

The Vertical Profunda Artery Perforator Flap for Perineal Reconstruction

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Background: Colorectal cancer is a significant cause of cancer-related death in the United States with abdominoperineal resection (APR) remaining a necessary procedure for many patients. The resultant defects of this radical operation are complex and characterized by significant tissue voids. Pedicled vertical profunda artery perforator flaps (vPAP) can be used to obliterate these defects in patients receiving minimally invasive APR or when the abdominal donor site is unavailable.

Methods: After receiving local institutional review board approval, a single center, retrospective cohort study from January 2020 to December 2021 was performed assessing pedicled vPAP flap reconstruction of APR defects. Age, sex, body mass index, primary diagnosis, comorbidities, concomitant oncologic procedures, radiation, timing, incorporation of gracilis flaps, follow-up, and complications were compared.

Results: Ten patients (70% male) with an average age of 56.2 years and BMI of 27.6 were included in the study. Rectal adenocarcinoma (50%) was the most common indication for APR, followed by rectal squamous cell carcinoma (30%), vulvar squamous cell carcinoma (10%), and Crohn disease (10%). Eighty percent of the patients received radiation, and 70% of reconstructions were delayed after the initial resection. The average length of clinical follow-up was 26.1 months. Concerning major complications, 2 patients were required to return to the operating room due to venous congestion (20%), and 2 patients suffered partial flap failure (20%). Minor complications were perineal dehiscence (50%), abscess requiring percutaneous drainage by interventional radiology (30%), and infection requiring antibiotics (20%). Twenty percent of patients developed fistulas requiring surgical excision. There were no instances of donor site dehiscence, and there was no complete flap loss, indicating successful reconstruction in all included cases.

Conclusions: vPAP flaps are a reliable method to reconstruct perineal defects with less donor-site morbidity than previous reconstructive options. vPAP flaps should be considered in the setting of delayed reconstruction, minimally invasive APRs, and when the abdominal donor site is unavailable.

Key Words: abdominoperineal resection, rectal cancer, profunda artery perforator flap

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With ~147,950 new cases every year, colorectal cancer is the second leading cause of cancer-related death in the United States causing ~52,000 deaths annually.¹ Despite significant advancements in the treatment of anorectal cancer and other perineal pathologies, abdominoperineal resection (APR) remains a necessary procedure for many patients.^{2–4} The resultant defects of this radical operation are complex and characterized by significant tissue voids that can make completely eliminating the dead space difficult. The loss of the perineum

is associated with significant morbidity, as it serves several critical structural, excretory, sexual, and obstetrical functions by preventing prolapse of the pelvic contents during rest, micturition, defecation, coitus, and childbirth.⁵ Richly innervated by the pudendal nerve and its branches, the perineum also carries an important sensory function. Given the critical nature of these roles, an acceptable functional and aesthetic perineal reconstruction is paramount to maximize quality of life among patients undergoing APR.

Achieving a successful reconstruction in this setting is challenging due to the substantial dead space, exposure to bacteria and intraperitoneal contents, and direct pressure to the area in both the sitting and recumbent positions.^{6–8} Furthermore, high rates of malnutrition and radiotherapy may hinder wound healing and predispose the site to infection, dehiscence, fluid collection, and sinus and fistula formation.^{9,10} Reconstruction may be further complicated by the need to reconstruct the vulva, vagina, scrotum, or penile base.^{3,11–14} Early vascularized tissue transfer for coverage of these complicated defects is paramount and has been shown to shorten hospital stay, reduce time to chemotherapy, and reduce patient morbidity.^{6,15–18}

