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A Novel Modification of the Endorectal Advancement Flap for Complex Anal Fistulas: Surgical Technique and Outcomes

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Objective: A modification of the endorectal advancement flap (EAF) procedure is described with outcomes in a single-center, large retrospective cohort study.

Summary of background data: Fistula-in-ano is a common problem encountered by surgeons that can be classified as either simple or complex. Complex fistulas (CFs) cause higher morbidity and are much more challenging to treat. Although numerous treatment options are available for CF, none are proven to be 100% effective. The endorectal advancement flap (EAF) procedure was developed as an alternative to conventional surgical treatments for CF.

Methods: Charts were reviewed of patients with CF who underwent EAF between 2004 and 2019. The conventional EAF procedure was modified by performing transverse imbrication of the internal sphincter over the internal fistula opening. The incidence of new-onset fecal incontinence and recurrence were analyzed at the last available date of in-person follow-up.

Results: With a median follow-up of 6.6 months (range, 3.3–24 months), 99 patients with CFs underwent a modified EAF. Of these, 93% (92 of 99) had resolution of fistula without adverse outcomes, 7% (7 of 99) experienced recurrence, and 1% (1 of 99) experienced new-onset fecal incontinence. Systemic steroid or immunomodulatory therapy use ($P = 0.001$)

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and patients with diagnosed inflammatory bowel disease ($P < 0.0001$) were associated with increased rate of recurrence.

Conclusions: EAF with transverse imbrication of the internal opening using interrupted, absorbable suture is an effective technique to treat complex or recurrent anal fistulas. It is associated with a low risk of recurrence (7%) and fecal incontinence (1%) and is a valid treatment option for CFs.

Key words: Rectal fistula – Surgical flaps – Fecal incontinence – Retrospective studies – Cohort study

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Perianal fistulas are one of the most common conditions treated by colorectal and general surgeons.[1,2] Although anal fistulas are not life-threatening, they result in debilitating pain and soiling, which negatively affect quality of life.[3,4] In most instances, history of perianal abscess precedes fistula-in-ano.[1,2,5] Although, 50% to 70% of patients resolve with surgical drainage, 30% to 50% progress to develop perianal fistula, which supports the theory that fistulas are commonly caused by cryptoglandular abscesses that fail to heal.[1,2,5] However, the progression of abscess to fistula is more common in patients with other underlying conditions, such as inflammatory bowel disease (IBD) or malignancy.[1,2] Thus, addressing the underlying cause is important to preventing recurrence.[1,2]

Simple fistulas are low-lying within the anal canal, close to the anal verge, and are associated with low risks of fecal incontinence as they are superficial to the external anal sphincter.[5] They can be treated by either fistulotomy or fistulectomy, with high rates of successful outcomes.[5] On the contrary, complex fistulas (CFs) are located deeper in the anal canal (or "high" in the pelvis) to include the rectum, and can involve more than 30% of the circumference of the external anal sphincter.[5] CFs can communicate with adjacent organs, such as the vagina, and often develop in conjunction with a history of radiation or IBD.[6] They can also be due to iatrogenic injury after colorectal surgery or obstetric trauma.[5] Because of the diversity of etiologies and complexity of condition, there have been a wide variety of surgical procedures developed to treat CFs, including ligation of the fistula tract (LIFT),[7] video-assisted anal fistula treatment (VAAFT),[8,9] fistula laser closure,[10] and endorectal advancement flap (EAF).[11,12] However, these are associated with some risk of fecal incontinence due to manipulation of the tissues around the external anal sphincter.[11,12] Although there are nonsurgical options, such as fibrin glue, plugs, or stem cell pastes, that have minimal risk of fecal incontinence, they have lower success rates compared with surgical options.[13,14] Thus, at present, there is no ideal treatment strategy for CF.[1,2]

EAF is one of the most common procedures performed for CFs. It was first reported by Nobel in 1902 for the treatment of rectovaginal fistulas that commonly resulted from obstetric trauma.[11,15] It was later modified using a flap of rectal tissue to close the tract between the source of the fistula deeper in the cryptoglandular tissue and its opening to the anal mucosa.[11,15,16] Flaps can be tongue-shaped, rhomboid, or elliptical and can include the rectal mucosa alone, or extend deeper to include the submucosa, partial layers of the internal anal sphincter, or the entire thickness of the internal anal sphincter.[1,2] Traditionally, the opening of the fistula within the rectum is either left open to heal by secondary intention or closed with simple, interrupted, or figure-of-eight sutures.[11,15,16] In addition to covering with a flap, the fistula tract can be treated with curette or coring out.[1,2] Although technically complex, the advantage of the EAF is that the sphincter complex is left intact, and thus EAF has a lower risk of fecal incontinence when compared to other surgical options.[1,2] After being studied for more than a century, EAF has an accepted recurrence rate of 7% to 48% with a risk of fecal incontinence of 15% to 20%.[1,2] However, the optimal thickness of the flap and technique for CF fistulas is unknown.

