Reconstruction of Acquired Defects of the Vagina and Perineum

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ABSTRACT

Successful reconstruction of vaginal and perineal defects requires close communication and cooperation between the extirpative and reconstructive surgeon. A variety of reconstructive options is available, dependent on the nature of the defect and extent of the ablative surgery. In all cases, obliteration of pelvic dead space and separation of intra-abdominal contents from the perineum are important considerations to ensure uncomplicated perineal wound healing. The decision for vaginal reconstruction is also contingent upon the age, sexual function, and wishes of the patient. In this article, we review options for vaginal and perineal reconstruction in acquired defects.

KEYWORDS: Vagina, vulva, clitoris, vulvar cancer, uterine cancer, vaginal cancer, labia majora, labia minora

Acquired defects of the vagina and perineum most commonly result following extirpative oncologic surgery, but may also result from less common causes such as trauma and necrotizing soft tissue infection requiring extensive debridement. Defects that cannot be closed primarily can result from curative or palliative surgery targeted toward treatment of colorectal, cervical, and less commonly vaginal, urinary tract, or anal malignancies. Pelvic exenterative procedures may result in very large defects, where locoregional flaps serve not only to close the wound, but also obliterate dead space, and improve wound healing in previously irradiated fields.¹

Often, planning for the reconstruction requires cooperation and discussion with the oncologic surgeon. Planning of incisions and location of stomas should be decided by both the extirpative and reconstructive team before the surgery to maximize reconstructive options, while not compromising oncologic clearance. The

radiation oncologist is another member of the multidisciplinary team with whom the case should be discussed. Previous radiation therapy may affect viability and availability of flaps. Intraoperative radiation and brachytherapy may also occur at the time of the extirpative surgery,² with implications for wound healing. The nonhealing perineal wound, for example, is the most common complication following proctectomy,^{3,4} with neoadjuvant radiation therapy increasing the risk of wound complications and infection.⁴ Involvement of the medical oncologist is also critical to success, to optimize the timing of surgery to minimize deleterious effects of chemotherapy on wound healing, which have been shown in some studies to occur maximally at 7 to 10 days after administration of chemotherapy.^{5,6} Finally, good nursing care, wound care, and rehabilitation will facilitate patient recovery and return to normal activities.

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PREOPERATIVE ASSESSMENT

The reconstructive surgeon aims to maximize wound healing and prevent complications. Toward that end, a nutritional assessment and consideration of the patient's comorbidities should be performed before surgery, with optimization of these parameters in consultation with the medical and extirpative surgical teams. Patients should be strongly encouraged to stop smoking prior to surgery, to decrease incidence of wound complications.

The young sexually active woman who undergoes vaginectomy has very different reconstructive requirements from the elderly woman. In the former, effort should be made to achieve a functional reconstruction to permit sexual activity after surgery. In the latter, primary wound closure after vaginectomy may suffice. In combined vaginal and perineal defects in the latter, simple flap closure of the perineum without reconstruction of the vagina may result in the quickest recovery and lowest incidence of complications. Discussion with the patient with regard to postoperative sexual and functional expectations is essential in planning for the reconstruction.

The condition of the surrounding tissues also dictates flap availability. Previous abdominal incisions may preclude the use of rectus abdominis flaps. Irradiated tissues require more careful handling, with increased risk of wound healing complications, and may not present the best choices for reconstruction if alternative reconstructive options are available. Discussion with the oncologic surgeon beforehand helps to determine the size and location of the defect, as well as the surgical plan.

CLASSIFICATION OF VAGINAL DEFECTS

Cordeiro's classification⁷ provides a useful aid in flap selection for reconstruction of full thickness vaginal defects, which are not amenable to primary closure or skin grafting. Type I defects are defined as partial non-circumferential defects of the vagina, and can be subclassified into type IA and type IB defects. Type IA defects involve the anterior and/or lateral vaginal wall, and may result from resection of primary vaginal cancers or urinary tract malignancies. Type IB defects involve the posterior vaginal wall and typically result from resection of locally advanced colorectal carcinomas. Type II defects are defined as circumferential defects, and are subclassified into type IIA and type IIB defects. Type IIA defects involve the upper one-third to two-thirds of the vagina, and may result from resection of cervical and uterine malignancies. Type IIB defects involve the entire vagina, and usually occur following pelvic exenteration.

RECONSTRUCTIVE OPTIONS FOR VAGINAL DEFECTS

Reconstruction of the vagina not only results in a closed wound, but also enhanced psychological well-being in a

woman.⁸ Improved quality of life after restorative surgery results from sexual function as well as enhanced body image.⁹ The neovagina has to fulfill several functions. It must be wide and deep enough to permit sexual intercourse and also provide sufficient soft tissue to permit healing of perineal wounds, obliterate dead space in the pelvis, and separate intraperitoneal contents from the perineum. Partial thickness defects may be closed primarily or reconstructed with a split thickness skin graft.