The surgical reconstruction of large perineal defects has historically centered around abdominal and thigh-based soft tissue flaps, with the vertical rectus abdominis muscle (vRAM) and gracilis myocutaneous flaps being primary workhorses.^{7,18,19} In recent years, the emergence of perforator flaps has revolutionized the reconstructive surgeon's armamentarium.^{3,20,21} Among these, the profunda artery perforator (PAP) flap, originally described by Angrigiani et al²⁰ in 1995 for use in pressure sores and burn contractures of the lower extremity, has regained popularity for breast and head and neck reconstruction due to its versatility, reliability, relative ease of harvest, and inconspicuous scar.^{22–25} Based on perforators of the profunda femoris artery, this fasciocutaneous flap may be designed with a vertical (vPAP), transverse (tPAP), diagonal (dPAP), or fleur-de-lis (fleur-de-PAP) style skin paddle and can incorporate the gracilis for increased bulk, also known as a PUG flap.^{22,23,26–28} However, the PAP flap remains a relatively uncommon option for perineal reconstruction, especially following APR, as demonstrated by the absence of its inclusion among several recent reviews and algorithms of perineal reconstruction techniques.^{3,4,7,29,30}

Furthermore, the PAP may be particularly suitable for both immediate and delayed reconstruction following minimally invasive APRs. As minimally invasive APRs avoid significant fascial violations of the abdominal wall, harvest of the rectus abdominis muscle may subject the patient to unnecessary long-term abdominal morbidity. Use of the muscle-sparing, thigh-based vPAP may instead provide a simple,

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robust alternative that provides adequate bulk while minimizing donor site morbidity.

METHODS

With institutional review board approval, all patients undergoing abdominoperineal resection with vPAP flaps from January 2020 to December 2021 at a single institution in the southeastern United States were retrospectively reviewed. All reconstructions were performed by the 2 senior authors (M.W.S. and D.J.W.).

Patient demographics and medical history were reviewed and data collected for age, sex, body mass index (BMI), diabetes, hypertension, hyperlipidemia, human immunodeficiency virus (HIV), smoking status, alcohol use, history of thromboembolic events, and prior radiation therapy. Complications were categorized into major and minor complications: major complications were defined as complications requiring a return to the operating room during the hospital stay or requiring readmission within 30 days of discharge, while minor complications could be managed in the outpatient setting. Major complications consisted of total and partial flap loss, flap arterial or venous insufficiency, readmission within 30 days, and a hematoma requiring evacuation in the operating room (OR). Minor complications were dehiscence managed with local wound care, surgical site infection managed by antibiotics alone or interventional radiology percutaneous drain placement, and fistula requiring operative excision via same-day surgery.

SURGICAL TECHNIQUE

Preoperatively, a computed tomography angiography (CTA) of the bilateral lower extremities is performed to visualize the profunda artery perforators. The dominant perforator can usually be found within 8 cm of the gluteal crease. Beyond this distance, we have found more difficulty obtaining adequate length for advancement of the flap into the perineum.

In the OR, the procedure is performed with the patient in the lithotomy position, facilitating both dissection of the flap and preparation of the perineal recipient site. The target perforator is identified with a hand-held Doppler ultrasound, guided by preoperative CTA findings.

The adductor longus is palpated and marked, as well as the approximate location of the gracilis. A longitudinal, vertically oriented ellipse is designed, ensuring inclusion of the dominant perforator and extending distally to provide adequate length and bulk to fill the dead space (Fig. 1, top right). It is imperative that the anterior incision is not designed beyond the posterior border of the gracilis, as it can then become difficult to include the perforator and close the site primarily due to the excessive width of the flap.

The dissection begins with the anterior incision, taken down to a subfascial plane while retracting the gracilis anteriorly. The target perforator is commonly visualized here, emerging from the adductor magnus. The perforator dissection is continued intramuscularly using deep self-retaining retractors to help separate the muscle fibers and is continued until adequate length is obtained, allowing the 180-degree rotation to be spread along the full length of the perforator. A subcutaneous tunnel is created between the donor site and the defect to allow for transfer of the flap to the recipient site. An incision can also be made between the donor site and recipient site if tunneling is not adequate; however, we have not found this to be necessary. The buried portion of the flap is then de-epithelialized, leaving a small skin paddle as needed, and transposed into the defect and ensuring that there is no residual dead space (Fig. 1, bottom right).