Herein, we describe a novel modification of the EAF procedure along with surgical outcomes in terms of recurrence and fecal incontinence after surgery. We also examine the factors associated with recurrence.

Materials and Methods

A retrospective chart review of patients with a diagnosis of complex rectal or anal fistulas who

underwent an EAF procedure by the principal investigator between January 2004 and February 2019 was done. This study was approved by the Institutional Review Board under protocol No. 2019-233.

Patients who presented with CFs and underwent evaluation for EAF placement were included. A CF was defined according to the Garg Classification of severe fistulas in which fistulotomy should not be attempted (grades III, IV, V).[17,18] These included a high linear transsphincteric fistula according (involving an estimated more than one third of the sphincter, a fistula associated with IBD, previous sphincter injury, postradiation exposure or an anterior fistula in a female), a transsphincteric fistula with either abscess, multiple tracts or a horseshoe component, or interssphincteric supralevator or extrasphincteric extension.[19] Because of discrepancy in fistula classification found historically in the literature, the newer Garg classification was compared with older classification systems (Parks[5] and St James University[20]) to better assess how our population compares to those previously reported. CFs were diagnosed and initially assessed by physical examination and confirmed by intraoperative exam under anesthesia. If fistula tract or anatomy was unclear by initial clinical exam, magnetic resonance imaging (MRI) was obtained to further define anatomy and classify the fistula-in-ano and aid with surgical planning. All patients who were included were confirmed by MRI and/or exam under anesthesia as having CFs, and therefore not amenable to simple fistulotomy.

Patient demographic information, including age, sex, race, body mass index (BMI), number and type of previous perianal surgeries, history of smoking, systemic steroid use, immunomodulator or immunosuppressive use, IBD [Crohn disease, ulcerative colitis (UC), or indeterminant colitis], chronic obstructive pulmonary disease, congestive heart failure, coronary artery disease, type 2 diabetes mellitus, hypertension, and chronic kidney disease, were recorded if listed as a diagnosis within the patient's chart at the time of initial preoperative clinical evaluation. Immunomodulator or immunosuppressive use was defined as those who before or at the time of surgery received the current US Food and Drug Administration–approved agents for the treatment of Crohn disease or UC (including mercaptopurine, azathioprine, infliximab, or any novel monoclonal antibodies), chemotherapy for alternative cancer, or immunosuppression for a history of solid organ transplantation. The etiology of fistula-in-ano, including cryptoglandular, Crohn disease, UC, postobstetric fistula, radiation-induced, untreated carcinoma, or hidradenitis suppurativa, was noted. Additional information regarding the surgical procedure was noted, including date of surgery, date of subsequent follow-up visits, and date of last follow-up, presence of recurrence of symptoms after surgery, and subsequent surgical interventions (such as diversion, fistulectomy, or repeat EAF). The presence of fecal incontinence, before and after surgery, was assessed at time of history taking during outpatient clinical exams.

Primary outcomes were fistula recurrence and new-onset fecal incontinence after EAF surgery. Recurrence was defined as "the presence of an abscess or purulent drainage from the primary fistula area after at least 6 weeks of healing from EAF." Fecal incontinence was defined as "difficulty controlling stools (soiling) during follow-up as described by the patient."[1,2] Fecal incontinence was assessed by thorough history, and any complaints of difficulty controlling stool or flatus was extracted from the patient's medical record. Healing from surgery was defined as absence of pain impairing activities of daily living, drainage, soiling, or signs of persistent inflammation consistent with concern for wound infection.

All patients received full bowel preparation prior to surgery. On the day of the surgery, a fleet or saline enema was given to the patient based on tolerability. All procedures were performed in the outpatient setting under spinal or general anesthesia. Patients who had fistulas with an anterior lying internal opening were positioned in a prone jack-knife position, whereas those with a posterior internal opening were placed in a lithotomy position.

