OPEN

PRS GLOBAL OPEN

ORIGINAL ARTICLE
Reconstructive

The Uroplastic Approach to Complex Rectourethral Fistula Repair: Indications, Technique, Results

Erin Brush, BS*
J. Andres Hernandez, MD, MBA†
Ann Marie Flusché, BS*
Nicholas C. Oleck, MD†
Hani I. Naga, MD†
Victoria Wickenheisser, MD†
Joshua P. Hayden, MD‡
Christopher R. Mantyh, MD§
Andrew C. Peterson, MD¶
Detlev Erdmann, MD, PhD, MHSc†

Background: Rectourethral fistulae are complex pathologies with significant morbidity that warrant multidisciplinary care. Although gracilis muscle interposition for fistula repair has been reported, specific indications and techniques for this mode of reconstruction remain unclear.

Methods: A retrospective quasi-experimental study was previously conducted to assess outcomes of rectourethral fistula management before and after the implementation of a multidisciplinary treatment algorithm. Patients with complex rectourethral fistulae and repair with gracilis muscle flap interposition were further investigated. Plastic surgery involvement for gracilis muscle interposition was indicated for (1) radiated rectourethral fistulae less than 3 cm and (2) nonradiated rectourethral fistulae more than 2 cm. Our preferred technique for gracilis muscle flap harvest, transposition, and inset is described in detail. Primary outcomes included healing of rectourethral fistulae and secondary reversal of urinary or fecal diversions.

Results: Twenty-three patients with complex rectourethral fistulae underwent gracilis muscle flap interposition between 2001 and 2022 before (n = 12) and after (n = 11) algorithmic implementation. The frequency of definitive rectourethral fistula healing improved in the postalgorithm group by 33%. There was no significant difference in fistula healing time or the rate of urinary or fecal diversions after algorithm implementation. The technique of gracilis muscle flap interposition is also described.

Conclusions: The gracilis muscle interposition flap is a valuable reconstructive option for complex rectourethral fistula repair. Implementation of a multidisciplinary treatment algorithm including plastic surgery involvement and refinement of the operative approach was associated with improved frequency of definitive healing of rectourethral fistulae. *(Plast Reconstr Surg Glob Open 2025;13:e6662; doi: 10.1097/GOX.0000000000006662; Published online 2 April 2025.)*

INTRODUCTION

Rectourethral fistulae are an uncommon but highly morbid condition involving an aberrant connection between the urethra and rectum. Associated urinary tract infections, fecaluria, and urinary or fecal incontinence can have devastating impacts on the quality of life of patients with rectourethral fistulae, as can the urinary and fecal diversions performed to manage the condition. Today, over half of all rectourethral fistulae reported are secondary to radiation therapy, brachytherapy, or cryoablation for the treatment of prostate cancer. However, fistulae may also result from inflammatory bowel disease, trauma, or pelvic surgery.[1–4]

Though the management of rectourethral fistulae has evolved, there has been a continuous emphasis on classifying fistulae as *simple* or *complex* to determine the treatment approach.[4–6] Most authors consider a rectourethral fistula complex if it is greater than 2 cm in size, has associated urethral stricture, has bladder neck contracture, or the patient has a history of pelvic radiation. Simple

*From the *Duke University School of Medicine, Durham, NC; †Department of Surgery, Division of Plastic Surgery, Duke University, Durham, NC; ‡Division of Urology, Lahey Hospital and Medical Center, Urology, Burlington, MA; §Department of Surgery, Duke University, Durham, NC; and ¶Department of Surgery, Division of Urologic Surgery, Duke University, Durham, NC.*

Received for publication May 30, 2024; accepted February 3, 2025.

DOI: 10.1097/GOX.0000000000006662

Disclosure statements are at the end of this article, following the correspondence information.