For full thickness defects, a variety of reconstructive options is in use. Fasciocutaneous and myocutaneous flaps are probably the most commonly used options for reconstruction of partial and circumferential vaginal defects. These have the advantage of providing a large quantity of pliable tissue, which can be used as soft tissue filler in the pelvis, in addition to tissue for vaginal reconstruction. The neovagina also tends to retain its caliber over time, and does not stenose. However, the lack of natural lubrication often necessitates the use of supplemental lubricants during sexual intercourse. Other disadvantages include incidence of partial or complete flap necrosis. However, the incidence of this is relatively low. Flap specific complication rates are lowest for vertical rectus abdominis myocutaneous (VRAM) flaps compared with gracilis and Singapore flaps.¹⁰ In addition, the necessity for a donor site creates the possibility of donor-site complications.

Reconstruction of circumferential vaginal defects with small or large bowel is well described,^{11,12} but has been criticized for excessive and often malodorous discharge, in addition to morbidity and complications associated with a bowel resection.¹³ However, good results have been achieved by some centers. The advantages of bowel for vaginal reconstruction¹² include the following: (1) maintenance of vaginal caliber and depth without requirement for vaginal stent, (2) natural mucus production allows sexual intercourse, and (3) similar texture and appearance compared with natural vagina. The use of bowel vaginoplasty is a well-established technique that has also been used successfully largely for reconstruction of congenital genitourinary conditions.¹⁴

Fasciocutaneous and Myocutaneous Flaps

Options for reconstruction of partial vaginal defects include the Singapore fasciocutaneous flap, VRAM flaps, and gracilis flaps. The Singapore, or neurovascular pudendal-thigh flap, was first described by Wee and Joseph in 1989.¹⁵ These flaps are based on the posterior labial arteries, which arise from the perineal arteries. They are raised with the patient in the lithotomy position, in the subfascial plane over the adductor muscles of thigh from an anterior to posterior fashion in the groin crease just lateral to the labia majora. A skin island measuring up to 6 × 15 cm may be elevated with

each flap.¹⁵ One flap may be used for reconstruction of partial vaginal defects, while bilateral flaps may be transposed toward the midline and sutured together to form a cylindrical skin-lined neovagina opening at the introitus for total vaginectomy defects. Anterior and lateral (type IA) defects are particularly suited to reconstruction with this flap. Donor sites are closed primarily. The advantages of this flap are decreased operative time compared with other reconstructive options, a thin, pliable and well-contoured neovagina, and concealed donor site scars.^{15,16} However, the Singapore flap has a risk of apical necrosis, with complete flap loss occurring in less than 15% of patients.¹⁷ Adverse vaginal symptoms, such as hair growth and vulvar pain may also discourage sexual intercourse. Nevertheless, the Singapore flap remains one of the best, technically easy reconstructive options for vaginal defects.

The VRAM flap is particularly useful for reconstruction of posterior (type IB) partial vaginal defects (Fig. 1). The flap not only allows restoration of vaginal integrity, but also provides well-vascularized muscle, which fills the pelvis, obliterating dead space as well as separating intraabdominal contents from the perineal wound and neovagina. The flap is designed with a vertical skin paddle centered over the superior portion of the muscle to allow maximal flap rotation for inset of the skin paddle, with care taken to preserve cutaneous perforators. The muscle is detached superiorly from its costal attachments, while the inferior insertion at the pubic symphysis may be maintained or released, depending on the desired arc of rotation. The flap is then rotated into the pelvis and inset, with the donor site closed primarily. A large skin paddle can be designed over the entire height of the rectus muscle.

Figure 1 A 43-year-old female with recurrent anal cancer underwent abdominoperineal resection with posterior vaginectomy and hysterectomy and was reconstructed with a vertical rectus abdominis myocutaneous flap tunneled to the perineum. A single elliptical skin paddle was used to reconstruct the posterior vaginal and perineal defect in continuity. (A) Preoperative image showing lesion. (B) Intraoperative image showing perineal defect. Flap has healed well 5 months after surgery, and the patient was able to resume sexual intercourse without dyspareunia. (C) View of patient in lithotomy position. (D) Posterior view.

Primary closure up to a width of around 8 cm may be achieved.