Initial exposure of the surgical field was provided using a Park anal retractor, which was later exchanged for a large or medium-sized Sawyer or Hill-Ferguson retractor to decrease tension on the lateral edges during flap closure. Because local anesthetic injection around the future flap site could potentially compromise flap perfusion, local anesthetic was not administered. The rectal mucosa was dissected using needle-tip electrocautery, ensuring a flap base that was 3 times wider than the apex of the flap (Fig. 1A). Once the flap was created, the internal opening was closed by imbricating the internal sphincter using multiple transverse interrupted 2-0 Vicryl sutures (Fig. 1B). This modification not only served to close the internal sphincter opening, but it also decreased tension on the flap during the closure. The flap was secured over the center of

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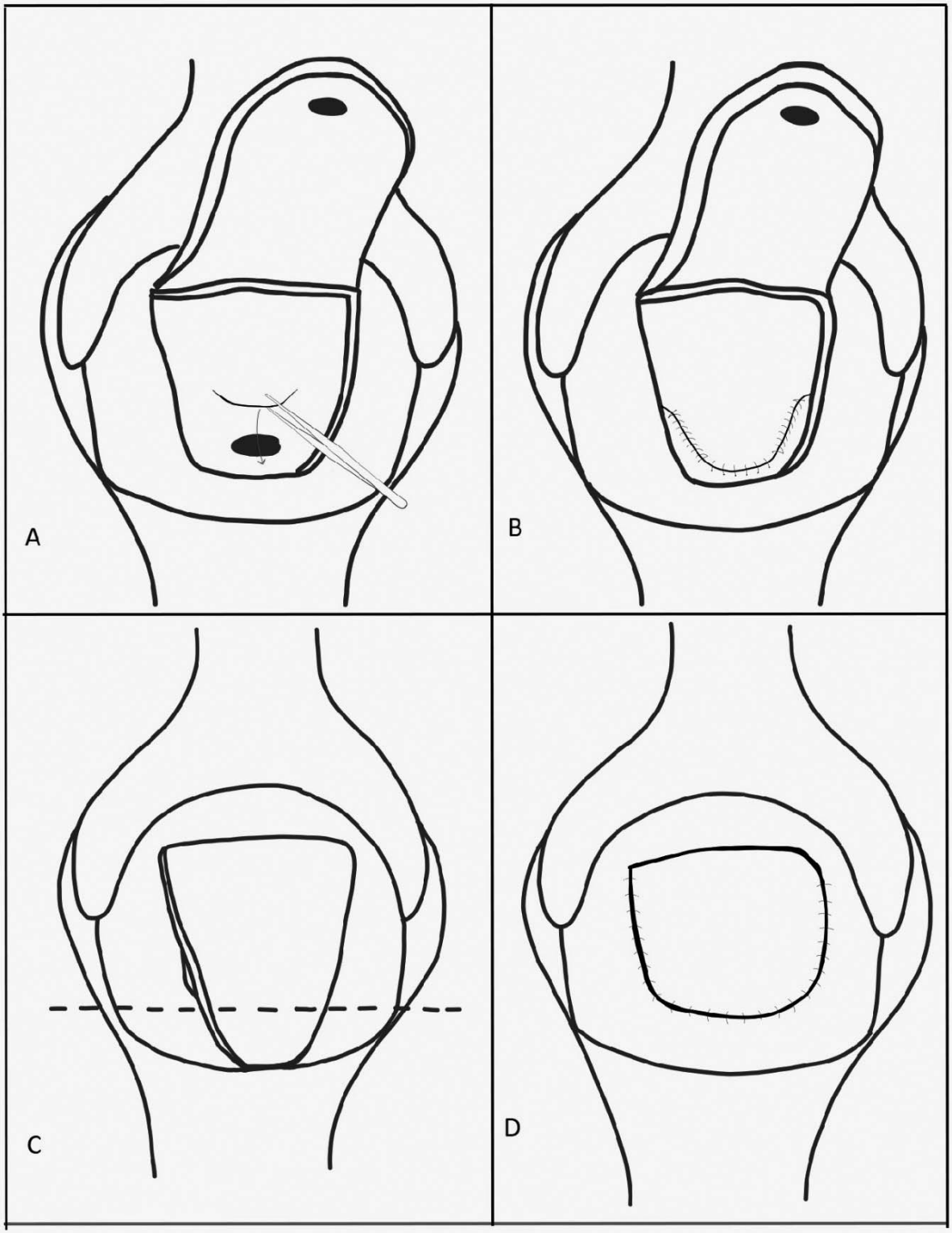

Fig. 1 (A) Rectal mucosa flap dissected with electrocautery, base 3 times wider than apex. (B) Internal opening is imbricated and closed with multiple interrupted 2-0 Vicryl sutures. (C) Apex of flap is brough below level of fistula opening (transverse hashed lines). (D) Interrupted sutures of 3-0 Vicryl used to secure the flap at inferior edge and laterally.