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

rectourethral fistulae are less than 2 cm and may result from damage to otherwise healthy tissue.[4] Simple fistulae have higher rates of spontaneous healing when treated with urinary and fecal diversion alone, whereas complex fistulae (especially if radiated) have lower rates of healing without surgical repair.[7,8] The operative repair of radiated rectourethral fistulae presents a unique surgical challenge due to the presence of inflammation, fibrosis, and contamination of the surrounding pelvic tissues.[9]

To this end, the use of the gracilis muscle flap to provide healthy intervening tissue after fistula takedown has become an accepted reconstructive method. It was first described by Ryan et al[10] in 1979 and has been utilized to provide a tissue barrier between the urethra and rectum, which also offers bulk to fill existent dead space. The gracilis muscle flap provides well-vascularized tissue into a compromised area that may be inflamed and fibrotic secondary to radiation therapy.[11] It can be harvested reliably with minimal donor site morbidity.[12–14] Previously reported outcomes for gracilis muscle interposition demonstrate high rates of successful fistula closure with low morbidity.[2,12–20]

Although the benefits of gracilis muscle flap interposition reconstruction have been described, refinements are helpful to optimize its use. Due to the relative rarity of the formation of complex rectourethral fistula, the literature on the indications for repair with gracilis muscle interposition is sparse. A prior study within our institution analyzed outcomes of rectourethral fistula repair before and after the implementation of a multidisciplinary treatment algorithm. This algorithm was developed in 2012 through analysis of an institutional database of patients with rectourethral fistula. Plastic surgery involvement was indicated for (1) irradiated fistulae less than 3 cm or (2) nonirradiated fistula greater than 2 cm or with an unfavorable proximal location. Nonirradiated fistulae less than 2 cm underwent primary urologic repair. Irradiated fistulae greater than 3 cm and patients with poor rectal tone were referred for pelvic exteneration. However, results of complex fistula repair including gracilis muscle interposition were not thoroughly investigated.[1] This study builds on our prior work and is the first to retrospectively compare cohorts of patients who underwent rectourethral fistula repair before and after the implementation of a multidisciplinary treatment algorithm with plastic surgery involvement for complex fistula repair. The goal of this study was to better describe the clinical indications for the utilization of the gracilis muscle, describe our technique in detail, and review our outcomes.

Takeaways

Question: What is the effect of implementing a multidisciplinary algorithm for care of patients with complex rectourethral fistula?

Findings: Plastic surgery involvement for irradiated fistulae less than 3 cm in size or nonirradiated fistulae more than 2 cm in size improves definitive fistula healing. We describe our preferred operative technique.

Meaning: Patients with large or irradiated rectourethral fistulae benefit from multidisciplinary care including plastic surgery involvement for gracilis muscle interposition.

METHODS

Study Design

A retrospective quasi-experimental study was previously conducted which analyzed clinical outcomes of rectourethral fistula repair at a single institution between 2001 and 2022. Surgical management of these patients followed 1 of the 3 paths: paracococcygeal transrectal transsphincteric (York-Mason) repair, transperineal repair with gracilis flap interposition, or pelvic exenteration with permanent urinary and fecal diversion. Starting in 2012, a multidisciplinary algorithm (Fig. 1) was implemented to better define indications for plastic surgery involvement in rectourethral fistula management. On diagnosis of rectourethral fistula, all patients underwent urinary and bowel diversion before repair to optimize fistula healing. In this study, patients who were diagnosed with complex rectourethral fistula and subsequently underwent repair with gracilis flap interposition before and after the implementation of a multidisciplinary treatment algorithm were further studied.[1]

Patient demographics, operative details, and clinical outcomes were collected and evaluated before and after algorithm implementation. The successful surgical management of rectourethral fistulae was determined by two primary outcome measures: fistula healing as defined by clinical resolution of symptoms with the absence of postoperative radiographic evidence, and reversal of urinary or fecal diversions. These parameters were analyzed both preimplementation and postimplementation of the multidisciplinary algorithm. Data were analyzed using the chi-square and Fisher exact probability tests for categorical variables and *t* test for continuous variables. Results with *P* values less than 0.05 were considered statistically significant. Analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC). The study was exempted from review by the institutional review board of Duke University.[1]

Indications

Based on the established algorithm, plastic surgery involvement and gracilis flap reconstruction was indicated for 2 presentations: (1) radiated rectourethral fistula less than 3 cm and (2) nonradiated rectourethral fistula greater than 2 cm. Fistulae less than 2 cm with no history of radiation therapy underwent primary urologic repair. Nonrepairable radiated fistulae (greater than 3 cm) and patients presenting with poor rectal tone were excluded from gracilis flap reconstruction and underwent pelvic exenteration. Patients who underwent gracilis reconstruction for urethroperineal reconstruction or who had no follow-up beyond 30 days were also excluded from the analysis.

