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Longitudinal Outcomes of Abdominoperineal Resection Reconstruction: A Single-center Retrospective Review

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Background: Reconstruction after abdominoperineal resection (APR) typically utilizes primary closure, locoregional myocutaneous flaps (gracilis or vertical rectus myocutaneous [VRAM]), or omental flaps. Although flap coverage is considered superior to primary closure, no specific flap is preferred, and reconstructive complications can occur in 20%–50% patients. The purpose of this study was to compare outcomes of perineal reconstruction with VRAM, gracilis, and omental flaps.
Methods: A single-institution retrospective cohort review was performed on all adult patients who underwent APR defect reconstruction with VRAM, gracilis, or omental flaps by the plastic surgery service between 2014 and 2023. Demographic, operative, and outcomes-associated variables were noted (surgical site infection, nonhealing wounds, flap necrosis/failure, need for additional procedures/operations, etc.).
Results: A total of 80 patients were identified, 11 diagnosed with inflammatory bowel disease (1 Crohn disease and 10 ulcerative colitis), and 58 diagnosed with colorectal cancer. Flap reconstruction was as follows: 24 VRAM, 49 gracilis, 7 omental. Mean follow-up was 34.9 months (1.56wk, 9.12 y). Enterocutaneous fistula formation was significantly more likely in VRAM versus gracilis flaps (gracilis odds ratio: 0.11, $P = 0.02$), when adjusted for neoadjuvant chemoradiation. Overall complication rate was 72.5% of patients, of whom 45% required procedural intervention.
Conclusions: Perineal reconstruction after APR can be achieved by various methods. Although the literature has shown flap closure to be more efficacious, differences in overall postoperative complication rate across flap type are minimal. Alternatives to VRAM reconstruction should be considered in patients predisposed to fistula formation. *(Plast Reconstr Surg Glob Open 2025;13:e6738; doi: 10.1097/GOX.0000000000006738; Published online 25 April 2025.)*

INTRODUCTION

Abdominoperineal resection (APR) consists of surgical removal of the distal colon, rectum, anal sphincter complex, and surrounding perineal structures. First described in 1908 by Sir William Ernest Miles, it is used as a surgical adjunct in the management of low-lying colorectal cancers; other pelvic/urologic/gynecologic malignancies; and inflammatory bowel disease (IBD), such as Crohn disease (with ulcerative colitis being far more rare).[1–3] A derivative of prior techniques that used transcoccygeal approaches, APR was previously performed in two stages: a midline laparotomy for sigmoid mobilization and colostomy formation, followed by perineal incision for colectomy and rectal extirpation.[1] In the late 1930s, procedures shifted toward a single-stage approach.[1]

Reconstruction after APR can be challenging and often requires a multidisciplinary team. The resulting defect is a product of extensive surgical resection for

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adequate oncologic margins combined with neoadjuvant chemoradiation that impairs tissue planes, compromises vascularity, and delays wound healing. Restoration of both form and function requires the full reconstructive ladder. Due to a robust regional blood supply and soft tissue laxity, a wide variety of options exist. Some colorectal surgeons consider "simple" APR to be instances in which APR is performed solely for rectal cancer. In such cases, primary closure is achievable when tissue edge advancement can be performed without tension. This remains the most common scenario and is generally very successful for select patients. For more complex cases, when operative indications include Crohn disease or colorectal cancer with multiorgan involvement (ie, locally advanced rectal cancer, necessitating concurrent vaginectomy and cystectomy), more complex closures are required. Should additional soft tissue need to be recruited, locoregional fasciocutaneous flaps can be provided by the perineum (Lotus, Singapore) or thigh (V-Y advancement). More substantial extirpative defects require larger muscle flaps (gracilis or vertical rectus myocutaneous [VRAM]); pedicled omental flaps; or, rarely, free tissue transfer. Each reconstructive technique has its own advantages and disadvantages and, ultimately, are subject to clinical history and context (such as prior abdominal surgery, extent of oncologic resection, presence of ostomies, neoadjuvant chemoradiation, operative positioning) and surgeon preference. For reconstructive purposes, the perineum is often divided into anterior and posterior halves. Critically, defect size and location assessed in real-time ultimately guide reconstruction.

