Purse-string versus conventional linear skin closure after loop-colostomy reversal: a prospective cohort study

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Objective
After a loop-colostomy reversal, this study aimed to compare the wound-infection rate and the operative outcomes between purse-string and linear skin closure.
Patients and methods
Patients who had loop-colostomy closure at Assiut University Hospital between January 2020 and April 2021 were studied using prospectively obtained data. In terms of wound infection, hospital stay, wound healing time, and ultimate scar length, the purse-string skin closure (*n*=30) and linear skin closure (*n*=30) were compared.
Results
There were no differences between the two groups in terms of age, sex, BMI, time between colostomy procedure and its reversal, operation time, or hospital stay. In the purse-string group, wound infection was discovered in 11 (36.7%) cases, while in the linear-closure group, it was found in 20 (66.7%) cases (*P*=0.03). The purse-string group's median postoperative time to full wound healing was 40 days (35–55 days), while that of the linear-closure group was 28 days (20–41 days) (*P*=0.001). The purse-string group had a wound scar length of 4.9 cm (4–6 cm) and the linear-closure group had a scar length of 8.5 cm (7.5–10 cm) (*P*=0.001).
Conclusion
Purse-string closure following loop-colostomy reversal is linked to a lower risk of wound infection and a smaller scar. However, it is linked to a longer healing duration for wounds.

Keywords:
colostomy reversal, linear closure, purse-string closure, wound infection

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Introduction

Colorectal cancer, inflammatory bowel disease, diverticulitis, and colorectal trauma are all treated temporary with a diverting stoma. It is applied to minimize anastomotic leakage and reoperation rates, especially in cases of rectal cancer with a very low anterior resection. The ileostomy and the colostomy are the two commonly used temporary diverting stomas [1,2].

Because the fistula size of an ileostomy is small, fecal odor is less, the danger of herniation is low, complications during ileostomy construction and its reversal are fewer than with a colostomy, and it is technically uncomplicated, ileostomy is more commonly performed than colostomy [3,4]. Surgical-site infection is another common consequence following stoma closure, with reported incidence rates as high as 40%. The presence of germs on the skin near the stoma site, as well as possible contamination with intestinal content during open-end bowel manipulation, creates a significant risk of surgical-site infection [5]. Following stoma reversal, traditional linear-sutured skin closure is still routinely applied.

Banerjee created the circumferential purse-string skin-closure technique in 1997 after an ileostomy closure, which creates a hole in the middle of the wound and allows for secondary-intention healing, potentially reducing the likelihood of surgical-site infection. According to Banerjee, if wounds are closed with purse-string skin closure following an ileostomy reversal, wound infection is reduced and scars are reduced, making it visually superior [6].

Thus far, researches examining the effectiveness of purse-string skin closure in the reversal of a colostomy, rather than an ileostomy, have been rare. As a result, the current study was designed to assess the efficacy of purse-string skin closure in a colostomy-reversal procedure.

Patients and methods

Patients who had loop-colostomy closure at Assiut University Hospital between January 2020 and April

2021 were included in a prospective cohort study. All patients who took part in the study gave their informed consent. Patient demographics, such as age, sex, and previous medical history, such as the presence of diabetes, were noted in medical charts. The following patients were excluded: those who died, developed anastomotic leakage, had intestinal obstruction, and had reintervention. This research was performed at the Department of General Surgery, Assuit University Hospitals. Ethical Committee approval and written, informed consent were obtained from all participants.

A spindle-shaped, elliptical incision was performed with a stoma mobilization in the linear-closure group. After excision of a piece of the large bowel, the anastomosis was either handsewn or stapled, or the fold-over technique was used. On the fascia of the rectus-abdominis muscle, a layer-to-layer linear closure was then done, subcutaneous tissues, at the time of skin closure, were closed with interrupted stitches.

A circular incision was made 1–2 mm lateral to the mucocutaneous junction in the purse-string group. The same stoma takedown and anastomosis techniques were used as in the linear-closure group. On the skin, purse-string suturing with absorbable sutures was performed on the subcuticular layer, leaving a 5-mm open orifice (Fig. 1a, b).

Figure 1

(a) Circular skin incision before purse-string closure. (b) Subcuticular purse-string closure leaving about 5-mm open orifice.

Antibiotics were given from the time the surgery was started to 3–5 days after the surgery. After confirming intestinal movement in individuals who did not have gastrointestinal-retention symptoms, postoperative meals were started. The patients were discharged under physician–patient consultation after adjusting their diets and achieving pain control.