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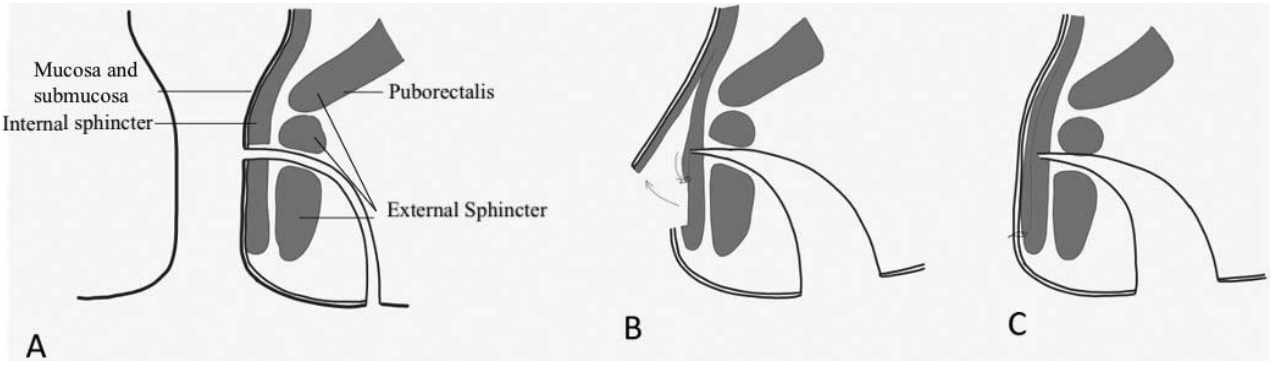

Fig. 2 (A) Anatomy of anus and rectum and intersphincteric fistula tract (sagittal view). (B) Internal fistula opening, coring out external opening, closure of internal defect, and flap creation. (C) Closure of flap, overlapping the fistula tract.

the defect by suturing the inferior edge of the flap with multiple interrupted 3-0 Vicryl sutures to the internal sphincter and anoderm distally to control the intersssphincteric tract and bringing the tongue of the flap below the level of the opening of the fistula tract (Fig. 1C and 1D). Compared with running sutures, interrupted suture placement was believed to allow drainage underneath the flap that would otherwise collect and impair healing. The lateral edges of the flap were then closed with 3-0 Vicryl sutures, with lateral bites that measured less than 3 mm from the wound edge (Fig. 1D). The fistula tract was debrided in a core-out fashion, and the fistula tract(s) were excised to the border of the external anal sphincter muscles. The steps, in relationship to anatomic landmarks, are represented in a sagittal view in Fig. 2. Postoperatively, patients are instructed to avoid strenuous activity and are provided with nonnarcotic analgesia for 7 days. The symptoms were assessed, and the operative site was examined by the surgical team at the same hospital at 1 to 2 weeks after surgery, and then every 3 months until complete healing. Fiber supplements are provided to maintain regular bowel movements and avoid constipation during postoperative healing.

Continuous data were analyzed for normality using the Shapiro-Wilki test. Normally distributed continuous variables were analyzed for statistical significance using Student *t* test and reported as means with standard deviation, whereas non–normally distributed continuous variables were analyzed for statistical significance using Mann-Whitney *U* tests and reported as median with 25th to 75th interquartile range (IQR). Categoric variables were compared using Pearson χ^2 test. Statistical analysis was performed using StataSE software (Stata Statistical Software, release 16, StataCorp LLC, College Station, Texas), and statistical significance was defined as $\alpha < 0.05$. Figures were created using Adobe Illustrator version 24.0.1.

Results

Records from 111 patients between 2004 and 2019 who underwent evaluation for EAF for CF were reviewed (Fig. 3). Twelve patients were excluded from analysis either because they were lost to follow-up after their first clinic visit at 2 weeks after operation (n = 6) before their outcomes could be appropriately assessed, or their underlying etiologies for CF involved a fundamentally different treatment pathway than being candidates for EAF creation (*i.e.*, n = 5 patients with CF secondary to diverticulitis who were treated with resection of the involved colon and/or diverting ostomy; n = 1 patient with CF secondary to squamous cell carcinoma that was treated primarily with radiation and chemotherapy). Therefore, the final cohort consisted of a total of 99 patients who were assessed for relevant outcomes, with a median follow-up of 6.6 months (IQR, 3.3–24 months). Of these, 3 patients underwent evaluation by MRI for further classification of their fistula because anatomy was not clear at time of clinical evaluation.