Description of Surgical Technique

All patients are placed in lithotomy position to facilitate access to the rectourethral fistula and the medial

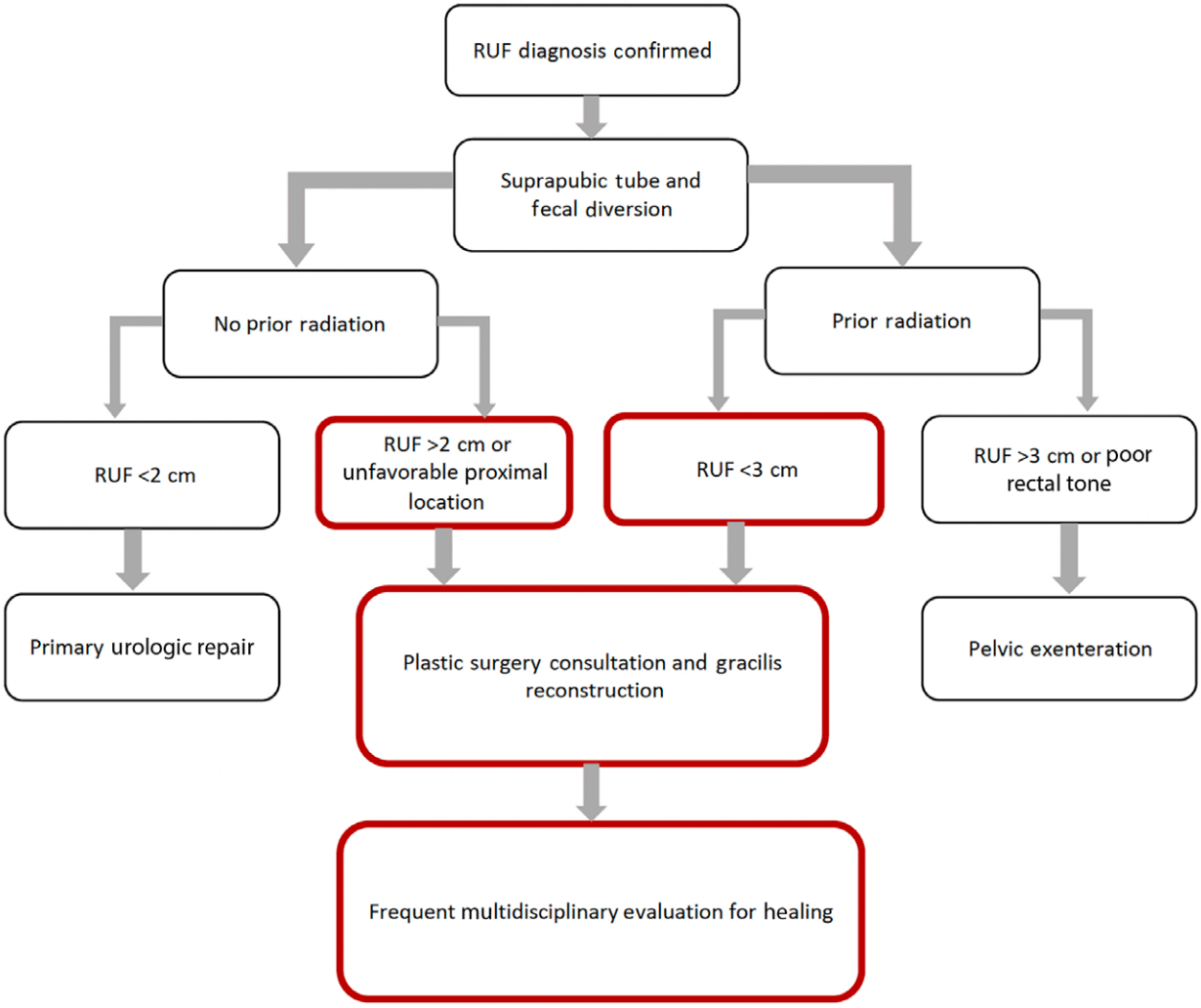

Fig. 1. Uroplastic treatment algorithm for rectourethral fistula (RUF) reconstruction. Adapted with permission from Hayden et al.[1]

