Feasibility of a subcutaneous gluteal turnover flap without donor site scar for perineal closure after abdominoperineal resection for rectal cancer

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ABSTRACT

Purpose

Abdominoperineal resection (APR) carries a high risk of perineal wound morbidity. Perineal wound closure using autologous tissue flaps has been shown to be advantageous, but there is no consensus as to the optimal method. The aim of this study was to evaluate the feasibility of a novel gluteal turnover flap (GT-flap) without donor site scar for perineal closure after APR.

Methods

Ten patients who underwent APR for primary or recurrent rectal cancer were included in a prospective non-randomised pilot study in two academic centres. Perineal reconstruction consisted of a unilateral subcutaneous GT-flap, followed by midline closure. Feasibility was defined as uncomplicated perineal wound healing at 30 days in at least five patients, and a maximum of two flap failures.

Results

Out of 17 potentially eligible patients, 10 patients underwent APR with GT-flap assisted perineal wound closure. Seven patients had pre-operative radiotherapy. Median added theatre time was 38 minutes (range 35-44). Two patients developed perineal dehiscence, likely because of too large width of the skin island. Two other patients developed purulent discharge and excessive haemoserous discharge, respectively, resulting in four complicated wounds at 30 days. No flap failure occurred, and no radiological or surgical re-interventions were performed. Median length of hospital stay was 10 days.

Conclusions

The GT-flap for routine perineal wound closure after APR seems feasible with limited additional theatre time, but success seems to depend on correct planning of the width of the flap. The potential for reducing perineal morbidity should be evaluated in a randomised controlled trial.

INTRODUCTION

To date, abdominoperineal resection (APR) for low rectal cancer still carries a significant risk of perineal wound problems (1). A recent randomised controlled trial on perineal wound closure after APR reported an incidence of complicated perineal wound healing of 34-37% at 30 days postoperatively (2), but incidence of perineal complications have even been reported to occur in up to 66% after APR and primary closure (3). In addition, patients may experience persisting perineal pain, or develop a chronic perineal sinus or perineal hernia (4-6).

The high risk of perineal morbidity after APR is related to the creation of a large pelvic dead space with bacterial contamination, making the surgical-site susceptible for infection. Furthermore, use of pre-operative radiotherapy significantly impairs the healing capacity of this dead space – secondary to the decreased angiogenesis. To prevent these wound problems, immediate soft tissue reconstruction has been advocated (7). The rationale is that by obliterating the surgical dead space with well-vascularised tissues, the risk of wound breakdown and infection is reduced. Another reason is related to the concept that autologous tissue may add strength to the (partially) excised pelvic floor muscles, which may potentially reduce the risk of perineal hernia formation. There is however no consensus on the optimal method for perineal wound closure after APR.

Several techniques are used to improve perineal wound healing, including reconstruction using a V-Y fasciocutaneous flap, a vertical rectus abdominis myocutaneous (VRAM) flap, a gluteal or a gracilis flap (8-11). However, there are potential disadvantages to these techniques. These include the need for a plastic surgeon, a substantially increased theatre time and the potential for donor site and recipient site complications, while often sacrificing the benefits of laparoscopy (12-17). Moreover, as a large percentage of patients will not develop healing difficulties, immediate reconstruction with large muscle flaps might be an unnecessary risk and expense. An optimal harm-benefit ratio of reconstructive techniques is especially important in relatively low-risk patients undergoing non-extensive resections without pre-operative radiotherapy. There is an urgent need for a simple and minimally-invasive technique for routine perineal wound closure after APR. We propose a novel unilateral subcutaneous gluteal turnover flap (GT-flap) without additional scarring or donor site morbidity.

The aim of this pilot study was to determine the feasibility of this procedure in patients who underwent APR for primary or recurrent rectal cancer.