As shown in Table 1, the median age at presentation was 46 years (IQR, 37–55 years), 55% (54 of 99) were male, and median BMI was 29 kg/m^2 (IQR, 22–36 kg/m^2). A total of 78% of the cohort was white, followed by African Americans (13%), Asian Americans (7.5%), and other minorities (1.5%). Thirty-nine patients (39 of 99; 39.4%) underwent anorectal surgery for fistula-in-ano prior to EAF, and the median number of prior fistula procedures was 2

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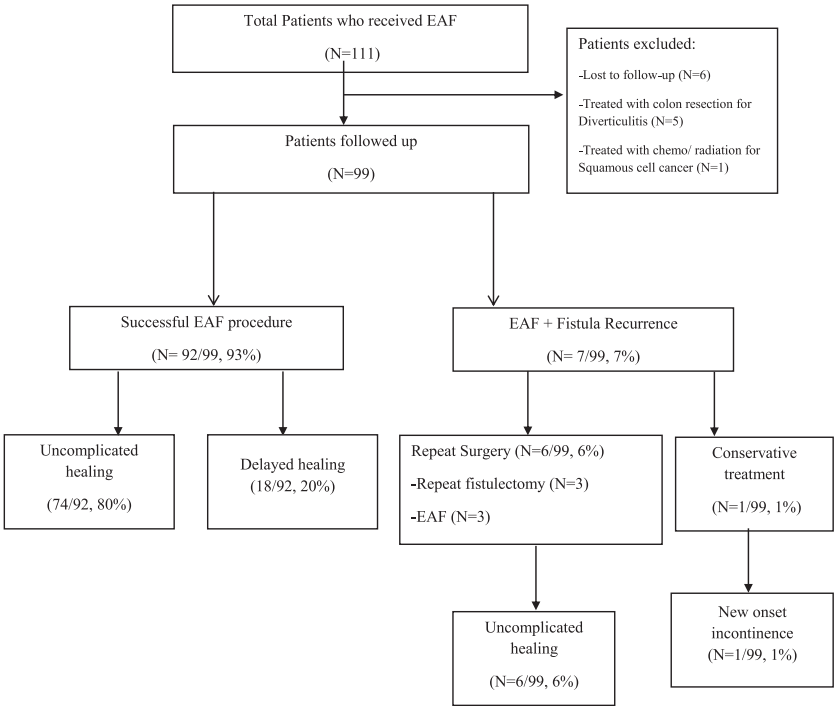

Fig. 3. Outcomes of Patients undergoing Endoadvancement Flap (EAF)

(IQR, 1–2). These previous procedures included fistulotomy/fistulectomy (33 of 99; 33%), LIFT (3 of 99; 3%), Henley drainage procedure for associated horseshoe abscess (1 of 99; 1%), and previously attempted EAF (2 of 99; 2%; Table 2). Notably, 3 patients who had undergone prior LIFT had documentation within the operative reports of increased technical difficulty while performing EAF because of scarring of the internal anal sphincter and accumulation of granulation tissue.

The most common etiologies of fistula-in-ano included cryptoglandular disease (76 of 99; 77%), Crohn disease (16 of 99; 16%), UC (2 of 99; 2%), radiation injury (2 of 99; 2%), indeterminate colitis (1 of 99; 1%), obstetric injury (1 of 99; 1%), and hidradenitis suppurativa (1 of 99; 1%), as shown in Table 3. Additionally, among the total cohort of 99 patients, 69 patients (69%) had abscesses associated with their fistulas, 5 patients (5%) had horseshoe tracts, and 7 patients (7%) had multiple tracts. There were also numerous comorbidities within our patient population, including 12% having diabetes mellitus (type 2), congestive heart failure (7%), and hypertension (32%), as shown in Table 4.

Of the 99 patients who underwent EAF, 93% (92 of 99) had successful healing, and 7% (7 of 99) experienced some sort of recurrence, as shown in Fig. 3. Of those who had successful healing, 80% (74 of 92) experienced healing within 1 to 2 weeks postoperatively, and 20% (18 of 92) experienced healing by the final postoperative visit without repeat surgical interventions. However, of those who experienced delayed healing, 2 patients, who

Table 1 Demographics of included patients (N = 99)

