Figure 3*). Undermining the surrounding skin around the donor and recipient sites may be required to obtain maximum mobility of the flap, reduce tension and to obtain the optimal position of the flap within the defect. The donor site is completely closed with interrupted sutures and the flap sutured in position (*Figure 4*). A paraffin gauze dressing is placed over the suture lines and a Foley catheter left in the bladder for 48 hours. Perineal irrigation with
normal saline is performed 3 times daily, followed by air drying with a hair dryer at low setting.

A literature review of rhomboid flaps for vulvar reconstruction by Burke et al. (17) reported no instances of flap necrosis or loss. Major wound disruptions occurred in less than 5% of cases. In a personal series of 15 rhomboid flaps in 13 patients (17), these authors reported minor wound separation in 13% of cases. There were no other early or delayed vulvar complications.

PERINEAL THIGH FLAP

PRINCIPLES. The perineal thigh flap is a variation of the rhomboid flap using the maximum 2:1 length to width ratio with tapering at the tip to facilitate closure of the donor site (18). It is most useful when the margin of the vulvar resection extends out to the labial crural fold. The flap is taken from the fascia lata and is raised with it to provide strength to support the flap in its new position and perhaps improve its blood supply. When used to cover vulvar defects, the closer the flap corresponds to the longitudinal direction of the thigh the more readily the donor site can be closed. Nevertheless undermining the adjacent skin is almost always required for primary closure of the donor defect.

TECHNIQUE. Unlike the classic rhomboid flap, the perineal thigh flap is based posterior to the mid diameter of the oval defect, and requires full use of the 2:1 maximal ratio for random pattern flaps. The length of the defect is measured and a line is drawn at 60 degrees and a flap maintaining the 2:1 ratio is fashioned to fit the defect. The flap is elevated after cutting through the deep fascia and rotated anteriorly onto the defect. The flap base and tissue around the donor site need to be undermined to cover the recipient and donor site. A key stitch is inserted at the point of rotation to take tension off the flap. The graft is sutured with interrupted absorbable sutures so that it lies in place without tension. A cone of tissue at the base of the flap due to rotation, constitutes part of the blood supply and must not be trimmed. This can be excised after complete healing.

AXIAL PATTERN FLAPS

PRINCIPLES. Axial pattern flaps are vascularised by one or 2 single anatomically constant subcuticular arteries. The most useful example in vulvar reconstruction is the mons pubis flap which is a groin axial flap based on the superficial external pudendal artery (SEPA). It is particularly useful after a radical hemivulvectomy and will be described.

SEPA FLAP (MONS PUBIS PEDICLE FLAP). The SEPA flap is an axial skin flap based on the SEPA that can be vertically (19) or horizontally (20) orientated. Both vertically and horizontally orientated flaps can be rotated to cover a vulvar defect. In vulvar reconstruction, the transverse SEPA flap has the advantage that it can bring hair down from the mons pubis and is sensate.

Figure 5. The mons pubis pedicle flap

TECHNIQUE. The path of the SEPA is drawn as a curved line from the femoral artery 2.5 cm below the inguinal ligament, passing upward 1 to 2 cm medial to the pubic tubercle and continuing toward the umbilicus, staying about 2 cm from the mid-line. Anastomoses occur across the midline and with the superficial epigastric artery (Figure 5).

The goal of the flap is to bring hair bearing skin of the mons pubis to the vulva. The flap is outlined on the contralateral mons pubis and the width and length of the flap should equal the dimensions of the vulvar defect to be covered. The flap length should be parallel and superior to the inguinal crease. The skin and subcutaneous fat are incised along the superior and inferior aspects of the pedicle flap, down to Scarpa's fascia, and the underlying fascia over the mons and upper thigh is exposed. The flap is mobilized from the contralateral side and rotated on a pedicle of subcutaneous tissue and skin to the defect on the vulva. The flap is secured with vicryl suture to cover the donor site. The slight distortion of the mons sec-
ROTATION FLAPS  Rotational skin flaps are often the method of choice for vulvar defects that have a triangular or oval shape. Figure 6 shows a patient with extensive perianal VIN III, while Figure 7 shows the superficial resection. A semicircular skin flap is drawn adjacent to the defect. The length of this half circle is three times the diameter of the defect. The mobility of this skin flap is obtained with a back cut. After separating the skin and subcutaneous fatty tissue and undermining the surrounding tissue, the flap is rotated into the defect (Figure 8). It is the back cut that lengths the flap sufficiently for the edges to meet.

ADVANCEMENT FLAPS

PRINCIPLES Advancement flaps of many types have been described in the gynecologic oncology literature (11, 18, 23-24) but they are in fact less commonly used in this specialty. Occasionally, the V-Y flap can be used on the vulva, especially in the elderly and the patient with redundant skin from weight loss. Also known as the kite flap, this involves movement of an island of skin on a subcutaneous pedicle. The distance it can be moved depends on the laxness of the skin tissue.