Prior literature has compared flap coverage with primary closure and has also investigated various flap types. Although flap coverage is generally considered superior to primary closure, no specific flap or technique is unanimously preferred.[4–9] Studies have shown that although VRAM flaps may have higher minor complication rates, overall major complication profiles remain similar between abdominal, perineal, and thigh-based flaps.[10–12] In specific settings such as fistulizing disease, chemoradiation, and/or cancer, a lack of pelvic drains has also been shown to increase complication risk.[13,14] Billig et al[15] demonstrated that patients requiring flap reconstruction concurrently carried a higher comorbidity index yet demonstrated no differences in outcomes at 6 months compared with primary closure, and that total overall costs were similar. Although outcomes analyses frequently compare primary closure to flap closure, there are clinical situations where primary closure is neither feasible nor physically possible. Reconstructive complications can occur in 10%–50% of patients and range from nonhealing incisional wounds to hernia formation or flap failure.[13,16–18]

The purpose of this study was to evaluate our institute's experience with flap-based perineal reconstruction, comparing cases of VRAM, gracilis, and omental flaps. With an emphasis on the reconstructive perspective rather than purely an oncologic or colorectal standpoint, the authors aimed to enhance multidisciplinary collaboration and shared decision-making. During preoperative consultation, patients can have a more continuous and thorough experience, linking surgical resection with subsequent reconstruction. We hope this serves as a framework for future collaboration between departments and institutes to further the study of perineal reconstruction and optimize patient outcomes.

Takeaways

Question: Perineal reconstruction after abdominoperineal resection can be achieved by various methods. Although the literature has shown flap closure to be more efficacious than primary closure, differences in overall postoperative complication rate across flap type are minimal. We investigate our institution's longitudinal experience of abdominoperineal resection reconstruction outcomes.

Findings: Our study shows that although outcomes across vertical rectus myocutaneous (VRAM), gracilis, and omental flap reconstructions are largely similar, gracilis flaps are significantly less prone to enterocutaneous fistula formation when compared with VRAM, suggesting that consideration of VRAM alternatives in high-risk patients is warranted.

Meaning: Although perineal reconstruction techniques generally have similar outcomes, some techniques need special consideration for certain patient populations.

METHODS

Institutional review board approval was obtained (No. 853271). A single-institution retrospective cohort review was performed on all adult patients who underwent APR defect reconstruction with VRAM, gracilis, or omental flaps by plastic and reconstructive surgeons between 2014 and 2023 at our institution. Inclusion criteria were adult patients who underwent flap reconstruction of APR defects. Patients who were scheduled for but did not undergo APR, or those who were closed primarily were excluded. Demographic, operative, and outcomes-associated variables were noted (surgical site infection, nonhealing wounds, flap necrosis/failure, need for additional procedures/operations). An adverse event was defined as necessitating intervention if a procedure and/or surgery was involved in its management (such as interventional radiology drain placement, or operative debridement/repair).

Statistical analysis was performed with R Studio. Descriptive statistics were performed, as well as univariate and multivariate logistic regression to determine the impact of demographic/operative predictors on outcome variables. Adjustment was performed via multivariable regression, in which potential confounders (chemoradiation) or variables of interest (flap reconstruction type) were held constant when manipulating other variables (outcomes). Statistical significance was achieved with P values less than 0.05.

RESULTS:

A total of 80 patients (male: 39 [48.8%]; female: 41 [51.2%]) were identified. Preoperative diagnoses included

inflammatory bowel disease (IBD; n = 11 [13.75%]), colorectal cancer (n = 58 [72.5%]), and other urologic/gynecologic malignancies or benign fistulizing disease (n = 11 [13.75%]). The mean age was 58.7 years (21.8–86.7 y). Pedicled flap reconstruction was as follows: 24 (30%) VRAM flaps, 49 (61.3%) gracilis flaps, and 7 (8.7%) omental flaps. The mean hospital length of stay was 10.3 days. A substantial portion of patients had neoadjuvant chemotherapy (n = 54, 67.5%) and radiotherapy (n = 56, 70%). Basic demographic information, along with patient comorbidities and perioperative details are outlined in Supplemental Digital Content 1 and 2, respectively. (**See figure, Supplemental Digital Content 1**, which displays APR flap demographics, **http://links.lww.com/PRSGO/D991**.) (**See table, Supplemental Digital Content 2**, which displays APR perioperative details, **http://links.lww.com/PRSGO/D992**.) Patient demographic or perioperative factors did not significantly predict the utilization of a specific flap type.