METHODS

Design and patients

A prospective longitudinal multicentre interventional cohort study was performed in 10 consecutive patients at two academic medical centres. All patients scheduled for extralevatory APR were pre-operatively informed on the study at the outpatient clinics. Written informed consent was obtained for all participants. Inclusion criteria were adult patients (age ≥ 18 years) and planned for APR for primary or recurrent rectal cancer. Exclusion criteria were need for total pelvic exenteration, sacral resection above S4/S5, severe concomitant diseases affecting wound healing (i.e. renal failure requiring dialysis, liver cirrhosis, peripheral vascular disease with Fontaine grade 3 or higher), or enrolment in other trials expected to influence perineal wound healing.

On day seven and day 30 after surgery, the perineal wound was evaluated by residents or surgeons using the Southampton wound score (supplementary table 1). Postoperative pain was assessed using the visual analogue scale (VAS) which ranged from 0 (no pain) to 10 (worst pain). In addition, photographs were taken, and all appointed wound scores were centrally reviewed by the trial coordinators (RDB and PJT). Patient demographics, neo-adjuvant treatment, tumour characteristics and surgical details were intra-operatively collected. Postoperatively, type and extent of any wound event or any other adverse event, and all medical, radiological and surgical interventions were recorded to the last day of follow-up. The study protocol has been approved by the Institutional Review Board of the Amsterdam UMC, University of Amsterdam, and the Erasmus MC (NL58380.018.16).

Surgical procedure

APR started with skin incision close to the anus with subsequent dissection along the external sphincter, in order to preserve as much perineal skin and subcutaneous fat as possible without compromising oncologically safety.

Perineal reconstruction is then performed using a unilateral, semilunar, de-epithelialized, subcutaneous GT-flap (figure 1). Creation of the GT-flap starts with drawing of a semi-circular incision adjacent to the surgical defect of approximately two-and-a-half centimetre in width. Success of the flap is contingent upon obtaining tension-free closure at the midline. For this reason, the flap can only be a few centimetres in width. Pre-operative mapping of the perforators is not deemed necessary due to the broad base of the turnover flap and its robust blood supply. Furthermore, due to the design of the flap, there is no need to elevate the flap on a single perforator. The flap is de-epithelialized followed by incision through the skin and slightly lateral dissection towards the gluteus muscle. It is important to perform the de-epithelialisation before dissecting the flap, as this makes it

easier. The flap is then hinged into the defect, and the dermis is anchored to the contra-lateral remnants of the levator muscles. Next, a vacuum drain is positioned on top of the flap and the subcutaneous fat and perineal skin are closed in a layered fashion in the midline over the flap.