If the defect is not adequately obliterated with the de-epithelialized portion of the vPAP, the gracilis, which is already well visualized in the donor site due to the skin paddle orientation, may be transposed into the wound to provide additional bulk. The donor site is then closed primarily in layers over a drain. Postoperatively, the patient is placed on an air-fluidized mattress for a total of 3 weeks with strict flat bed rest. Sitting upright or putting direct pressure on the flap is avoided. At 3 weeks, we begin a sitting protocol using an air-pressurized mattress or support surface to maintain a maximum pressure distribution of 60 mm Hg.³¹

RESULTS

Table 1 provides an overview of the 10 patients included in the series who underwent pedicled vPAP-based perineal reconstruction.



FIGURE 1. Reconstruction of perineal defect following APR using a pedicled vPAP flap. Top left: cylindrical perianal defect following APR. Top right: skin markings depicting the design of the vPAP flap. Bottom left: pedicle isolation. Bottom right: flap inset and final result.

TABLE 1. Series Overview

Patient Identifier	Age	Sex	BMI, kg/m ²	Diagnosis	Comorbidities	Concomitant Procedures	APR	Prior XRT	Reconstruction Timing	Gracilis	Defect Size, cm	OR Time, min	F/U, mo
1	60	M	30.7	Rectal AC	DVT (prior), CKD, nicotine, EtOH	None	Open	Y	Delayed	Y	15 × 8 × 1	591	50.4
2	53	M	27.9	Anal SCC	HIV, HTN, nicotine	None	Open	Y	Delayed	Y	20 × 7 × 15	410	4.1
3	61	M	36.6	Anal SCC	DVT/PE (current), asthma, nicotine	None	Open	Y	Immediate	N	N/A	626	8.6
4	61	M	22.8	Anal SCC	Nicotine	Pelvic exenteration, gluteal advancement flap	Open	N	Delayed	N	N/A	365	33.6
5	40	F	26.1	Vulvar SCC	HIV/AIDS, DVT (current), HTN, EtOH	Pelvic exenteration, TAH/BSO	Robotic	Y	Immediate	Y	N/A	313	29.6
6	53	M	23	Crohn disease	Hepatitis B, nicotine	None	Open	Y	Delayed	N	8 × 6 × 12	327	38.5
7	46	F	29.9	Rectal AC	None	Pelvic exenteration			Laparoscopic	Y	Delayed	N	
8	52	F	29.3	Rectal AC	5 × 7 × 9 CHF, DM, HLD, HTN, CVA, EtOH, nicotine	443 Posterior vaginectomy, TAH/BSO	Robotic	Y	Immediate	N	N/A	478	11.7
9	70	M	22.5	Rectal AC	HTN, nicotine, EtOH	None	Robotic	Y	Delayed	Y	13 × 10 × 5	616	29.5
10	66	M	27.5	Rectal AC	HTN, nicotine	None	Open	N	Delayed	N	N/A	563	22.2

XRT indicates radiation therapy; F/U, follow up; M, male; F, female; AC, adenocarcinoma; SCC, squamous cell carcinoma; DVT, deep venous thrombosis; CKD, chronic kidney disease; EtOH, alcohol use; HIV, human immunodeficiency virus; HTN, hypertension; PE, pulmonary embolism; CHF, congestive heart failure; DM, diabetes mellitus; HLD, hyperlipidemia; CVA, cerebrovascular accident; TAH, total abdominal hysterectomy; BSO, bilateral salpingo-oophorectomy.

The average age and BMI for our series were 56.2 years and 27.6 kg/m², respectively. The average length of follow-up was 26.1 months, with a standard deviation of 14.4 months. Rectal adenocarcinoma (50%) was the most common indication for APR, followed by rectal squamous cell carcinoma (30%), vulvar squamous cell carcinoma (10%), and Crohn disease (10%). Eighty percent of patients had received radiation therapy. Table 2 provides a summation of demographics and comorbidities for all patients in the series.