During the visit, photos of the stoma site were taken to assess the scar's appearance (Fig. 2). According to the Centers for Disease Control and Prevention (CDC), postoperative wound infection is defined as a superficial or deep infection in the surgical wound that occurs within 30 days of surgery [7]. A purulent discharge, flares, or edema at the wound were considered infectious.

The program IBM SPSS Statistics, version 22.0, was used for all statistical analyses (IBM Corp., Armonk, New York, USA). The Mann–Whitney *U* test was used on continuous variables. The χ^2 test was used for categorical variables. *P* values less than 0.05 were considered statistically significant findings.

Results

The characteristics of patients

Between January 2020 and April 2021, 60 patients who underwent colostomy closure were classified into two groups according to the methods of skin closure, 30 patients in purse-string group and 30 patients in linear-closure group. Concerning the male-to-female ratio in the purse-string group, it was 19: 11 (63.3%: 36.7%) and it was 16: 14 (53.6%: 46.7%) in the linear-closure group (*P*=0.60). The purse-string group had a median age of 36.5 years, while the linear-closure group had a median age of 38 years (*P*=0.45). The BMI of the two groups did not significantly differ (*P*=0.74). In the purse-string group, the underlying disease for the colostomy was benign disease in 13 (43.3%) patients, malignant disease in seven (23.3%) patients, and traumatic

Figure 2

(a) Appearance of the purse-string closure on the fifth day postoperative. (b) Appearance of the wound on postoperative day 30. (c) Appearance of the scar on postoperative day 45.

Table 1 The characteristics of patients

	Total [*n* (%)]	Purse-string closure (*N*=30) [*n* (%)]	Linear closure (*N*=30) [*n* (%)]	*P* value
Sex				
Male	35 (58.3)	19 (63.3)	16 (53.6)	0.60
Female	25 (41.7)	11 (36.7)	14 (46.7)	
Age (years)				
Median (minimum–maximum)	37 (16–36)	36.5 (16–57)	38 (21–63)	0.455
BMI (kg/m^2)				
Median (minimum–maximum)	26.3 (17–35)	26.7 (17–34)	24.9 (17–35)	0.745
Indication of colostomy				
Benign	27 (45)	13 (43.3)	14 (46.7)	0.889
Malignant	12 (20)	7 (23.3)	5 (16.7)	
Traumatic	21 (35)	10 (33.3)	11 (36.7)	
Time duration from colostomy to closure (month) median (minimum–maximum)	4 (2–7)	4 (2–7)	4 (2–6)	0.774

Table 2 Perioperative outcomes and follow-up

Operative time (min)	Total	Purse-string closure	Linear closure	*P* value
Median (minimum–maximum)	79.5 (45–130)	81.5 (50–130)	79.5 (45–120)	0.505
Hospital stay (day)				
Median (minimum–maximum)	7 (5–13)	6.5 (5–12)	7.5 (6–13)	0.130
Wound infection [*n* (%)]				
Yes	31 (51.7)	11 (36.7)	20 (66.7)	0.038
No	29 (48.3)	19 (63.3)	10 (33.3)	
Time to full healing (day)				
Median (minimum–maximum)	35 (20–55)	40 (35–55)	28 (20–41)	0.001
Final wound size (cm)				
Median (minimum–maximum)	6.7 (4–10)	4.9 (4–6)	8.5 (7.5–10)	0.001

in 10 (33.3%) patients. It was benign illness in 14 (46.7%) patients, malignant tumors in five (16.7%) patients, and traumatic in 11 (36.7%) patients in the linear-closure group (*P*=0.88). Between the two groups, there was no statistically significant difference in the time from colostomy procedure to its reversal (*P*=0.77) (Table 1).

Perioperative outcomes and follow-up

The purse-string group's median operating time was 81.5 min (50–130 min), while that of the linear-closure group was 79.5 min (45–120 min).

Postoperative wound infection was seen in 11 (36.7%) patients in the purse-string suture group and 20 (66.7%) patients in the linear-closure group (*P*=0.038). The purse-string group's median hospitalization period was 6.5 days (5–12 days), while that of the linear-closure group was 7.5 days (6–13 days) (*P*=0.130).

The purse-string group had a median postoperative follow-up duration of 40 days (35–55 days) and the linear-closure group had a median postoperative follow-up period of 28 days (20–41 days) (*P*=0.001). The median size of the wound scar after full wound healing was 4.9 cm (range, 4–6 cm) in the purse-string group and 8.5 cm (7.5–10 cm) in the linear-closure group (*P*=0.001) (Table 2).

Risk factors of wound infection

The purse-string skin closure was found to be present in 11 (35.5%) patients who developed wound infection, whereas the linear-closure technique was found to be present in 20 (64.5%) patients who developed wound infection (*P*=0.038).