thigh. A line is first drawn from the pubic tubercle to the medial femoral condyle to identify the adductor magnus muscle. For confirmation, the muscle belly of the adductor magnus is easily palpated. The gracilis muscle lies just posterior to the adductor magnus, and an incision is then made 2–3 cm posterior to our previously drawn line. Dissection is carried down through the superficial fascia of the medial thigh, with care taken to spare the great saphenous vein. The gracilis muscle is then easily identified and the incision is either extended distally or a second, step incision is made to identify the tendinous insertion of the muscle onto the medial tibial condyle (Fig. 2). The muscle is then disinserted distally, and the dissection is completed proximally. Segmental perforators to the muscle are controlled with surgical clips. The dominant vascular pedicle (medial circumflex femoral artery and vein) may then be identified 8 cm distal to the pubic tubercle; however, it is rarely isolated to avoid injury. We commonly maintain the muscle's proximal attachment at the pubic bone and leave the obturator nerve intact. Although postoperative sporadic muscle spasms remain anatomically possible without ligation of the obturator nerve, we have not found this to be clinically significant in our patient population. After sufficient dissection, the tendinous (distal) portion of the gracilis muscle is then tunneled under a bluntly dissected skin bridge to reach the pelvis (Fig. 3). (See **Video [online]**, which displays intraoperative tunneling of a gracilis muscle flap into the pelvis.) The gracilis muscle is then inset as an interposition between the rectum and bladder with a parachuting suture technique. The perineum is closed in layers using absorbable polyfilament sutures at the dermis level and interrupted absorbable monofilament sutures at the epidermis layer.

RESULTS

Twenty-eight patients underwent rectourethral fistula repair with gracilis flap interposition reconstruction between 2001 and 2022. Five patients were excluded because they did not have postoperative follow-up. Patients were divided into groups based on whether their repair occurred before (n = 12) or after (n = 11) the implementation of the multidisciplinary treatment

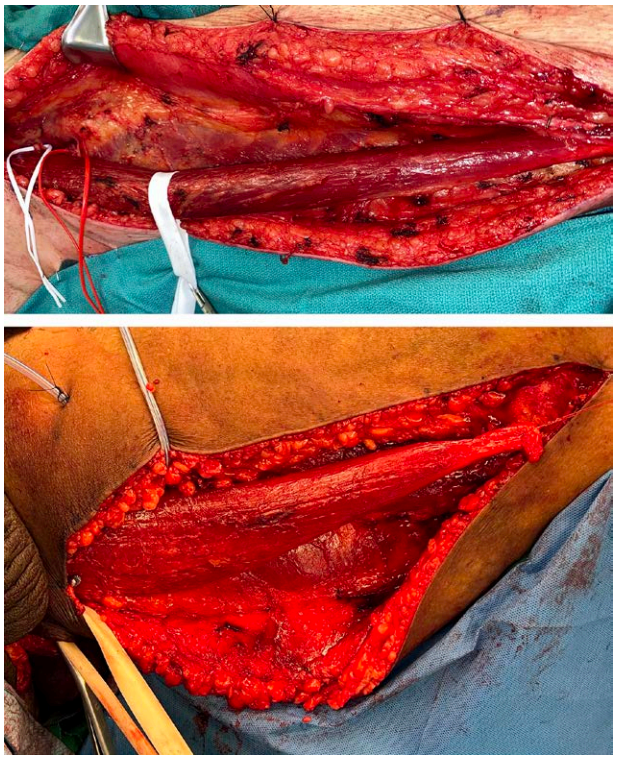

Fig. 2. Photographs of the gracilis muscle flaps harvested from 2 patients. The distal (tendinous) end is disinserted before tunneling and transposition into the pelvic defect.

algorithm. There were no significant differences between the demographics and baseline comorbidities of the prealgorithm and postalgorithm groups (Table 1). The groups were also similar in preoperative albumin, urethral fistula size, and rectal fistula size. In the prealgorithm group, 75% of patients had prior perineal radiation compared with 36% of patients in the postalgorithm group ($P = 0.15$). Multivariable logistic regression analysis indicated that radiation exposure was associated with a decreased likelihood of fistula healing, with a coefficient of 1.09 and an odds ratio of 3.00 (95% confidence interval; 0.23–45.5), though this association was not statistically significant ($P = 0.40$).

