Purse-string closure versus conventional wound closure technique following stoma reversal: a prospective randomized controlled trial

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Background
Stoma reversal is associated with a high risk of postoperative wound infection of up to 41%. The conventional method of skin closure during stoma reversal has been primary skin closure (PC) with interrupted nonabsorbable sutures. The purse-string skin closure (PSSC) method creates a hole in the center of the wound to promote secondary intentional healing. This alternative technique of skin closure can reduce the risk of wound infection.

Patients and methods
A prospective randomized controlled trial was conducted on all patients undergoing stoma closure at Ain Shams University hospitals between September 2020 and December 2021. Patients were divided using computerized randomization into two groups based on skin closure technique: PC or PSSC.

Results
A total of 52 patients were included: 27 patients underwent primary closure (group 1) and 25 patients underwent PSSC (group 2). There was a statistically significant increase in the incidence of wound complications in the PC group compared with the PSSC group. Seroma occurred in 12 (44.4%) cases in group 1 compared with no cases in group 2. There were 10 (37.0%) wound infection cases in group 1, and three (12.0%) in group 2. There was prolonged healing time among the PC group (4.22±1.48 weeks) compared with the PSSC group (3.16±0.62 weeks). In terms of patient satisfaction, patients in the PSSC group were more satisfied, having more favorable survey-based satisfaction.

Conclusion
PSSC for stoma reversal significantly reduces wound complications and surgical site infection and shortens the wound healing time.

Keywords:
purse-string skin closure, secondary intention, stoma reversal

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Introduction

Stomas are usually a considerable tool for the treatment of intestinal malignancies or inflammatory diseases, and their reversal is associated with a high incidence of surgical site infection (SSI) up to 41% [1,2]. This high incidence rate is due to many factors such as steroid usage, anemia [3], presence of germs on the skin around the stoma site, and the potential for contamination with intestinal content, which leads to increased health care costs, decreased patient quality of life, and increased morbidity [4,5].

Consequently, the effectiveness of several conventional wound closure methods in reducing wound infection has been evaluated and compared; keeping wounds fully exposed or partially closed helps reduce SSI, with the lowest SSIs occurring in wounds that are allowed to heal by secondary intention [1,6]. These traditional skin closure methods during stoma reversal used linear primary skin closure (PC) with nonabsorbable interrupted sutures, but SSI rates remain high, encouraging research into alternative skin closure methods [5,7].

Banerjee [8] introduced in 1997 an alternative method of skin closure during stoma reversal, which has been proposed as a simple, inexpensive, reliable, and cosmetically preferred method. Here, a subcutaneous absorbable purse-string suture is taken to close the skin after bowel re-anastomosis, and sheath closure. The circular purse-string skin closure (PSSC) technique is stated to reduce the risk of SSI, with smaller wounds, and increase patient satisfaction.

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This was a comparative study of conventional linear PC and alternative form of skin closure, PSSC, following stoma reversal procedures to assess postoperative wound infection rates and patient satisfaction.

Patients and methods

Study design

This was a prospective randomized controlled study for all patients having stoma reversal at Ain Shams University hospitals between September 2020 and December 2021. Using computer-based randomization, patients were split into two groups based on the method of skin closure. A total of 52 patients were included in our study and were divided into two groups: group 1 (control group, 27 patients) underwent PC and group 2 (25 patients) underwent PSSC.

After ethical committee approval from Ain Shams University, all patients received information about surgical technique, risks associated with surgery, and alternative treatment options. All patients gave written informed consent before the procedure.

All patients who were older than 18 years and had undergone prior abdominal surgery with a temporary stoma (colostomy, ileostomy) were included in the study. We excluded patients who were under the age of 18 and those who had inflammatory bowel diseases such as Crohn's and ulcerative colitis.

A novel six-point patient satisfaction scale, created by Milanchi *et al.* [3], was used to measure patent satisfaction based on a validated questionnaire, which was administered by the interviewer 3 months after surgery, as shown in Table 1.