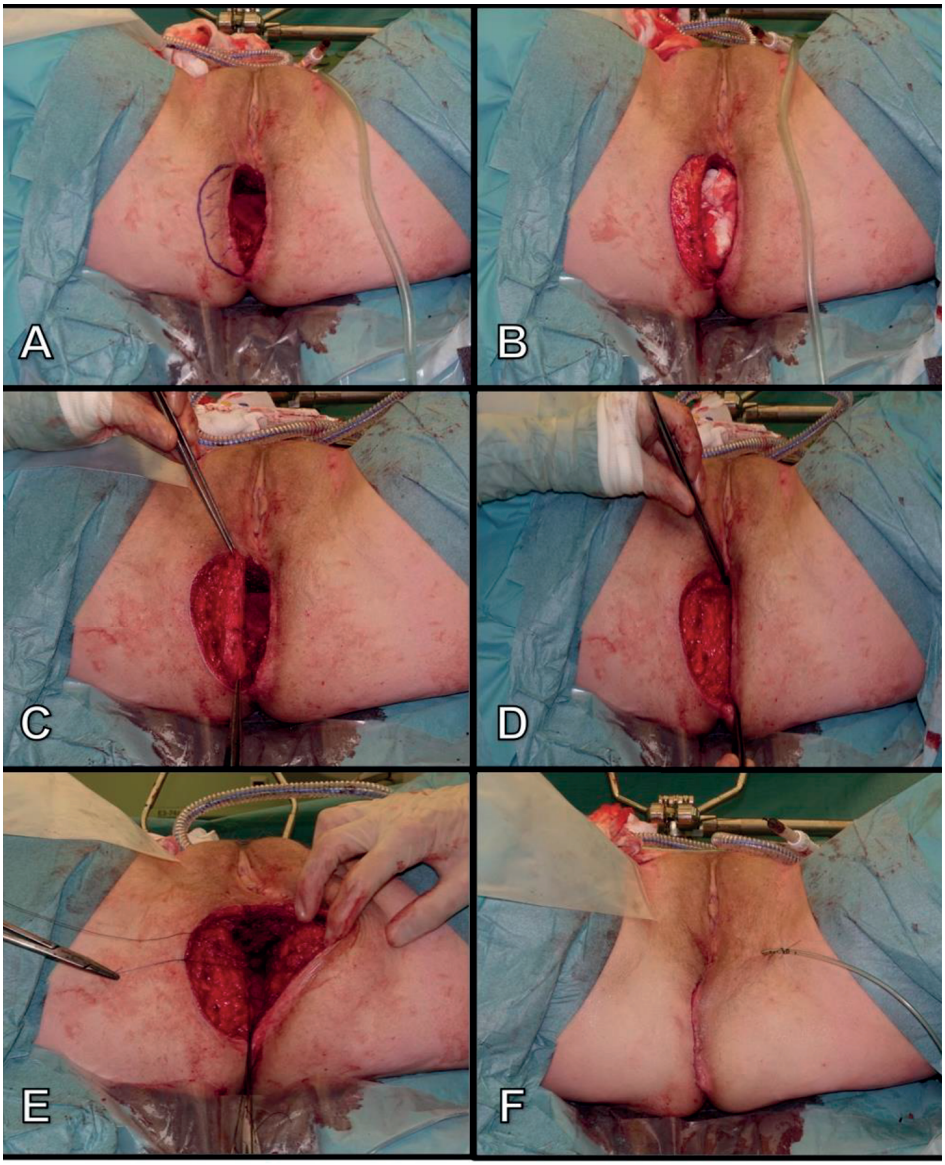

Fig. 1 Reconstruction of an abdominoperineal defect using a gluteal turnover flap. a) marking of the flap, b) de-epithelialisation of the dermis, c) flap after having transected onto the gluteal fascia, d) rotation of the flap e) fixation of flap to the contra-lateral remnants of pelvic floor muscles, f) midline scar following layered closure of the ischio-rectal and perineal tissues over the flap.

Patients were allowed to mobilise on the first postoperative day, but were instructed not to sit directly on the perineal wound the first few days. The drain was removed after at least 3 days according to the surgeons' judgement.

Feasibility criteria and secondary outcome measures

The procedure was deemed feasible if 1) no more than five patients had a complicated wound healing at 30 days postoperatively, 2) including no more than two flap failures. Complicated wound healing was defined as a Southampton wound score equal or greater than II (supplementary table 1). We hypothesised that, since the flap is covered and not visually accessible for evaluation of flap perfusion, flap failure would eventually result in wound breakdown. Therefore, flap failure was defined as a Southampton wound score of V.

Secondary endpoints were median length of the procedure, hospital stay duration, number of specific complications, and number of re-interventions and re-admissions.

Statistical analysis

Categorical data were expressed as absolute numbers with corresponding proportions, and continuous data according to distribution as means with standard deviation (SD) or medians with interquartile range (IQR). The treatment effect was determined based on a per-protocol analysis. All analyses were performed with IBM SPSS statistics, version 24.0.0 (IBM Corp., Armonk, NY, United States).

RESULTS

Among 17 eligible patients, 11 were willing to participate and signed informed consent. Patient characteristics are demonstrated in table 1. Mean age was 64 years, and seven were male. Indications for APR were primary rectal cancer (n=8), recurrent rectal cancer (n=2), and one patient that had a clinical diagnosis of rectal cancer, but appeared to have recurrent prostate cancer on postoperative pathological examination. Pre-operative radiotherapy was given in eight patients.