The frequency of definitive fistula healing improved in the postalgorithm group (100% versus 66%, $P = 0.04$, Table 2). A trend in fistula healing time reduction was seen in the postalgorithm group; however, this was not significant (29.6 versus 12 wk, $P = 0.056$). Both groups had similar rates of urinary or fecal diversion reversal (67% versus 73%, $P = 0.765$).

DISCUSSION

Rectourethral fistulae are complex pathologies that have prompted a wide range of treatment approaches.[21] This may be due to the varying etiologies of the disease. Notably, the proportion of rectourethral fistula secondary to radiation therapy, cryoablation, and brachytherapy has increased over the past several decades.[8,22] This presents a challenge, as these fistulae are less likely to heal by urinary and fecal diversion alone.[9,23]

The gracilis flap is well suited for the repair of rectourethral fistula with a history of radiation, given that it can be reliably harvested and mobilized to bring healthy tissue to a radiated area with minimal donor site morbidity.[2,11,13,20] Other options such as the rectus abdominis muscle flap have been less frequently described for this indication. Across the literature, healing rates for rectourethral fistula treated with gracilis flap interposition range from 53% to 83%.[12,14,24,25] Our data revealed a 100% healing rate for 11 patients with our gracilis muscle interposition technique, as described in detail previously.

Though several groups have described the benefits of gracilis muscle interposition for the treatment of

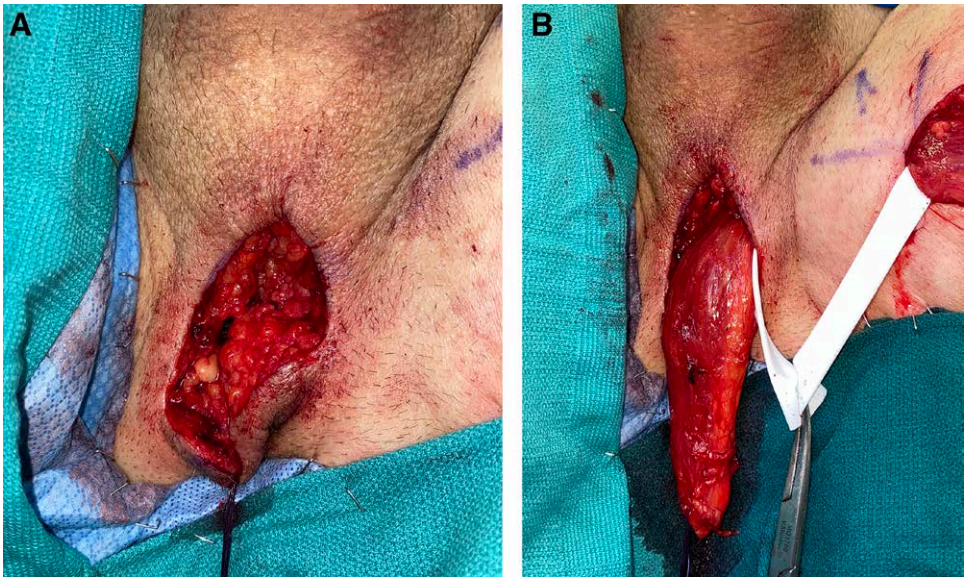

Fig. 3. Photographs of a single patient's pelvic defect before (A) and after (B) tunneling of the gracilis muscle.

Table 1. Patient Demographics

	Prealgorithm (n = 12)	Postalgorithm (n = 11)	*p*
Age, y (mean)	65.73	67.20	0.67
BMI, kg/m^2 (mean)	25.96	27.14	0.51
ASA classification (mean)	2.64	2.80	0.43
Diabetes	2/12 (20%)	4/11 (36%)	0.28
Preoperative albumin (mean)	3.45	3.99	0.21
Urethral fistula size, cm (mean)	2.43	1.94	0.38
Rectal fistula size, cm (mean)	2.65	2.23	0.53
Prior perineal radiation	8/12 (75%)	4/11 (36%)	0.15

ASA, American Society of Anesthesiologists.