Four (40%) patients underwent laparoscopic or robotic-assisted APR with the remaining 6 being open APR. Three patients (30%) received immediate perineal reconstruction while 7 (70%) were delayed. Formal measurements of the defect following APR were available for 5 of the patients in the series. For those in which formal measurements were available, the average defect volume was 752 cm³ (range of 120–2100 cm³). Four patients (40%) necessitated use of the gracilis to help fill additional dead space. Of the 5 patients with formal defect measurements, 3 patients required the addition of the gracilis with an average defect volume of 957 cm³ (120–2100 cm³), while the remaining 2 patients who did not require the gracilis had an average defect volume of 446 cm³ (315–576 cm³). The average operating time for the plastic surgery portion of the cases was 473.2 minutes (313–626 minutes).

Three patients had major complications requiring a return to the OR during admission. Of these, a technical error occurred in 1 patient when the vein was injured during dissection of the perforator. This was identified intraoperatively at the time of injury, and a vena comitantes from a nearby perforator was used to repair the vessel injury prior to flap transfer. Unfortunately, venous congestion was noted the following day, requiring return to the OR and revision of the venous anastomosis. Another patient experienced both venous congestion and partial flap failure due to kinking of the pedicle requiring unkinking and surgical delay at the donor site. The final patient who suffered a major complication had distal flap necrosis likely secondary to inadequate width of the distal flap, leading to insufficient collateral circulation. For our series, we had no instances of total flap loss, flap arterial insufficiency, hematoma requiring evacuation, or readmission within 30 days.

For minor complications, dehiscence of the recipient site occurred in 50% of cases and was managed with local wound care. There were no instances of donor site dehiscence in our series. A pelvic abscess requiring interventional radiology percutaneous drainage occurred in 30% of cases and infection managed only with antibiotics occurred in 20% of cases. Fistulas in the perineum requiring excision occurring >3 months from the initial procedure were noted in 20% of

TABLE 2. Summation of Demographics and Comorbidities

	N = 10 (%)
Age, y	56.2
Male, n (%)	7 (70)
BMI, average	27.6
BMI >30 kg/m ² , n (%)	2 (20)
Primary disease, n (%)	
Rectal AC	5 (50)
Rectal SCC	3 (30)
Vulvar SCC	1 (10)
Crohn disease	1 (10)
Comorbidities	
DVT, current	2 (20)
DVT, prior	1 (10)
HIV	2 (20)
Diabetes mellitus	1 (10)
Hypertension	5 (50)
Hyperlipidemia	1 (10)
Chronic kidney disease	1 (10)
Congestive heart failure	1 (10)
Cerebrovascular accident	1 (10)
Hepatitis B	1 (10)
Alcohol use	4 (40)
Tobacco use	8 (80)
Radiation therapy, n (%)	8 (80)
Delayed reconstruction	7 (70)
F/U, average months (SD)	26.1 (14.4)

M indicates male; F, female; AC, adenocarcinoma; SCC, squamous cell carcinoma; DVT, deep venous thrombosis; HIV, human immunodeficiency virus; F/U, follow-up; SD, standard deviation.

cases. Table 3 summarizes the postoperative complications seen in our series with an average long-term follow-up of 26.1 months.

DISCUSSION

Classically, APR involves removal of the distal colon, rectum, mesorectum, anal canal, and anus through concurrent abdominal and perineal incisions; a permanent end colostomy is then constructed.^{2,4} However, an increasing number of colorectal surgeons are transitioning from the classical open technique to minimally invasive laparoscopic and robotic approaches.^{32,33} The rationale behind this progression is to minimize surgical site morbidity; this principle should guide the reconstructive surgeon as well. Although these patients remain at high risk for postoperative complications, the fasciocutaneous pedicled vPAP flap attenuates donor site morbidity and may be especially suitable for patients undergoing minimally invasive APR in which the abdomen is minimally violated.