Parameter	
Age, median (IQR), y	46 (37–55)
Sex, n (%)	
Male	54/99 (55)
Female	45/99 (45)
Race, n (%)	
White	64/82 (78)
African American	11/82 (13)
Asian American	6/82 (7.5)
Other	1/82 (1.5)
BMI, median (IQR), kg/m^2	29 (22–36)
Follow-up period, median (IQR), mo	6.6 (1.6–84.5)
Incontinence present before surgery, n (%)	5/99 (5)
Previous fistula repair, n (%)	39/99 (39.4)
No of previous procedures, median (IQR)	2 (1–2)

Table 2 Previous perianal surgeries (% of patients who underwent a given procedure previously)

Surgery	
Fistulectomy with or without debridement	33/99 (33)
LIFT	3/99 (3)
Henley drainage procedure	1/99 (1)
Previous EAF	2/99 (2)

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Table 3 Underlying etiology

	n (%)
Cryptoglandular disease	76/99 (77)
Crohn disease	16/99 (16)
Ulcerative colitis	2/99 (2)
Radiation injury	2/99 (2)
Indeterminate colitis (IBD)	1/99 (1)
Obstetric injury	1/99 (1)
Hidradenitis suppurativa	1/99 (1)

Table 4 Comorbidities

	n (%)
Systemic immunomodulator, steroid, or chemotherapy use	13/99 (13)
Active smoker/former smoker	13/99 (14), 5/99 (5.5)
Diabetes mellitus, type 2	12/99 (12)
Chronic obstructive pulmonary disease	5/99 (5)
Congestive heart failure	7/99 (7)
Coronary artery disease	9/99 (9)
Hypertension	32/99 (32)
Chronic kidney disease	1/99 (1)

had fecal incontinence preoperatively, experienced persistence of fecal incontinence. Among the 7 patients who experienced fistula recurrence, 1 patient was managed conservatively with wound care but remained symptomatic until last follow-up and experienced new-onset fecal incontinence (1%). For the patient who developed new-onset fecal incontinence, her fistula was secondary to hidradenitis suppurativa, and symptoms were improved with stool-bulking agents by date of last follow-up at 7 months postoperatively, but she did not wish to undergo surgical treatment. The other 6 patients who experienced recurrence (6 of 7; 86%) required repeat surgery with either repeat fistulectomy (n = 3) or repeat EAF (n = 3). All 6 of these patients experienced resolution of their symptoms and fistula healing by last date of follow-up. Thus, among 99 patients initially, a total of 102 EAF procedures were performed, with 3 patients receiving repeat EAF for fistula recurrence within our practice, as shown in Fig. 3.

On comparing patients who experienced recurrence to those who experienced successful healing, there were no significant differences in recurrence rates when comparing between different ages, races, sexes, BMIs, histories of smoking, other chronic comorbidities ($P > 0.05$ for all; Table 5). However, there was a statistically significant lower rate of fistula recurrence in patients who had no history of systemic steroid use compared with those with a history of taking these medications during and after EAF ($P = 0.0001$). Additionally, there was a higher recurrence rate in patients who had IBD versus no diagnosis of IBD (5 of 7; 71.4% versus 14 of 92; 15%; $P < 0.0001$).

Discussion

Many studies discuss the limited descriptive data on CF populations who undergo EAF.[1,2] At present, there is still no clear definition of a "typical" patient with this pathology, and it is unclear if the results from this series can be applied to other populations. Traditional EAF is known to have a recurrence rate of 7% to 48% in patients with CFs.[1,2,21] Other treatment options available to treat fistulas-in-ano include VAAFT surgery, which has an overall recurrence rate of 17.7%,[22] and LIFT, a sphincter-sparing technique that has gained popularity recently because of high success rates of 76% for complex anal fistula.[23] Also worth mentioning is the fistula laser closure, another sphincter-saving procedure, which has an overall success rate of 69% for fistula-in-ano.[10]

This study reports a relatively large cohort of patients with complex anal rectal fistulas undergoing EAF by using transverse imbrication of the internal sphincter over the internal fistula opening. Our modification of EAF demonstrates a much lower recurrence rate of 7%. Additionally, the rate of postoperative fecal incontinence (1%) is low compared with other studies (15%–20%).[1,2,21] These results can potentially be explained by a modification that securely closes the opening of the fistula while eliminating tension from the flap. Our cohort consisted of patients with various etiologies of CFs, such as cryptoglandular disease, Crohn disease, UC, radiation, and obstetric trauma.[1,2] Among this diverse population, there was a recurrence-free rate of 93%, making this study relatively large, with short-term success that would need to be corroborated by long-term follow-up.[1,2,21]