The rectus abdominis flap is also very useful for reconstruction of circumferential (type II) vaginal defects. The flap may be folded on itself such that the middle of the skin paddle becomes the apex of the vaginal vault,¹⁸ or the flap may be rolled and tubed to form a pouch.¹⁹ Where the flap is rolled to form a cap, a transverse instead of vertical skin island may be used to facilitate formation of the vaginal pouch. Cordeiro and colleagues^{7,19} favor the use of the rolled rectus flap for reconstruction of circumferential defects involving the upper portion of the vagina (type IIA). A “cap” is formed that is sutured to the remnant of the vaginal cylinder, which provides tissue to fill the pelvis. In general, the VRAM flap has the lowest incidence of flap complications¹⁰ compared with the Singapore and gracilis flap. Use of the rectus abdominis flap is contraindicated in patients whose blood supply from the deep inferior

epigastric artery is unreliable, who have had an abdominoplasty, or who have a stoma that runs through the muscle.

Gracilis flaps provide another reconstructive option (Fig. 2), and may be used in restoration of partial vaginal defects where rectus and Singapore flaps are not available. In patients with two stomas through the recti for fecal and urinary diversion or in the presence of previous abdominal scars, these flaps are very useful. They are particularly useful in repair of total circumferential (type IIB) vaginal defects,^{7,20} where bilateral gracilis myocutaneous flaps, providing a large quantity of skin for restoration of the vaginal vault can be tunneled from the thigh through the perineum, recreating an entire neovagina extending from apex to introitus. Accompanying soft tissue and muscle also provides tissue for obliteration of dead space in the pelvis. The reliability of the skin island is a matter of some debate, with some authors reporting flap loss rates of up to 15%,²¹ while

Figure 2 A 44-year-old female with Buschke-Lowenstein tumor had reconstruction of a posterior vaginal wall defect with bilateral gracilis flaps. (A) Intraoperative view showing large perineal and posterior vaginal wall defect. (B) Bilateral gracilis flaps have been inset to reconstruct the posterior vaginal wall. (C) Well healed donor site 2 months after surgery. (D) Close-up view of well-healed introitus and vagina.

others report no problems with viability of the skin paddle.⁷ In general, preservation of cutaneous perforators over the adductor musculature and location of a proximal skin paddle will maximize viability of the skin paddle.

The gracilis flap is supplied by the medial circumflex femoral artery, originating from the profunda femoris, and entering the gracilis 8 to 10 cm from its origin. The flap is designed over the medial aspect of the thigh, centered over an axis between the pubic tubercle and semitendinosus tendon. An elliptical skin island is outlined over the proximal aspect of the muscle. The flap is elevated with care taken to preserve cutaneous perforators and to identify the pedicle, which enters the proximal third of the gracilis muscle between the adductor longus and adductor magnus muscles. The gracilis is divided distally and the myocutaneous flap tunneled into the vaginal defect. Donor site is closed primarily. A major disadvantage of the gracilis flap is prominent donor scars.

A less commonly used fasciocutaneous flap is the posterior thigh flap,²² which has been used for partial (single flap) and total vaginal reconstruction (bilateral flaps). The flap is based off the inferior gluteal artery, and is raised with the patient in the lithotomy position. A skin paddle measuring 34 × 15 cm can be raised,¹⁸ centered over the posterior thigh, with the pedicle originating at the midpoint of a line between the greater trochanter and ischial tuberosity, marking the exit of the inferior gluteal artery from under the gluteus maximus muscle.

Recently, pedicled perforator flaps have been described for vaginal reconstruction. These include deep inferior epigastric perforator (DIEP) flaps,^{23,24} muscle-sparing vertical rectus,²⁵ superior and inferior gluteal artery perforator (SGAP, IGAP) flaps²⁶ and even free-style perforator flaps.²⁷

Bowel Flaps

Bowel vaginoplasty is a technique that has proven useful in reconstruction of circumferential vaginal defects. Options for donor sites include rectosigmoid, ascending colon and small bowel. Bowel preparation prior to surgery lowers the incidence of infection and wound healing problems. Harvest of the bowel segment can be performed through a regular laparotomy or through laparoscopic techniques. Use of a colonic segment has the advantage of decreased quantity of secretions and a larger caliber compared with jejunum or ileum. As a caveat, isolated complications have been reported following the use of colonic segments for vaginoplasty. Ulcerative colitis of the neovagina developed in a patient 14 years after sigmoid colon vaginoplasty.²⁸ Prolapse of the neovagina 33 years after sigmoid vaginoplasty was treated successfully with retroperitoneal sacropexy.²⁹

Other techniques reported for management of neovaginal prolapse include anchoring the neovagina to the anterior rectus sheath or sacrospinous ligament.