Table 2. Outcomes of Pre- and Postalgorithm Cohorts

	Prealgorithm (n = 12)	Postalgorithm (n = 11)	*P*
Fistula healing rate, %	66	100	0.04
Time to fistula healing, wk	29.6	12	0.06
Urinary/fecal diversion reversal rate, %	67	73	0.76

rectourethral fistulae, a consensus on the indications for this procedure has not been reached.[4,6] Some authors have suggested that muscle interposition should be utilized in any case of rectourethral fistula in a radiated field.[15,23] Our previously proposed algorithm implores plastic surgery involvement for any patient with a nonradiated rectourethral fistula that is proximal in location, greater than 2 cm in size, or with a radiated rectourethral fistula less than 3 cm in size.[1,8] Radiated rectourethral fistulae greater than 3 cm in size have a very low incidence of healing, even with muscle interposition, and thus require pelvic exenteration.[26]

The anatomical and surgical complexity of rectourethral fistulae necessitates the collaboration of several disciplines.[1,8,27] Although urologists and colorectal surgeons have historically managed these pathologies and have authored almost all the literature regarding the management of rectourethral fistulae, the involvement of plastic surgeons is a key element in our institution's treatment algorithm, which was initially proposed in 2022.[1] Plastic surgeons are highly familiar with the harvest and mobilization of gracilis muscle flaps as well as with the basic principles of wound management utilizing vascularized interposing tissue. Now, with evidence of a statistically significant improvement in fistula healing with the implementation of multidisciplinary care, we believe this establishes plastic surgeons as valuable contributors to the management of these patients. The involvement of plastic surgeons in cases of patients who undergo pelvic exenteration is also reasonable, especially for patients in whom significant soft tissue reconstruction is needed.

There are limitations to the presented data. Due to the low incidence of rectourethral fistula, the sample size is naturally limited despite the 19-year study period. Differences between the prealgorithm and postalgorithm groups, although not statistically significant, may be clinically relevant. This is particularly important in considering the differences in radiation between the prealgorithm and postalgorithm groups (75% versus 36%). Technological advancements and improvements in surgical care over the study period may have also played a role in the success of the postalgorithm group. Finally, as this study represents the experience of our single institution, it may lack external validity. Larger multicenter trials are needed to validate the utility of the algorithm and should be the focus of future studies.

CONCLUSIONS

Rectourethral fistulae are complex pathologies that necessitate a multidisciplinary team approach. We suggest that plastic surgery involvement for gracilis muscle interposition may improve rates of complete fistula healing in complex fistulae, particularly as the rate of radiation-induced fistulae continues to increase.

Erin Brush, BS
Duke University School of Medicine
40 Duke Medicine Circle
Durham, NC 27710
E-mail: Erin.brush@duke.edu

DISCLOSURE

The authors have no financial interest to declare in relation to the content of this article.

REFERENCES

1. Hayden JP, Boysen WR, Kowalik U, et al. Outcomes of an algorithmic, multidisciplinary approach to rectourethral fistula repair: a pre- and postintervention quasi-experimental study. *Dis Colon Rectum.* 2023;66:598–608.
2. Gupta G, Kumar S, Kekre NS, et al. Surgical management of rectourethral fistula. *Urology.* 2008;71:267–271.
3. Buckley JC. Complications after radical prostatectomy. *Curr Opin Urol.* 2011;21:461–464.
4. Ramírez-Martín D, Jara-Rascón J, Renedo-Villar T, et al. Rectourethral fistula management. *Curr Urol Rep.* 2016;17:22.
5. Choi JH, Jeon BG, Choi SG, et al. Rectourethral fistula: systemic review of and experiences with various surgical treatment methods. *Ann Coloproctol.* 2013;30:35–41.
6. Medina LG, Rangel E, Fuchs I, et al. Rectourethral fistula: operative technique and outcomes. *Curr Bladder Dysfunct Rep.* 2019;14:151–156.