Overall, 72.5% of patients (n = 58) experienced a complication, of whom 45% (n = 26) required procedural intervention for that complication. Three flaps experienced some degree of necrosis, and there was 1 flap failure (VRAM). Clinical outcomes were largely similar regardless of flap type, and there were no significant differences in rates of adverse events when stratified by flap type, summarized in Supplemental Digital Content 3. (**See table, Supplemental Digital Content 3**, which displays outcomes by APR flap type, **http://links.lww.com/PRSGO/D993**).

Fourteen (17.5%) patients presented to the emergency department (ED) a total of 20 times, at a mean 769 days postoperatively (14 d, 7 y). Eight patients returned to the ED within 90 days of the index surgery. The most common reason for ED visits was abdominal/pelvic pain. Overall, 48 (60%) patients accounted for 119 total hospital readmissions at a mean of 539 days postoperatively (3 d, 7.5 y). Of these, 39 readmissions were within 90 days.

In total, 44 (55%) patients underwent 94 additional procedures/reoperations at a mean of 600 days postoperatively (2 d, 7.5 y). Thirty-two reoperations were within 90 days of the index APR operation. Repeat operative procedures mostly involved the abdomen (n = 51, 54.3%) and perineum (n = 41, 43.6%), with 2 localized to the donor site (2.2%). Broadly categorized, reoperations (presented as proportions of all reoperative indications) were related to the flap (n = 29, 22.8%), a nonhealing wound (n = 27, 21.3%), a hernia/mesh (n = 10, 7.9%), or the stoma (n = 6, 0.8%). The largest reason for reoperation was classified as "other" (n = 55, 43.3%).

Enterocutaneous fistula (ECF) formation was significantly more likely in VRAM versus gracilis flaps (gracilis odds ratio: 0.11, $P = 0.02$), when adjusted for neoadjuvant chemoradiation. Nine (11.25%) patients developed ECF: 5, 2, and 2 in the VRAM, gracilis, and omental cohorts, respectively. The fistulae were located in the perineal (n = 6, 67%) and abdominal (n = 3, 33%) regions. Seven (77.8%) of these patients required surgical intervention for fistula management.

The mean follow-up was 34.9 months (1.56 wk, 9.12 y). A total of 25 (31.3%) patients died, at a mean 95.98 weeks (1.84 y) after their index surgery (1.57 wk, 8.8 y). Six of these patients died within 90 days of the index operation (24% of all mortalities and 7.5% overall cohort). No deaths were directly related to the flap reconstruction.

DISCUSSION

APR is reserved for the management of several low-lying colorectal pathologies. Given the broad differences in extirpative defects, reconstruction after APR often presents a unique challenge to plastic and reconstructive surgeons. Clinical context and provider judgment are paramount in both resection and reconstruction. To optimize patient outcomes, providers and patients must be engaged in collaborative efforts and multidisciplinary meetings.

We retrospectively reviewed 80 patients who underwent APR defect reconstruction with pedicled VRAM, gracilis, or omental flaps from 2014 to 2023 at our institution. The mean follow-up time in our cohort was almost 3 years, longer than many existing studies, with typical follow-up times of roughly 1–2 years, excluding systematic reviews and meta-analyses.[8,16–18] Our database tracks the last known contact dates with members of the surgical team (either plastic or colorectal surgery) and with the entire institution as a whole, to calculate follow-up dates. Four patients did not have outpatient follow-up, as these patients died before hospital discharge. Most patients, (n = 52, 65%) had follow-up more than 15 days postoperatively. Our institution does not utilize a standardized follow-up protocol, as these patients are predominantly followed up by colorectal surgery, with the exception of cases involving flap complications; for this reason, this study did not have a specifically defined minimum follow-up period. However, when calculating follow-up periods, the authors excluded visits/encounters that did not specifically address APR and its reconstruction, so as to ensure that the reported timeframes were accurate with respect to reconstructive assessment and surveillance. Of the 25 individuals who died in our study, the deaths were unrelated to flap reconstruction, mostly secondary to an underlying cancer diagnosis. Although most postoperative outcomes did not significantly differ by flap type, our results demonstrate that ECF formation was significantly more likely to occur after VRAM reconstruction when compared with gracilis flaps.