Kim et al¹² evaluated patients who had undergone rectosigmoid vaginoplasty at a mean of 5 years follow-up and found that the depth and width of the vaginal vault was well maintained, with low incidence of malodor and excessive mucosal discharge (8.3%). All patients were able to resume sexual activity. The rectosigmoid flap is based off the superior rectal artery, with a length of 8 to 12 cm, and is transposed locally on its pedicle within the pelvis to create a neovagina. Jejunal flaps have also been used successfully for vaginal reconstruction.^{11,30} Fig. 3 illustrates the use of bowel vaginoplasty for reconstruction of a Type IIA vaginal defect. In this patient, a pedicled colonic flap was used for vaginal reconstruction. Regular douches help to decrease incidence of malodor. If necessitated, dilation at the neovaginal introitus can be performed to prevent scar contracture and subsequent stricture.

RECONSTRUCTIVE OPTIONS - PERINEAL DEFECTS

Perineal defects result most often from resection of locally advanced rectal cancer, recurrent anal cancer, pelvic extenteration, or more rarely, anorectal melanoma.³¹ This patient population is plagued by perineal wound problems. Reconstruction requires both replacement of missing skin and closure of dead space in the pelvis. In patients having undergone abdominoperineal resection (APR) and external beam radiation, perineal wound complications can occur in up to 66% of cases.³¹ Use of muscle flaps such as rectus³²⁻³⁴ and gracilis³ have been shown to significantly decrease perineal wound complications from a range of 30–49% to 9–26% of patients. Fewer perineal hernias were also found in patients who had undergone APR for anal cancer and VRAM reconstruction (0%) compared with patients closed primarily (15.4%).³⁴

Standard reconstructive options include the rectus and gracilis flaps. These provide a large quantity of vascularized soft tissue for obliterating dead space in the pelvis and separating intra-abdominal contents from the perineal wound. The skin island over the rectus muscle may be designed in an oblique fashion³⁵ to provide a greater quantity of soft tissue to fill pelvic defects. The skin paddle is designed extending in a superolateral direction toward the lateral costal margin, and based on periumbilical perforators.

Thigh flaps have also proven very useful in reconstruction of perineal defects, and provide a useful alternative where rectus is unavailable. As a caveat, the incidence of major complications with thigh flaps has been reported to be significantly higher compared with VRAM flaps.³⁶ These complications include pelvic

Figure 3 A 64-year-old female with recurrent cervical cancer underwent pelvic exenteration with an ileal conduit and end colostomy, as well as near circumferential vaginal resection involving the upper two-thirds. A portion of descending colon was isolated on a vascular pedicle and was used for reconstruction of a neovagina. (A) Intraoperative image showing isolated bowel loop. (B) Flap has been inset. Suture line demarcating junction between introitus and colon can be seen. (C) 18 months after surgery. Well healed with contracture at junction of bowel flap and native vaginal tissue requiring dilation at 3 months which is a not uncommon minor complication of this procedure.

abscesses, major wound dehiscence, infection and delayed healing. The posterior thigh flap,³⁷ based on the descending branch of the inferior gluteal artery, provides a large amount of soft tissue, and can be harvested with ease in a short period of time. The pedicle is usually spared in pelvic exenterative procedures, and is also outside the field of pelvic irradiation.

Anterolateral thigh flaps^{38–41} has been used with increasing frequency for reconstruction of perineal defects. The vastus lateralis can be raised in continuity with the fasciocutaneous flap, providing a large quantity of vascularized tissue for closure of pelvic dead space. The flap is based on the descending branch of the lateral circumflex femoral artery, and centered on an axis extending from the anterior superior iliac spine to the lateral border of the patella. Where perineal closure can be achieved primarily, the vastus lateralis muscle can be tunneled over the inguinal ligament into the pelvis. Where a skin paddle is required,³⁸ the flap can be tunneled under the rectus femoris muscle and subcutaneously through the medial thigh to the perineum, where isolated perineal or combined perineal-posterior

vaginal wall defects can be reconstructed in continuity. Disadvantages of the anterolateral thigh flap include limited arc of rotation in patients with short thick thighs and risk of perineal wound dehiscence.

Omental flaps⁴² when used with or without adjunctive myocutaneous flaps, have been shown to decrease incidence of major pelvic complications such as abscesses, urinoma, flap dehiscence and fistulas. The omentum is based on a single pedicle and transposed to lie on the pelvic floor. It can also be used by itself to fill small pelvic defects without a cutaneous component, providing an excellent source of vascularized tissue. Larger defects will require obliteration by flaps with increased bulk, such as rectus or gracilis.

CONCLUSION

Planning for reconstruction of vaginal and perineal defects benefits from close collaboration between the extirpative and reconstructive surgeon. Flap selection, in this area perhaps more than anywhere else, is dictated by previous surgeries as well as factors that are often outside

the control of the reconstructive surgeon, such as requirement and placement of stomas as well as necessity for radiation therapy. Being facile with a large variety of flaps ensures that a successful reconstruction can be achieved for all variety of patients.

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