Surgical details are shown in table 2. In one patient, it was considered unfeasible to obtain tension-free midline closure using a GT-flap due to the large size of the perineal skin defect after resection. A GT-flap with midline perineal closure could be performed in the remaining 10 patients. Median total theatre time was 305 minutes (IQR 249-370 minutes), and median time taken for flap harvesting and insertion into the neo-pelvic floor was 38 minutes (IQR 35-44 minutes).

Table 1. Patient characteristics

Patient	*Age (yr)*	*Sex*	*BMI[b] (Kg/m²)*	*ASA[c]*	*Smoking*	*Diabetes*	*Prior pelvic surgery*	*Indication*	*Distance ARJ[e] (Cm)*	*Threatened MRF[g]*	*Neo-adjuvant therapy*
1	59	F	28.4	II	Never	Yes	Hysterectomy	Primary rectal cancer	1	Yes	Radio-chemotherapy
2	67	F	23.1	II	Never	No	None	Primary rectal cancer	3	Yes	Radio-chemotherapy
3	79	M	28.7	II	Never	No	None	Recurrent prostate cancer	NA[f]	NA[f]	None
4	48	M	31.8	II	Never	No	Transanal TME[d]	Recurrent rectal cancer	0	NA[f]	None
5	68	M	27.8	III	Never	No	None	Primary rectal cancer	4	Yes	Radio-chemotherapy
6[a]	71	M	27.93	III	Stopped > 10 yr	No	Prostatectomy	Primary rectal cancer	0	Yes	Radio-chemotherapy
7	68	F	33.9	II	Never	No	None	Primary rectal cancer	0	Yes	Radio-chemotherapy
8	66	M	26.5	I	Stopped < 10 yr	No	None	Primary rectal cancer	1	No	None
9	44	M	32.7	II	Stopped < 10 yr	No	None	Primary rectal cancer	Missing	Yes	Radio-chemotherapy
10	73	F	30.0	III	Stopped > 10 yr	Yes	Hysterectomy	Primary rectal cancer	Missing	Yes	Radio-chemotherapy
11	68	M	27.2	I	Stopped < 10 yr	No	Laparoscopic TME[d]	Recurrent rectal cancer	9	NA[f]	Radio-chemotherapy

[a] *Patient was excluded intra-operatively*
[b] *Body mass index*
[c] *American Society of Anaesthesiologists classification*
[d] *Total mesorectal excision*
[e] *Anorectal junction*
[f] *Not applicable*
[g] *Mesorectal fascia*

Table 2. Surgical details and intra-operative outcome

Patient	*Type of APR*[a]	*Position*	*Abdominal approach*	*Perineal approach*	*Adjacent organ resection*	*Intraop RTX*[d]
1	Extralevator	Lithotomy	Open	Open	None	No
2	Extralevator	Lithotomy	Open	Open	None	No
3	Extralevator	Lithotomy	Open	Open	None	No
4	Extralevator	Lithotomy	Laparoscopic	Open	None	No
5	Extralevator	Lithotomy	Open	Open	None	No
6	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]
7	Extralevator	Lithotomy	Open	Open	None	No
8	Extralevator	Prone	Laparoscopic	Open	None	No
9	Extralevator	Lithotomy	Laparoscopic	TAMIS[c]	None	No
10	Extralevator	Lithotomy	Laparoscopic	TAMIS[c]	Posterior vaginectomy	No
11	Extralevator	Lithotomy	Open	Open	Left pelvic sidewall	Yes

[a]*Abdominoperineal resection*
[b]*Not applicable*
[c]*Transperineal minimally invasive surgery using GelPOINT path and Airsea*
[d]*Intra-operative radiotherapy*
[e]*Time in minutes*