TECHNIQUE A triangle of skin oriented in the direction of the greatest mobility of the adjacent skin is drawn such that the edge of the defect forms the base of the triangle (Figure 9). The length of the triangle is 1.5 to 2 times the diameter of the defect in the direction in which it is to be closed (25). If necessary, 2 V-Y flaps can be used to close the defect. After the flap has been defined, the skin and subcutaneous tissue are incised down to the fascia. For added mobility, the leading edge and the tail of the flap can be undermined. The donor defect created by advancing the triangular flap is closed side to side, making a kite shaped suture line.

Tateo et al. (26) reported 6 patients undergoing bilateral V-Y flaps with radical vulvectomy for SCC vulva. The average operating time for a single V-Y flap was 40 minutes and blood loss for complete construction was less than 100 ml. In 5 patients, the flaps were completely healed at discharge.
after an average of 21 days for non-radiated patients. One patient experienced a partial diastasis at the vaginal edge. There were no delayed surgical complications and a satisfactory introitus was noted in all 6 cases.

**MYOCUTANEOUS FLAPS**

**PRINCIPLES** The skin derives its blood supply either directly from cutaneous arteries or indirectly from perforators, arising from arteries in the underlying muscles. The most important consideration in selecting the appropriate myocutaneous flap is its capacity to cover the defect (i.e. size and proximity). Secondary considerations are the restoration of form and function at the recipient site, effect on function at the donor site, ease of closure of the donor site and overall morbidity.

Myocutaneous flaps have the great advantage of having a blood supply that is outside the field of radiation and away from the site of tumour removal. They are particularly useful when a new blood supply is needed to ensure healing because of prior radiation, or when the defect is too large for pedicle flaps.

The arc of rotation, size of flap and alignment of skin over the muscle must be accurately measured before the flap is elevated. The correct muscle must be raised with the flap and the blood supply preserved. Generalised vasculopathy as seen in diabetics or in smokers can impair circulation to potential flap sites. Hypothermia can also contribute to poor perfusion and necrosis, as can postoperative events such as haematoma, seromas, infection and position of the patient leading to pressure and tension on the vascular pedicle.

Flap viability is of paramount importance but can only be determined after raising the flap. Fresh bleeding is the best indication of satisfactory perfusion and focal compression of the skin should produce blanching followed by capillary filling. Flap viability can also be tested by a Woods ultraviolet light after IV fluorescein injection, where viable tissue is characterised by a bright yellow or greenish colour and non-perfused tissue appears dark or purple (27).

**RECTUS ABDOMINIS MYOCUTANEOUS (RAM) FLAP**

**PRINCIPLES** In gynaecologic oncology, the RAM flap is often regarded, as the flap of choice for covering groin and vulvar defects, especially if these areas were previously irradiated. The flap is vascularised by the superior epigastric artery and the inferior epigastric artery. The latter is larger and will support the entire muscle and overlying skin.

It is essential to the distally based flap that the inferior epigastric artery be intact. If the patient had previous radical pelvic surgery, especially a pelvic or groin node dissection, a urinary or intestinal stoma, or previous transverse abdominal incision, the integrity of the inferior epigastric artery must be documented.

The RAM flap is excellent for covering defects in the anterior vulva and contralateral inguinal region because of its reliability, size, range and many variations. Many papers (28-34) have reported very good results using the RAM flap for difficult cases including complete reconstruction after combined radical surgery and radiation treatment for advanced vulvar carcinoma.

When applied for closure of vulval skin defects alone, its bulkiness unfortunately can give rise to cosmetic and functional problems such as abnormal urinary stream, discomfort when walking and erosion due to friction. Hatoko et al. (35) reported 2 cases of RAM flap transfer with secondary liposuction to reduce the flap volume some 9 to 12 months postoperatively with good improvement of symptoms, cosmesis and acceptability.

**TECHNIQUE** The skin and subcutaneous tissue are incised down to the external oblique aponeurosis, thus outlining the skin island. The caudal part of the medial incision skirts the umbilicus. The superior margin of the flap is incised down to and includes the anterior rectus sheath, identifying the lateral edge of the rectus muscle. Next, the anterior rectus sheath along the inferior margin of the skin island is similarly incised. This corresponds approximately to the level of the arcuate line. Next, the sheath is incised longitudinally over the rectus muscle 1 to 2 cm from its lateral and medial borders, thus defining the island of anterior rectus sheath that is to be elevated with the skin island. Next, the rectus muscle is transected at the superior margin of the island and dissected off the posterior sheath. The superior epigastric artery is identified and ligated superiorly. The anterior rectus sheath is divided in the midline from the arcuate line and caudally, allowing the rectus muscle to be further dissected off the transversalis fascia down to the symphysis pubis. The vessels that are usually located at the posterior aspect of the muscle have to be preserved. A wide tunnel must be created under the mons pubis and over the symphysis pubis. The completely mobilized muscle and skin island is tunneled through this space into the vulval defect.

The donor site is closed by repairing the anterior sheath with a heavy monofilament suture. Undermining of the lower abdominal wall skin is often needed to facilitate closure. A mesh may be required if the anterior sheath will not come together easily. A suction drain is inserted and the skin closed with staples.