7. Chrouser KL, Leibovich BC, Sweat SD, et al. Urinary fistulas following external radiation or permanent brachytherapy for the treatment of prostate cancer. *J Urol.* 2005;173:1953–1957.
8. Hanna JM, Turley R, Castleberry A, et al. Surgical management of complex rectourethral fistulas in irradiated and nonirradiated patients. *Dis Colon Rectum.* 2014;57:1105–1112.
9. Vanni AJ, Buckley JC, Zinman LN. Management of surgical and radiation-induced rectourethral fistulas with an interposition muscle flap and selective buccal mucosal onlay graft. *J Urol.* 2010;184:2400–2404.
10. Ryan JA, Beebe HG, Gibbons RP. Gracilis muscle flap for closure of rectourethral fistula. *J Urol.* 1979;122:124–125.
11. Higashino T, Sakuraba M, Fukunaga Y, et al. Surgical outcome for colorectal or urinary tract-related fistula: usefulness of vascularized tissue transfer—a retrospective study. *J Plast Reconstr Aesthet Surg.* 2021;74:1041–1049.
12. Zmora O, Potenti FM, Wexner SD, et al. Gracilis muscle transposition for iatrogenic rectourethral fistula. *Ann Surg.* 2003;237:483–487.
13. Ulrich D, Roos J, Jakse G, et al. Gracilis muscle interposition for the treatment of recto-urethral and rectovaginal fistulas: a retrospective analysis of 35 cases. *J Plast Reconstr Aesthet Surg.* 2009;62:352–356.
14. Garoufalia Z, Gefen R, Emile SH, et al. Gracilis muscle interposition for complex perineal fistulas: a systematic review and meta-analysis of the literature. *Colorectal Dis.* 2023;25:549–561.
15. Nyam DCNK, Pemberton JH. Management of iatrogenic rectourethral fistula. *Dis Colon Rectum.* 1999;42:994–997.
16. Ghoniem G, Elmissiry M, Weiss E, et al. Transperineal repair of complex rectourethral fistula using gracilis muscle flap interposition—can urinary and bowel functions be preserved? *J Urol.* 2008;179:1882–1886.
17. Takano S, Boutros M, Wexner SD. Gracilis transposition for complex perineal fistulas. *Dis Colon Rectum.* 2014;57:538.
18. Harris CR, McAninch JW, Mundy AR, et al. Rectourethral fistulas secondary to prostate cancer treatment: management and outcomes from a multi-institutional combined experience. *J Urol.* 2017;197:191–194.
19. Sbizzera M, Morel-Journel N, Ruffion A, et al. Rectourethral fistula induced by localised prostate cancer treatment: Surgical and functional outcomes of transperineal repair with gracilis muscle flap interposition. *Eur Urol.* 2022;81:305–312.
20. Park KM, Rosli YY, Simms A, et al. Preventing rectourethral fistula recurrence with gracilis flap. *Ann Plast Surg.* 2022;88:S316–S319.
21. Muñoz-Duyos A, Navarro-Luna A, Pardo-Aranda F, et al. Gracilis muscle interposition for rectourethral fistula after laparoscopic prostatectomy: a prospective evaluation and long-term follow-up. *Dis Colon Rectum.* 2017;60:393–398.
22. Lane BR, Stein DE, Remzi FH, et al. Management of radiotherapy induced rectourethral fistula. *J Urol.* 2006;175:1382–1387; discussion 1387.
23. Voelzke BB, McAninch JW, Breyer BN, et al. Transperineal management for postoperative and radiation rectourethral fistulas. *J Urol.* 2013;189:966–971.
24. Emile SH, Horesh N, Strassmann V, et al. Outcomes of gracilis muscle interposition for rectourethral fistulas caused by treatment of prostate cancer. *Tech Coloproctol.* 2023;27:937–944.
25. Wexner SD, Ruiz DE, Genua J, et al. Gracilis muscle interposition for the treatment of rectourethral, rectovaginal, and pouch-vaginal fistulas. *Ann Surg.* 2008;248:39–43.
26. Krischak MK, Hayden JP, Krughoff K, et al. Patient-reported and physiologic outcomes following pelvic exenteration for non-repairable radiated rectourethral fistula. *Urology.* 2022;166:257–263.
27. Keller DS, Aboseif SR, Lesser T, et al. Algorithm-based multidisciplinary treatment approach for rectourethral fistula. *Int J Colorectal Dis.* 2015;30:631–638.