Primary end points included monitoring the wound complications rate. Secondary end points were healing time and patient satisfaction by completing a six-point patient satisfaction scale.

Table 1 Six-pint score patient satisfaction sale [3]

Cosmetic aspect, what do you think about the appearance of your scar?
1. It looks horrible, it is so disgusting.
2. It looks very ugly, I hate it.
3. It looks ugly, but I do not hate it.
4. It is not that great; it doesn't look good.
5. It doesn't bother me, it looks ok.
Patient's satisfaction, is the appearance of your scar different than what you expected before surgery?
1. It looks remarkably worse.
2. It looks worse.
3. This scar is what I expected before surgery.
4. It looks better.
5. It looks remarkably better.
Postoperative pain, how did you assess the severity of your pain after the surgery from the time of surgery until the wound healed?
Use a scale of 5e1, five for slight pain and one for excruciating pain.
Time of healing, did your wound heal as fast (or as slow as) you expected?
1. It healed remarkably longer than I expected.
2. It healed longer than I expected.
3. It healed as fast as I expected.
4. It healed faster than I expected.
5. It healed remarkably faster than I expected.
Wound care, did you have a problem with the dressing change?
1. Yes, it was a nightmare, it paralyzed my life, and I hated it so much.
2. Yes, it was so cumbersome and annoying, I hated it.
3. Yes, I didn't like it, it bothered me.
4. Ni, I didn't like it but it was not a big deal, it was OK.
5. No, it was so easy.
Activity After the surgery, did you have to limit your daily activities (e.g. grocery shopping, laundry, etc.) because of your wound, whether it was pain, discomfort, having a dressing, oozing from the dressing or any other reason?
1. Very severely limited my activities (could not do anything).
2. Remarkably limited my activities.
3. Moderately limited my activities.
4. Slightly limited my activities.
5. Not at all (I did whatever I wanted to do).
1–5 are the numerical score for each response. A higher score denotes better satisfaction. The total score is calculated by summing up the individual scores of each response.

Technique

Before surgery, the patient was required to consume a clear liquid diet for 24 h and a distal bowel enema was prescribed the night before. Antibiotics were administered prophylactically at the beginning of the induction of anesthesia and during the postoperative hospital stay.

A circumferential incision was made around the ileostomy, and the stoma loop was separated from the anterior abdominal wall. Adhesiolysis was done to be sure that the ileostomy loop is completely mobilized. Intestinal anastomosis was performed and advanced into the abdominal cavity. The rectus sheath was closed using a vicryl 1 round needle. Next, in group 1, to prevent dog-earing, the wound was reshaped into an ellipse, and the skin was closed with a vertical mattress technique using Prolene 3–0 cutting needle, as shown in Fig. 1, and in group 2, the purse-string subcuticular suture was taken using prolene 2/0-cutting needle leaving ~5–10 mm in the center of the wound, and then a wet gauze was inserted into the gap, which healed by secondary intention, as shown in Fig. 2.

Standardized techniques were performed by the same surgical team for both procedures. Twelve hours after surgery, patients drank clear fluids if they felt comfortable. Patients remained hospitalized until sepsis was cleared, bowel function was restored, and full oral nutrition could be resumed. From the second day after surgery until discharge from the hospital, the wound was checked every day, and follow-up was performed on an outpatient basis. Stitches are removed 2 weeks after surgery. If wound infection was suspected, wound culture and sensitivity were checked, and if present, it was treated by removing the sutures, washing the area, applying antiseptic dressings, and topical and systemic antibiotics.

Results

A total of 52 patients were included in our study: 27 patients as a control group who underwent PC (group 1), and 25 patients who underwent PSSC (group 2). The mean age was 53.56±9.79 years in group 1 and 52.64±11.32 years in group 2. The mean preoperative BMI was 33.63±5.35 in group 1 and 35.76±5.60 in group 2. Females accounted for

Figure 1

Purse-string stoma closure with gauze in the middle of the wound.

Figure 2

Primary closure of ileostomy wound.