**GRACILIS MYOCUTANEOUS (GMC) FLAP**

**PRINCIPLES** The GMC flap can be used for covering defects in the groin, vulva and perineum. The arc of rotation anteriorly allows the flap to reach the groin and the mons pubis, whilst its 180 degree posterior arc of rotation reaches the perianal area and vagina. The point of rotation is the proximal dominant vascular pedicle. This pedicle arises from the medial femoral circumflex artery, a branch of the deep femoral artery.

Common causes of failure include failure to centre the skin...
island over the muscle, unreliable vascularity of the distal one-third of the posterior medial thigh, vascular spasm secondary to tension and poor surgical technique. The reported complications related to the GMC flap for vulvar reconstruction are few, unlike the GMC neovagina.

**Technique** The graft is harvested from the medial aspect of the thigh. A line is drawn from the pubic tubercle to the medial epicondyle, and a second line 2 cm posterior and parallel to this delineates the anterior margin of the graft. The posterior margin of the graft is a mirror image of the anterior margin but can run up to 2 cm below the posterior edge of the gracilis. The length of the flap is guided by the size of the vulvar defect.

The anterior skin edge of the graft is incised first, downward to the adductor longus fascia. The posterior incision is then carried out through the skin, subcutaneous tissue and fascia, after which the gracilis muscle is divided by diathermy, completely freeing the distal end of the flap. The vascular pedicle of the gracilis is invested by the fascial layer which separates the adductor longus and the adductor magnus muscles. The fascia to the adductor longus muscle is then progressively reflected, elevating the graft from its distal end and exposing the proximal vascular bundle of the gracilis muscle approximately 10 cm from the pubic ramus. The fascia of the gracilis muscle is dissected off the adductor magnus and brevis distally and posteriorly. The proximal dissection is continued between the gracilis fascia and the adductor magnus and brevis to the pubic ramus. The GMC flap is then transposed to the recipient vulvar defect. The donor site is irrigated with saline and haemostasis secured. The donor site closed by suturing the deep fascia, followed by interrupted sutures to the skin (Figure 10).

**Tensor Fascia Lata (TFL) Flap**

**Principles** The TFL flap is a very reliable flap with a large skin territory and sensation. It has been used to cover groin, vulvar (36-37) and ischial defects. Its popularity in gynaecologic oncology has declined over the past decade because of the unavoidable deformity, difficulty closing the donor site, risk for lateral knee instability, and availability of more attractive alternatives for covering the vulvar and groin defects. The most important current indication for the TFL flap is to cover groin defects after resection of irradiated groin nodal metastases in patients with vulvar carcinoma when the contralateral RAM flap cannot be used, and to repair mons pubis defects when the ipsilateral gracilis flap is not suitable. The TFL flap is more reliable than the GMC flap for groin coverage because the full length of the GMC flap including the unreliable distal third may be needed to cover the groin.

The TFL flap is nourished by the terminal branch of the lateral circumflex femoral artery which is characteristically a branch of the deep femoral artery, and is located deep to the fascia lata between the rectus femoris and vastus lateralis. The skin territory is innervated predominantly by the lateral femoral cutaneous nerve. Injury to the nerve may result in meralgia paresthetica which is characterized by intractable pain or paresthesia mimicking a trapped nerve syndrome, a situation also seen occasionally after extensive groin node dissection. To avoid injury to the nerve, the anterior incision line should be along the rectus femoris muscle, elevating the nerve with the flap.

**Technique** The graft is obtained by harvesting a myocutaneous pedicle from its proximal origin at the anterior superior aspect of the iliac bone. The length of the proposed flap is determined by measuring the distance from the muscle’s vascular supply, located 6 to 8 cm distal to the anterior superior iliac spine (ASIS) to the most inferior or distal point of the recipient site. The anterior border of the graft is defined as a line from the ASIS to the lateral condyle of the knee while the posterior border of the graft is defined as a line from the greater trochanter of the hip down to the knee. The distal border is located about 5 cm proximal to the knee. The width of the flap is determined by the width of the defect to be covered, but typically it is 6 to 8 cm with a length of up to 40 cm. The pedicle graft is harvested after the defect has been created in order to permit a
more accurate measurement of the flap. The flap is first incised distally, and care is taken to avoid injury to the proximal blood supply. Once the flaps are elevated, they are rotated into place and sutured from the most distal point to the proximal. The donor site is closed primarily (Figure II).

CONCLUSION In managing patients with vulvar disease, the gynaecologic oncologist must not only be a surgeon skilled in disease extirpation but also a physician sensitive to the patients' needs, expectations and goals. Vulvar reconstructive surgery, when indicated, reduces morbidity, restores form and function and improves the quality of life for the patient and should therefore be an integral part of the overall management plan in the surgical treatment of vulvar cancer.

REFERENCES


16. Hoffman MS, LaPolla JP, Roberts WS, et al. Use of local flaps for pri-
mary anal reconstruction following perianal resection for neoplasia. Gynecol Oncol 1990; 36:348.