Surgical outcome

Median follow-up duration was 33 days (IQR 27-35 days). Postoperative outcome is displayed in table 3. Median length of hospital stay was 10 days (IQR 8-12 days). In total, four patients had a complicated perineal wound healing at 30 days (Southampton wound score ≥ II). Two patients developed a superficial dehiscence of a few centimetres in depth, of whom one had concomitant pus discharge. The underlying GT-flaps were unaffected (figure 2). Retrospective evaluation of these two patients revealed that the design of the flap was too wide, resulting in tension on the perineal wound after midline closure. Both patients needed no further treatment besides irrigation with saline. One patient developed perineal infection with a small pus pocket necessitating manual drainage and antibiotic therapy for seven days. The last patient with a complicated wound healing at 30 days developed perineal pain secondary to a non-infected perineal seroma, which required manual drainage at the outpatient clinic. There were no cases of flap necrosis. With a total of four complicated perineal wounds at 30 days and no flap failures, predefined feasibility criteria were met.

Two more patients had perineal seroma, but both resolved within 30 days and without further treatment. In the remaining four patients, the perineal wound healed uneventful. Perineal pain at seven days was reported for seven patients with a median VAS score of 0. Perineal pain at thirty days was reported for six patients with a median VAS score of 1. During follow-up, there were no re-admissions, and no radiological or surgical re-interventions.

Omentoplasty	Abdominal drain	Type of surgeon	Buttock	Perineal drain	Skin closure	Reconstruction time[e]	Total theatre time[e]
Yes	Yes	Plastic	Left	Yes	Transcutaneous	42	207
Yes	Yes	Plastic	Left	Yes	Transcutaneous	55	510
Yes	Yes	General	Left	Yes	Transcutaneous	45	302
No	Yes	Plastic	Left	Yes	Intracutaneous	35	151
Yes	Yes	Plastic	Right	Yes	Transcutaneous	38	305
NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]
Yes	Yes	General	Left	Yes	Transcutaneous	36	327
No	Yes	Plastic	Right	Yes	Intracutaneous	Missing	Missing
No	Yes	Plastic	Left	Yes	Intracutaneous	35	310
No	No	General	Left	Yes	Intracutaneous	31	291
Yes	Yes	Plastic	Right	No	Transcutaneous	40	412