The morbidity associated with APR is significant, with reported wound complications ranging from 40% to 65%.^{6,11,34–36} Specifically, APR produces a full-thickness, cylindrical perianal defect that extends to the pelvic floor. The sizable cavitation created by APR necessitates a reconstructive balance between bulk and contour. Unlike in small to moderate-sized perineal defects in which the requirement is resurfacing, volume replacement is critical in these larger defects to minimize dead space, prevent fluid collection and abscess formation, and provide structural support.^{18,21,37} Furthermore, APR wound beds are frequently complicated by high rates of both pre- and postoperative radiation, comprising tissue quality and successful primary repair.²

Leakage of bowel contents during APR may increase the risk of postoperative infection. Among wounds with exposed vessels, prosthetic material, or high urinary and fecal outputs (ie, urinary leak, enteric fistula), additional well-vascularized tissue may be necessary.²⁹ The fundamental goals of perineal reconstruction are to ensure containment of peritoneal contents while obliterating dead space with acceptable cosmesis.³⁸ Vascularized tissue transfer assists with achievement of these goals by decreasing wound tension and improving vascular supply, facilitating the delivery of oxygen, leukocytes, and antibiotics to resist infection and augment wound healing.^{18,39} Relative to flap coverage, 1 recent meta-analysis found rates of major wound complications to be 3.6 times higher among APR defects closed via primary closure and exhibited over twice as many complications overall.¹⁸

As previously mentioned, the vRAM is considered by many as the standard option for perineal defects due to its substantial bulk, long arc of rotation, and robust and consistent vascularity.^{3,18,40,41} It can be easily harvested from the operative field during an open APR, and several reports of vRAM-based perineal reconstructions following APR recount modest major complication rates (13%–22%) when considering the hostility of the usual reconstructive field.^{41–44} Furthermore, a comparative study by Nelson and Butler⁴¹ found that vRAM-based perineal reconstructions had a 14.9% major complication rate compared to 42.1% for thigh-based reconstructions, a statistically significant finding. However, long-term ventral hernia rates with this technique have been reported as high as 16%.⁴⁵

Several common contraindications may prohibit selection of vRAM for reconstruction. As described by Friedman et al,⁴⁶ these include previous division of the rectus muscle or inferior epigastric artery, prior elevation of an abdominal flap, unfavorable abdominal incisions and scarring, and the presence of 2 stomas exiting the recti for fecal and urinary diversion. In our experience, we have found the presence of 2 stomas to be the most common contraindication for the vRAM. For these reasons, the vPAP may serve as a useful instrument in cases where further abdominal wall morbidity can be avoided.

The design capabilities of the vPAP correspond well to the reconstructive needs of the perineum and adjacent structures. The skin of the medial thigh provides a similar skin, hair, and texture match to the perineum, and the skin paddle can be designed with nearly 30 cm of width and with flap volumes as large as 695 g.^{22,47} This may be

TABLE 3. Postoperative Complications

Complications	Number	%
Patients with any complication	8	80
Major complications		
Total flap loss	0	0
Partial flap loss	2	20
Hematoma requiring evacuation	0	0
Flap arterial insufficiency	0	0
Flap venous insufficiency	2	20
Readmission within 30 d	0	0
Minor complications		
Dehiscence	5	50
Recipient site	5	50
Donor site	0	0
Surgical site infection	5	50
Abscess requiring IR drainage	3	30
Required antibiotics	2	20
Fistula requiring excision	2	20

IR indicates interventional radiology.

sufficient for filling large defects and can easily be contoured for inset. Upon secondary assessment, volume can be augmented by stacking with a vPAP from the contralateral thigh or with the already exposed gracilis.³⁸ It is important to note that our series largely represents patients with BMIs less than 30 kg/m² with 8 of our patients falling below this mark. For patients with higher BMIs, we do not utilize any particular restrictions or strict BMI cutoff when considering the vPAP. Higher BMI patients may be less likely to require recruitment of the gracilis for dead space obliteration compared to their lower BMI counterparts, depending on the distribution of excess adiposity and the amount of dead space that is present.

The vPAP possesses consistent and reliable perforators of considerable length and width and possesses a greater reach relative to a transverse or diagonal design. This vertical orientation allows easy access to the gracilis for transposition into the wound bed, if necessary. Importantly during flap harvest, the surgeon should completely dissect the pedicle to its origin, as the 180-degree rotation can be then distributed along the entire length of the pedicle, limiting the chances of kinking.