With longer term follow-up, this series was able to track patients for fistula occurrences. Interestingly, our study showed that fistula rates were more frequent in patients reconstructed with VRAM flaps, when compared with those patients reconstructed with gracilis flaps. Conventionally, VRAM flaps are thought to be more reliable than thigh-based flaps in the setting of perineal reconstruction.[19,20] Described in the 1950s and 1970s, the gracilis muscle is traditionally limited by size or bulk.[21–23] Although improved recently through cadaveric studies, it characteristically has an unreliable distal skin paddle when elevated as a myocutaneous flap.[24,25] We suspect that our elevated fistula rates were most likely correlated with extirpative defect size and volume. Given the additional abdominal morbidity risk of VRAM harvest, our principle reconstructive surgeon will

generally reserve VRAM reconstruction for massive or cavitary defects. These large defects may be more prone to fistula formation. Other factors such as steroid use and malnutrition are correlated with postoperative fistulas and may have contributed to our outcomes.[26] Prior literature has also identified postoperative surgical site infection and delayed wound healing as independent factors resulting in fistula formation.[27]

Our study included 11 individuals (13.75%: 1 Crohn disease and 10 ulcerative colitis) with diagnosed IBD. For patients with IBD, the exact indication for APR was not always specifically mentioned (ie, fistula, pain, terminal diversion). With respect to etiologies of disease linked with each flap subtype, only 1 (4.2%) patient in the VRAM cohort had Crohn disease, compared with 7 (14.3%) patients with ulcerative colitis in the gracilis cohort. As such, it is unlikely that a Crohn disease diagnosis alone contributed to the higher proportion of ECF in VRAM patients. It is essential to capture this significant proportion of the study cohort because of the generalizability to a broader population, one that mirrors the general population more closely. Frequently, studies investigating APR solely include colorectal cancer patients because APR for IBD patients is less frequent and generally warranted in cases of severe or recalcitrant disease. Our study broadly incorporates individuals with colorectal cancer, IBD, urologic/pelvic/gynecologic malignancies, and benign fistulizing disease, which strengthens diversity. Most of the study cohort (73.75%) had diagnosed colorectal cancer, still making this study applicable to a target audience of oncologic APR candidates, in which a major constituent is colorectal cancer. As patients with IBD possess an underlying predisposition for colorectal carcinoma, it is paramount that these individuals are represented within study cohorts.

Our study revealed an overall complication rate of 72.5% (n = 58), of which 45% (n = 26) required an intervention for their management. This is distinct from the 55% (n = 45) of patients who underwent an additional procedural intervention or reoperation. Although seemingly conflicting, not all reinterventions were direct consequences of the index surgery. In other words, patients might have had another operation, even years later, for reasons other than a postoperative complication, such as cancer recurrences or other unrelated procedures. Thus, the 45 individuals (55% of the study population) who underwent additional procedures includes the 26 individuals (45% of all patients with complications) who required interventions for a postoperative complication.

Overall, our complication rate is comparable to reported literature. Chong et al[28] demonstrated that more than 60% of their APR reconstruction patients had a medical or surgical complication. In separate nationwide analysis of 1309 patients, more than 45% of patients had at least 1 complication in 30 days following their procedure.[29] It is important to note that our complication rates may be elevated given the high morbidity of the patient population, composed significantly of patients with cancer, and our extended follow-up. Given that these patients often had neoadjuvant chemoradiation or were immunocompromised, it is likely that they were more vulnerable to adverse events and complications. Determining which adverse events are "relevant" can be nuanced, and even reviewer-dependent at times. For example, a postoperative patient requiring cardiac pacemaker insertion is a reoperation that can generally be considered unrelated to APR reconstruction. However, that same patient presenting to the ED with nonspecific abdominal pain must be considered, as bowel obstruction and/or herniation could be directly related to the patient's oncologic resection and flap reconstruction. Furthermore, with heightened acuity, these patients may be more likely to require hospital readmission, sometimes even in an abundance of caution, which may lead to misleading rates of ED presentations and readmissions. The same can be stated for reoperations. If a patient undergoes a reoperation for a recurrent cancer excision, or a bowel obstruction, it may or may not be related to the flap reconstruction. The type of flap must also be considered. Although the creation of a colostomy creates a fascial defect, a bowel obstruction secondary to a parastomal hernia that requires operative intervention may be related to a VRAM or omental flap reconstruction but unrelated to a gracilis flap reconstruction. The complications and adverse events most-directly related to flap reconstruction are typically those involving surgical sites, wounds, or the flap itself. Adverse events, readmissions, and reoperations related to these were the most "relevant" and can be considered with higher priority in relation to flap reconstruction. Other "less-relevant" instances were nonetheless captured in our dataset to highlight the general morbidity of the patient cohort and should be considered when determining candidacy for flap reconstruction after APR, in terms of both safety and complication profiles in these patient populations.