Indeed, one of the limitations of this study is the 5 patients who were lost to follow-up, which represents a significance source of selection bias commonly found in retrospective reviews. Additionally, there was relatively short-term follow-up in our patients (median of 6.6 months), which limits the confidence with which this approach can be recommended for definitive fistula treatment. An important future direction for advancing the treatment of this condition is performing closure follow-

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Table 5 Factors associated with success versus recurrence after EAF

Parameter	Successful EAF (n = 92)	Recurrence (n = 7)	*P* value
Age, y	47 (15–77)	38 (25–68)	0.42
Sex, n (%)			
Male	48/92 (52)	6/15 (85)	
Female	44/92 (48)	1/15 (15)	0.08
Race, n (%)[a]			
White	58/76 (76.3)	4/6 (68)	0.61
Black	11/76 (14.5)	1/6 (16)	
Asian	6/76 (7.9)	1/6 (16)	
Other	1/76 (1.3)	0/6 (0)	
BMI, median (IQR) kg/m^2	29 (25–32)	33 (18–35)	0.15
Systemic immunomodulator, steroid or chemotherapy use, n (%)	9/92 (9)	4/7 (57)	0.0001*
Active smoker or former smoker, n (%)	16/91 (17.6)	2/7 (28.6)	0.46
Diabetes mellitus type 2, n (%)	11/92 (12)	1/7 (14)	0.1
Chronic obstructive pulmonary disease, n (%)	5/92 (5.4)	0/7 (0)	0.52
Congestive heart failure, n (%)	6/92 (6.5)	1/7 (14.3)	0.44
Coronary artery disease, n (%)	8/92 (8.7)	1/7 (14.3)	0.62
Hypertension, n (%)	29/92 (31.5)	3/7 (42)	0.53
Inflammatory bowel disease, n (%)	14/92 (15)	5/7 (71.4)	<0.0001*
Total No. of prior procedures	2 (1–2)	2 (2–3)	0.62
Required diverting stoma, n (%)	3/92 (3.2)	0/7 (0)	0.62

[a]In the cohort, 17 patients had unknown race.

up with patients who otherwise did not return for postoperative care, as well as continued surveillance and outcome reporting during long-term follow-up of at least a year. Finally, patients were studied from a single center with a single surgeon team leader, thus limiting the generalizability of the results based on variance in surgeon technique and population of patients.

Additionally, preoperative imaging was not routinely performed, and it is possible that routine imaging by MRI would provide more accurate classification and perioperative planning of CFs. Furthermore, a formal fecal incontinence assessment scale was not routinely used in preoperative and postoperative clinical assessment, which limits the accuracy of the assessment of fecal incontinence and will be considered for future study to more accurately assess the degree of symptoms of incontinence and whether they were present preoperatively. In this cohort, more severe scarring likely resulted in more extensive dissection, and therefore increased risk of sphincter involvement. Further study of these patients would be required to see how much this new-onset fecal incontinence was impacting their lives, and if it was an improvement over their original fistula symptoms.

Further research is needed to compare this modified EAF procedure to other approaches, such as a traditional figure-of-8 closure or no-suture closure, or those involving flaps with partial- or full-thickness internal sphincter components. These efforts might better delineate which modifications of the EAF procedure would result in higher success rates. Furthermore, comparisons between various EAF modifications and other sphincter-sparing procedures, such as fibrin glue,[13] stem cell pastes,[14] and more invasive surgical procedures, such as LIFT and VAAFT,[8,9] are needed to optimize treatment planning for those at high risk of incontinence.

The study describes a modified EAF procedure along with outcomes of fistula recurrence and new-onset fecal incontinence. This novel procedure shows low recurrence (7%) and new-onset incontinence (1%) rates in a 6.6-month follow-up period, suggesting that it seems to be a valid treatment option for CFs. Additional long-term studies are needed to compare this modification with the traditional EAF technique, and with other treatment types for CFs.

Acknowledgments

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and E.E.B. contributed equally to this work; both provided concept, data collection, data analysis, and manuscript drafting. Additionally, K.S. provided data analysis, and E.E.B., G.D., and M.D. provided manuscript drafting and final revisions. All authors read and approved the final manuscript. The authors wish to acknowledge Maya Deshmukh, MD, for contributing the drawings for the figures.