Cadaveric studies have found the profunda femoris to supply 5 perforators on average, with up to 65% being septocutaneous and 35% musculocutaneous.⁴⁸ The most proximal perforators are located within the inferior gluteal fold while the most distal are approximately 10 cm proximal to the femoral condyle.⁴⁸ With its consistent anatomy and abundance of septocutaneous perforators, the vPAP can be harvested rapidly and has less of a learning curve compared to other perforator flaps, such as the deep inferior epigastric perforator (DIEP) and anterolateral thigh (ALT) flap.^{13,25,49} Possessing an average pedicle length of 10 cm, the vPAP possesses sufficient length for extension and rotation to reach deep into the pelvis.^{50,51} The vPAP can even be taken as a sensate flap by incorporating the internal pudendal nerve, allowing for sensation during intercourse.¹² Finally, the donor site can be closed primarily, leaving a relatively well-hidden scar along the medial thigh.²⁵

The vPAP may be especially well suited to perineal reconstruction following APR from logistical, technical, and strategical standpoints. For example, although some colorectal surgeons have found superior outcomes when performing APR in the prone position, lithotomy remains the most common positioning for both open and minimally invasive approaches.^{4,32} As the vPAP is harvested with the patient in the lithotomy position, patient repositioning is not required. As demonstrated in our series, the vPAP may provide adequate bulk without being overly disruptive to sitting and pelvic functions. In cases where the bulk is inadequate, an additional assessment of the defect can be made, sacrificing additional muscle. In contrast, conventional flaps such as the vRAM, DIEP, and ALT tend to be overly bulky and do not resurface convoluted perineal defects well.^{11,21} Although these flaps can be thinned to some degree, the risk of compromising flap perfusion can be significant and revisionary debulking procedures carry additional operative risk and cost.⁵² Furthermore, use of the perforator flap can preserve alternate flaps based on the pudendal artery, medial circumflex femoral artery, and gluteal arteries for future reconstruction should malignancy recur.⁴⁹

The use of regional PAP flaps for perineal applications has increasingly been reported with a broad array of flap design, highlighting the versatility of its reconstructive capabilities.^{12,13,38,49,53} These include V-Y advancement flaps, island flaps, propeller flaps, and PAPs combined with a transverse upper gracilis.^{12–14,38,53} A recent report by Arquette et al⁵⁴ described a series of 15 patients undergoing successful perineal reconstruction using pedicled PAP flaps; however, our paper differs in many ways. The most clear and substantial difference is that only vPAP flaps were included in our series, while Arquette et al used only transverse and diagonal flap designs. Our series had a higher representation of the male sex with 70% of our series being male versus 33% in the other paper. This is particularly relevant, as Arquette et al found a significant association between the female sex and postoperative complications. As one would expect with relatively small sample

sizes of 10 and 15 patients, respectively, there are many additional differences in the 2 cohorts when considering differences in demographics, comorbidities, and postoperative outcomes, highlighting the need for continued research to accurately guide decision-making and provide our patients with optimal reconstructive outcomes.

Other reports have described using the PAP for vulvar reconstruction.^{12,13,49} Chang et al¹³ and Scaglioni et al¹⁴ have reported achieving excellent outcomes with the PAP in reconstructing vulvo-perineal and perineo-scrotal defects, respectively. Several authors have attempted to craft reconstructive algorithms incorporating surgical indications, defect characteristics, the need for laparotomy, neoadjuvant therapy, and patient positioning.^{3,4,7,29,30} However, while these algorithms certainly provide valuable insight for approaching perineal reconstruction, none have yet specifically included the PAP flap.

The vPAP may have several advantages over other thigh-based options described for perineal reconstruction. Historically, the gracilis myocutaneous flap has been the thigh-based workhorse for perineal reconstruction, but its skin paddle is unpredictable when treated as a random skin pattern and provides inadequate bulk.^{55,56} Furthermore, the cutaneous distribution of its proximal pedicle frequently traverses the muscle, making the distal third of a vertical skin paddle unreliable and severely limiting its reach when designed transversely.⁴⁶ In contrast, preoperative perforator imaging allows the PAP flap to overcome this limitation by mapping the limits of cutaneous perfusion.¹⁸ Given that the skin paddle is raised on a known perforator, it can be more reliably designed while ensuring adequate fit of the defect.