Other risk factors such as BMI, diabetes, operation time, underlying colostomy disease, duration till colostomy reversal, and bowel-anastomosis technique, were not shown to be substantially linked with wound infection (Table 3).

Discussion

After a colostomy reversal, purse-string skin closure is a type of healing with a secondary intention. It allows for drainage through a small skin defect, until granulation tissues and skin epithelialization develop, preventing wound infection. In this study, individuals who had purse-string skin closure had a considerably reduced rate of wound infection than those who had linear skin closure (*P*=0.038). Purse-string closure, on the other hand, had a significantly longer wound-healing period than linear skin closure (*P*=0.001). Within 60 days, the wound was totally healed in at least 90% of the patients who received purse-string closure, according to Banerjee [6]. Similarly, Sutton *et al*. [8] found that

Table 3 Risk factors of wound infection

Wound closure	Wound infection: yes (*N*=31) [*n* (%)]	Wound infection: no (*N*=29) [*n* (%)]	*P* value
Purse string	11 (35.5)	19 (56.5)	0.038
Linear	20 (64.5)	10 (34.5)	
Diabetes mellitus	8 (25.8)	4 (13.8)	0.337
BMI			
<25	16 (51.6)	8 (27.6)	0.07
≥25	15 (48.4)	21 (72.4)	
Operative time			
<100 min	25 (80.6)	25 (86.2)	0.732
≥100 min	6 (19.45)	4 (13.8)	
Time from colostomy to closure			
<3	5 (16.1)	1 (3.4)	0.196
≥3	26 (83.9)	28 (96.6)	
Methods of anastomosis			
Hand-sewing	28 (90.3)	27 (93.1)	1.000
Stapled	3 (9.7)	2 (6.9)	
Indication of colostomy			
Benign	14 (45.2)	13 (44.8)	1.000
Malignant	6 (19.4)	6 (20.7)	
Traumatic	11 (35.5)	10 (34.5)	

after an ileostomy reversal, complete epithelialization was achieved within 30 days, which they attribute to a decreased rate of wound infection. In patients with purse-string skin closure, Williams *et al*. [9] found a longer wound-healing time and a higher medical cost. Nonetheless, Reid *et al*. [10] found that the purse-string skin-closure wound-healing time was 20.6 days and the linear skin-closure wound-healing time was 24.6 days, although the difference was not statistically significant.

According to studies, the risk factors for wound infection following stoma reversal differed substantially. In 125 patients who had an ileostomy following surgery for rectal cancer, Akiyoshi *et al*. [11] found that having wound infection at the time of rectal-cancer surgery and having wound infection after the ileostomy reversal were significant risk factors for wound infection after the ileostomy reversal. A contaminated or unclean wound, as well as prolonged operative period, are risk factors for wound infection following surgery, according to the National Nosocomial Infections Surveillance System (NNIS) [12]. Other risk factors, such as those listed in Table 3, were not found to be substantially linked with wound infection in our study.

When purse-string skin closure is used, scar cosmosis after wound healing is a problem since large scars that occur with traditional linear skin closure are prevented. Reid *et al.* [10] used the visual analog scale [1–8,13,14] to compare the cosmetic satisfaction of patients with scars from linear skin closure and purse-string skin closure after an ileostomy reversal, the linear skin-closure group scored 7.3, while the purse-string skin-closure group scored 7.8, but the difference was not statistically significant. Although we were unable to apply an objective cosmetic scale in our research, in the purse-string skin-closure scenarios, scabs formed on the skin after full wound healing, and the scars that remained on the skin were substantially smaller than those in the linear-closure group.

Several studies have found that the length of hospitalization following stoma reversal is unaffected by wound-closure technique [3,10]. Similarly, the median length of hospitalization did not differ significantly, depending on the type of skin-closure techniques used in our study. The hospitalization period of the purse-string skin-closure group was significantly shorter, according to Lee *et al*. [15], however, it is difficult to interpret these findings as a difference between wound-closure techniques because most linear closures were performed prior to 2008, whereas most purse-string closures were performed after 2008, with the trend toward shorter hospital stays through the use of early recovery programs. As a result, patient-selection bias may have an impact on the length of time spent in the hospital.

The small number of participants in each group, the single-center experience, and the lack of a medical-cost parameter are all the limitations of our study. It is suggested that a large-scale multicenter study be conducted, including a cost-effectiveness analysis.

Conclusion

After loop-colostomy reversal, purse-string closure is linked to a decreased rate of wound infection and

a smaller scar size. However, it is linked to a longer healing time for wounds.

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Conflicts of interest

There are no conflicts of interest.

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