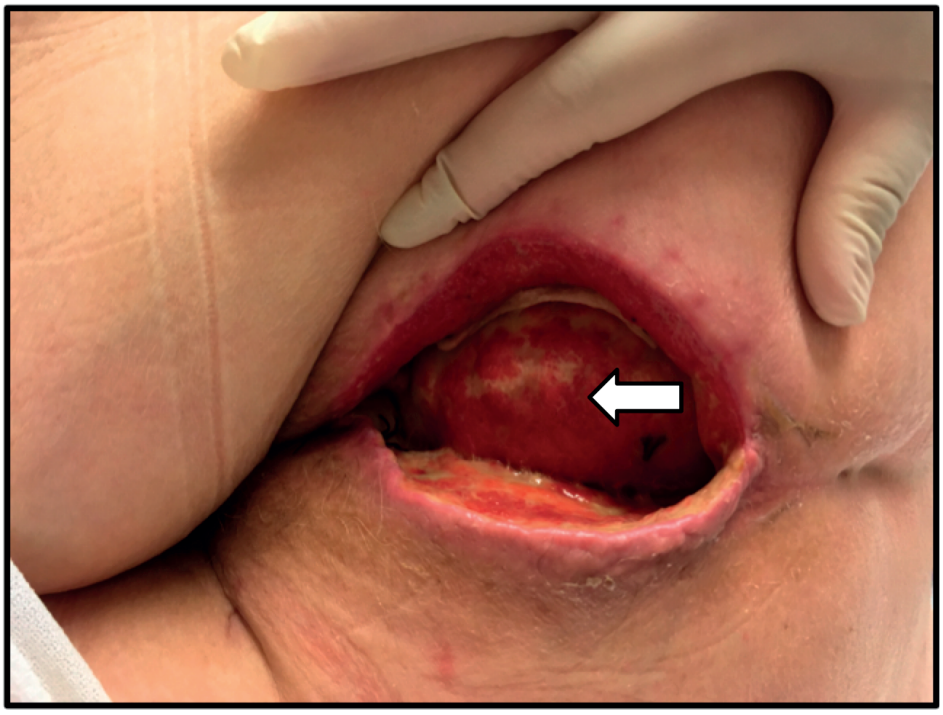

Fig. 2 Perineal wound dehiscence of 2,5 centimetre in depth with mild inflammation following abdominoperineal resection with insertion of gluteal turnover flap. The underlying sub cutis of the flap is still viable (white arrow), and ensures that there is no atmospheric connection to the intra-abdominal cavity.

Table 3. Short-term outcome after abdominoperineal resection and gluteal turnover flap

Patient	*Histopathology*	*Hospital stay (days)*	*7-day wound score*[c]	*30-day wound score*[c]	*VAS*[d] *7 days*	*VAS*[d] *30 days*	*Perineal complications*	*Perineal re-interventions*	*Other complications*	*Other interventions*	*Follow-up (days)*
1	pT0N0Mx	8	0	0	0	0	None	None	UTI[f], urinary retention	AB[e] for UTI[f]	35
2	pT0N0Mx	10	I	IV	2	1	Infection	Manual drainage and AB[e]	None	None	29
3	pT4N2Mx[a]	11	0	III	0	4	Dehiscence, Seroma	Manual drainage	None	None	36
4	pT3N0Mx	9	I	I	0	0	Seroma	Perineal irrigation	Ileus	TPN[g]	41
5	pT3N0Mx	10	0	0	0	1	None	None	Ileus, urinary retention, abscess right buttock	I&D[h] abscess	32
6	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]	NA[b]
7	pT3N0M1	13	IV	II	Missing	Missing	Dehiscence, Infection	None	UTI[e]	AB[d] for UTI[f]	34
8	pT2N2M1	6	0	0	2	Missing	None	None	Urinary retention	Tamsulosine	20
9	pT0N0Mx	6	II	III	3	Missing	Seroma	Manual drainage	None	None	19
10	pT3N1Mx	20	III	0	Missing	Missing	Seroma	None	Ileus, pneumonia, delirium	TPN[g], AB[e] for pneumonia, haldol	33
11	pT0N0Mx	8	0	0	Missing	3	None	None	Urinary retention	None	31

[a] *Recurrent prostate cancer*
[b] *Not applicable*
[c] *According to the Southampton Wound Scoring System*
[d] *Visual analogue pain rating scale measured in rest*
[e] *Antibiotic therapy*
[f] *Urinary tract infection*
[g] *Total parenteral nutrition*
[h] *Incision and drainage*

Additional postoperative complications included ileus (n=3), unrelated abscess on buttock (n=1), urinary retention (n=4), urinary tract infection (n=2), pneumonia (n=1), and delirium (n=1).

DISCUSSION

This pilot study aimed to determine the feasibility of the GT-flap in routine perineal reconstruction after APR. The GT-flap was technically feasible with midline closure in all patients, except for one patient in whom more perineal skin had to be excised for oncological reasons. The flap added only limited additional theatre time. The majority of patients had uncomplicated perineal wound healing at 30 days postoperatively without any flap failure, thereby fulfilling our predefined feasibility criteria. Retrospective analysis of two cases of wound dehiscence revealed the critical part of the procedure, namely planning the appropriate width of the skin island that still allows for tension-free closure in the midline.

The GT-flap displays a favourable profile, compared to existing literature on flap-repair (7, 9). The flap seems to exhibit no partial necrosis or total flap loss as can be observed after muscle flaps, although the sample size is still small (18). The procedure can be combined with laparoscopy, contrary to conventional VRAM flaps for example. In addition, median additive theatre time was only 38 minutes, which included a learning curve and time needed for photographing the procedure. This is likely to decline in the future with increasing experience. Another benefit is the ease of flap harvesting, not necessarily requiring a plastic surgeon. Nonetheless, the procedure should preferably be performed by a surgeon already familiar with harvesting perforator flaps, or after initially being proctored by a plastic surgeon. Injury to the perforators can have serious consequences. If the flap is raised too large, this will lead to undue tension of the perineal skin, which can result in a major dehiscence. However, these basic principles of the technique are quite simple and easy to learn.