Perhaps most notably, the vPAP is muscle sparing and therefore avoids the loss of muscle function while preserving the gracilis for future surgical applications. Other flaps of the medial thigh that have been described include Lotus and Singapore-style pudendal thigh flaps, the internal pudendal artery perforator flap, and perineal perforator-based island flaps.^{21,49,57} The internal pudendal artery perforator flap has been used to reconstruct large perineal defects, but at least 2 flaps are generally required.⁵⁷ In contrast, here we have been able to fill large defects following APR with a single flap while still possessing the option to augment bulk with a gracilis or contralateral flap, if needed. The ALT has also been described for perineal reconstruction, but this flap is significantly bulkier than the vPAP and portends a much more challenging and time-consuming harvest.^{6,29,58}

Several gluteal-based flaps have also been described for perineal reconstruction.^{17,53,59–61} While proponents have cited expanded bulk, lithotomy positioning, and well-hidden scars as key advantages, gluteal flaps have several significant disadvantages, which are curtailed by the vPAP. In our experience, gluteal flaps often lack adequate pedicle length and subsequent reach for reconstruction of perineal defects that extend anteriorly toward the base of the scrotum or vagina. Another major disadvantage of these gluteal flaps is the discomfort that occurs in the sitting position in the acute postoperative period.⁷ Although inferior scar portions may be well hidden within the gluteal crease, the remaining scar limbs may be rather prominent over the gluteal surface.

The high rates of postoperative complications in our cohort, particularly of infection and minor dehiscence, are unsurprising given nearly all patients were irradiated and at a high risk for bacterial contamination secondary to APR. Given the challenges of tunneling and positioning the flap within this compromised area, a reasonable learning curve is to be expected. Greater surgical experience may reduce vascular complications secondary to kinking and torsion of the pedicle.

Furthermore, we believe that preoperative consultation to allow for immediate reconstruction at the index procedure may have allowed for reduced complication rates through increased integration and optimization of the proposed treatment plan for all specialists involved. The primary reason for delayed reconstruction in our series was due to an attempt by the extirpative team to close the surgical site primarily following APR, with subsequent wound dehiscence leading to our consultation.

One important benefit of our series was that sacrifice of the hemiabdominal wall was not required. In the setting of radical surgical

excisional procedures such as APR, the simple vPAP flap provides a rapid mechanism for achieving primary coverage while averting unnecessary morbidity to the abdominal wall and thigh donor site.

Our report does suffer from several notable limitations. Our sample of only 10 patients limits statistical power to perform meaningful analyses and evaluate confounding factors. We also lack a standard control group for comparison. The retrospective nature of our series imparts inherent limitations, as illustrated by our failure to document defect size in every patient. We observed a high rate of complications overall, which might be attributable to the high rate of delayed reconstructions and increasingly contaminated operative fields, compounded by the numerous comorbidities and poor socioeconomic support characteristic of our patient population.

Therefore, these findings may be less representative of centers with differing population demographics and may be mitigated by closer collaborative relationships with their colorectal surgeons, facilitating immediate reconstruction.

CONCLUSION

Our series demonstrates the clinical utility of pedicled vPAP flaps for perineal defects secondary to APR. This may be a particularly important technique in the era of minimally invasive APRs and in complex cancer patients that require bilateral stomas exiting the rectus abdominis muscles for fecal and urinary diversion. Relative to other options, the vPAP does not violate muscle, has a relatively consistent vascular anatomy, can be designed with a large skin paddle of sufficient reach, has a reasonably well-hidden donor site scar, and has a relatively low learning curve. The vPAP provides good long-term, functional, and aesthetic perineal reconstruction results following APR or other excisional perineal operations and should be included in future treatment algorithms.

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