This study served to provide a retrospective review of perineal reconstruction techniques performed plastic surgeons at our institution following abdominoperineal resection by colorectal surgeons. The study is not all-encompassing of reconstructive techniques but evaluates the experiences of 6 plastic surgeons and eight colorectal surgeons among 80 patients at University of Pennsylvania Health System. Results were not compared between plastic surgeon providers given the limited statistical power. An exhaustive number of studies have previously compared primary versus flap closure, and our analysis did not seek to compare the same. Specifically, operations in which the perineum was primarily closed and cases that did not involve a plastic surgeon were excluded from our analysis. Furthermore, this investigation was not intended to compare all types of perineal reconstruction: notably, there are other thigh-based or gluteal-based fasciocutaneous flaps not included in our analysis because these techniques are less commonly used at our institution. Subsequent results and external comparison should take this into account because the indications for APR and subsequent reconstruction differ between patients. Our statements for consideration of alternatives to VRAM reconstruction in patients who may be predisposed to fistula formation do not necessarily advocate for or against 1 flap versus another—instead, they are meant to highlight

the importance of clinical consideration and underscore the need for multidisciplinary care as well as patient counseling.

Some limitations of this study include the retrospective study design. Although electronic medical records and information technology have revolutionized healthcare, it is not perfect, and data may be lost, incomplete, or inaccurate, especially from dates before a health systems transition to, or between, electronic medical records. This, compounded with a retrospective study design, can result in missing or incomplete data. In our study, there were only seven omental flaps, and the small sample size detracts from statistical significance and overall generalizability of the study. In recent literature, there has been a large shift toward the utilization and inclusion of patient-reported outcome (PRO) measures, to better elucidate outcomes from the patient's perspective. This study focuses on objective clinical outcomes and does not include PROs. Finally, it is important to note that the general context of this study is focused on the reconstruction of existing APR defects, and not the diagnosis and management of the etiological indication for APR. There are several factors that were not addressed in this study, particularly as it relates to these conditions: tumor grade, stage, neoadjuvant/adjuvant treatment, the use and duration of disease-modifying antirheumatic drugs or biologics. Moreover, specifics as to the location fistulae and delineation of anatomic involvement (enterocutaneous, enteroatmospheric, rectovaginal) were not addressed. Our aim was to focus on the subsequent reconstruction of an existing APR defect. By contributing to current literature on APR defect reconstruction, providers have an enlarged armamentarium which can provide more-thorough patient education in the preoperative setting. This, in turn, can encourage patient-provider discussion and manage postoperative outcomes and expectations. Ultimately, future studies are warranted that focus on larger, more diverse patient cohorts, along with the inclusion of PROs.

CONCLUSIONS

Perineal reconstruction after APR can be achieved by various methods. Although the literature has shown flap closure to be more efficacious, differences in overall postoperative complication rate across flap type are minimal. Our study shows that gracilis flaps are significantly less prone to enterocutaneous fistula formation and suggests that alternatives to VRAM reconstruction should be considered in patients predisposed to fistula formation.

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DISCLOSURES

Dr. Stephen Kovach is a consultant and speaker for the following organizations: Becton Dickinson, WL Gore and Company, Integra Life Sciences, Checkpoint Surgical, and AbbVie Consulting. The other authors have no financial interest to declare in relation to the content of this article.

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