Another advantage of the GT-flap over other options is the symmetrical midline scarring, thereby preserving the gluteal cleft and restoring normal perineal aesthetics (figure 3). This is a major advantage compared to the VRAM or conventional gluteal flaps (e.g. V-Y transposition, SGAP, IGAP), which leave both large and visible scarring. Furthermore, no dissection of muscle is performed. Patients are allowed to mobilise directly. The GT-flap seems to avoid problems with balance, sitting or walking secondary to muscle weakness or pain that is often seen after gluteal muscle transpositions. Considering these benefits, the GT-flap may be very attractive for routine perineal wound closure after APR.

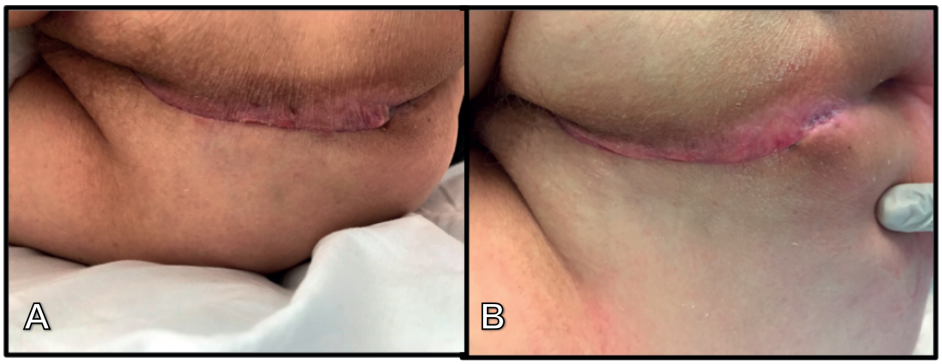

Fig. 3 Healed perineal wound with symmetrical midline scarring a) on day 7, and b) day 30 after abdomino-perineal resection and gluteal turnover flap for rectal cancer.

The GT-flap is only a valuable option if the perineal skin and subcutaneous fat can be maximally preserved from an oncological point of view. Therefore, distal rectal cancer without involvement of the perineal skin and subcutaneous fat requiring APR with a certain extent of resection of the levator muscles seems to be the optimal indication. If additional perineal skin has to be excised, for example in case of advanced anal cancer or radiation-induced skin fibrosis, there is a need for flap assisted closure that adds a skin island, such as the VRAM flap.

Due to the design of this pilot study of small sample size and with relatively short follow-up, it was not possible to assess the impact of the GT-flap on the risk of long-term perineal complications. A recent publication by Chasapi et al. reported on a similar reconstructive procedure in 14 patients undergoing APR for anorectal cancer (19). The type of flap used differed from the presently described technique by the fact that the flap was detached from the gluteal fascia with one remaining perforator for blood supply. They showed favourable outcome with only one patient suffering from superficial skin dehiscence, and one developing a perineal hernia 7 months after surgery. These findings support our feeling that in selected patients, adjacent gluteal skin and subcutaneous fat can be relatively easily used for perineal closure after APR, with the potential advantages of reduced perineal morbidity by filling the space of the resected anal sphincter complex. The next step is conducting a randomised controlled trial to determine the effectiveness of this intervention in reducing perineal morbidity after APR, both short-term and long-term.

Conclusions

The GT-flap is a technically feasible and safe method for perineal wound closure after APR in patients with primary or recurrent rectal cancer if no additional perineal skin has to be sacrificed. The procedure is relatively quick and easily applicable, and seems associated with no apparent donor site morbidity or scarring. Further research is warranted to assess

the potential for reducing perineal wound morbidity and to evaluate long-term quality of life.

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