References

1. Balciscueta Z, Uribe N, Balciscueta I, Andreu-Ballester JC, García-Granero E. Rectal advancement flap for the treatment of complex cryptoglandular anal fistulas: a systematic review and meta-analysis. *Int J Colorectal Dis* 2017;**32**(5):599–609
2. Gottgens K, Smeets R, Stassen L, Beets G, Breukink S. Systematic review and meta-analysis of surgical interventions for high cryptoglandular perianal fistula. *Int J Colorectal Dis* 2015;**30**(5):583–593
3. Jayarajah U, Wickramasinghe DP, Samarasekera DN. Anal incontinence and quality of life following operative treatment of simple cryptoglandular fistula-in-ano: a prospective study. *BMC Res Notes* 2017;**10**(1):572
4. Visscher AP, Schuur D, Roos R, van der Mijnsbrugge GJH, Meijerink WJHJ, Felt-Bersma RJF. Long-term follow-up after surgery for simple and complex cryptoglandular fistulas. *Dis Colon Rectum* 2015;58(5):533–539
5. Parks AG, Gordon PH, Hardcastle JD. A classification of fistula-in-ano. *Br J Surg* 1976;**63**(1):1–12
6. Lewis RT, Maron DJ. Anorectal Crohn's disease. *Surg Clin North Am* 2010;**90**(1):83–97
7. Stellingwerf ME, van Praag EM, Tozer PJ, Bemelman WA, Buskens CJ. Systematic review and meta-analysis of endorectal advancement flap and ligation of the intersphincteric fistula tract for cryptoglandular and Crohn's high perianal fistulas. *BJS Open* 2019;**3**(3):231–241
8. Meinero P, Mori L. Video-assisted anal fistula treatment (VAAFT): a novel sphincter-saving procedure for treating complex anal fistulas. *Tech Coloproctol* 2011;**15**(4):417–422
9. Schwandner O. Video-assisted anal fistula treatment (VAAFT) combined with advancement flap repair in Crohn's disease. *Tech Coloproctol* 2013;**17**(2):221–225
10. Elfeki H, Shalaby M, Emile SH, Sakr A, Mikael M, Lundby L. A systematic review and meta-analysis of the safety and efficacy of fistula laser closure. *Tech Coloproctol* 2020;**24**(4):265–274
11. Hilsabeck JR. Transanal advancement of the anterior rectal wall for vaginal fistulas involving the lower rectum. *Dis Colon Rectum* 1980;**23**(4):236–241
12. Dudukgian H, Abcarian H. Why do we have so much trouble treating anal fistula? *World J Gastroenterol* 2011;**17**(28):3292–3296
13. Christoforidis D, Pieh MC, Madoff RD, Mellgren AF. Treatment of transsphincteric anal fistulas by endorectal advancement flap or collagen fistula plug. *Dis Colon Rectum* 2009;**52**(1):18–22
14. Herreros MD, Garcia-Arranz M, Guadalajara H, De-La-Quintana P, Garcia-Olmo D. Autologous expanded adipose-derived stem cells for the treatment of complex cryptoglandular perianal fistulas. *Dis Colon Rectum* 2012;**55**(7):762–772
15. Elting AW. The treatment of fistula in ano. *Ann Surg* 1912;**56**(5):726–752
16. Aguilar PS, Plasencia G, Hardy TG, Hartmann RF, Stewart WRC. Mucosal advancement in the treatment of anal fistula. *Dis Colon Rectum* 1985;**28**(7):496–498
17. Garg P. Comparing existing classifications of fistula-in-ano in 440 operated patients: Is it time for a new classification? a retrospective cohort study. *Int J Surg* 2017;**42**:34–40
18. Garg P. Is fistulotomy still the gold standard in present era and is it highly underutilized? an audit of 675 operated cases. *Int J Surg*. 2018;**56**:26–30
19. Parks AG. Advances in the surgery of the colon and rectum. *The Practitioner* 1968;**201**(204):669–675
20. Morris J, Spencer JA, Ambrose NS. MR imaging classification of perianal fistulas and its implications for patient management. *Radiographics* 2000;**20**(3):623–635
21. Lee CL, Lu J, Lim TZ, Koh FH, Lieske B, Cheong WK *et al*. Long-term outcome following advancement flaps for high anal fistulas in an Asian population: a single institution's experience. *Int J Colorectal Dis* 2015;30(3):409–412
22. Emile SH, Elfeki H, Shalaby M, Sakr A. A systematic review and met-analysis of the efficacy and safety of video-assisted anal fistula treatment (VAAFT). *Surg Endosc* 2018;**32**(4):2084–2093
23. Emile SH, Khan SM, Adejumo A, Koroye O. Ligation of intersphincteric fistula tract (LIFT) in treatment of anal fistula: an updated systematic review, meta-analysis, and meta-regression of the predictors of failure. *Surgery* 2020;**167**(2):484–492

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