48.0% of group 1 and 56.0% of group 2 patients. Overall, 40% of patients had diabetes mellitus (DM) in group 1 compared with 36% in group 2. As shown in Table 2, there were no statistically significant differences between the two groups regarding patient demographics.

There were no statistically significant differences between the two groups concerning the time between stoma creation and closure and stoma type (ileostomy or colostomy). A total of 13 (48.1%) patients in group 1 received preoperative neoadjuvant or adjuvant chemotherapy and 12 (48.0%) in group 2 received neoadjuvant or adjuvant chemotherapy, with no statistical significance between both groups, as shown in Table 3.

Regarding wound complications, there was a statistically significant difference between the two groups, as 88.9% of cases in group 1 with primary closure showed wound complications, in comparison with 28% in group 2, especially in seroma, which was statistically highly significant, with 12 (44.4%) cases in group 1 and no cases with seroma in group 2, as shown in Table 4 and Fig. 3.

Wound healing time was statistically significant between both groups with prolonged healing time

Table 2 Comparison between primary closure group and purse-string group according to demographic data

Demographic data	Primary closure group (*N*=27)	Purse-string group (*N*=25)	Total (*N*=52)	*P* value
Sex [*n* (%)]				
Female	12 (44.4)	14 (56.0)	26 (50.0)	0.405
Male	15 (55.6)	11 (44.0)	26 (50.0)	
Age (years)				
Mean±SD	53.56±9.79	52.64±11.32	53.12±10.46	0.756
Range	34–70	30–72	30–72	
BMI (kg/m^2)				
Mean±SD	33.63±5.35	35.76±5.60	34.65±5.52	0.167
Range	24–41	27–45	24–45	
DM [*n* (%)]	10 (40.0)	9 (36.0)	18 (36.0)	0.938

DM, diabetes mellitus. *t*, independent sample *t* test. χ^2, χ^2 test. *P* value more than 0.05 (nonsignificant).

Table 3 Comparison between primary closure group and purse-string group according to preoperative data

Preoperative data	Primary closure group (*N*=27)	Purse-string group (*N*=25)	Total (*N*=52)	*P* value
Type of stoma [*n* (%)]				
Colostomy	14 (51.9)	16 (64.0)	30 (57.7)	0.376
Ileostomy	13 (48.1)	9 (36.0)	22 (42.3)	
Neoadjuvant or adjuvant therapy	13 (48.1)	12 (48.0)	25 (48.1)	0.991
The duration between diversion and closure (weeks)				
Mean±SD	16.52±4.14	17.32±4.92	16.90±4.50	0.527
Range	12–24	12–28	12–28	

t, independent sample *t* test. χ^2, χ^2 test. *P* value more than 0.05 (nonsignificant).

Table 4 Comparison between the primary closure group and purse-string group according to wound complications

	Primary closure group (*N*=27) [*n* (%)]	Purse-string group (*N*=25) [*n* (%)]	Total (*N*=52) [*n* (%)]	*P* value
Wound complications[a]				
Dehiscence	2 (7.4)	4 (16.0)	6 (11.5)	0.337
Infection	10 (37.0)	3 (12.0)	13 (25.0)	0.039*
Seroma	12 (44.4)	0	12 (23.1)	<0.001**
Total	24 (88.9)	7 (28.0)	31 (59.6)	<0.001**
Healing time (weeks)[b]				
Mean±SD	4.22±1.48	3.16±0.62	3.71±1.26	0.002*
Range	2–8	2–5	2–8	
Incisional hernia[a]	4 (14.8)	1 (4.0)	5 (9.6)	0.186

[a]χ^2, χ^2 test. [b]*U*, Mann–Whitney test. *significant; **highly significant.

among the primary closure group (4.22±1.48 weeks) compared with the purse-string group (3.16±0.62 weeks), as shown in Fig. 4. There was no statistically significant difference between both groups according to incisional hernia occurrence as a complication during the follow-up period, as shown in Table 4.

According to the six-point patient satisfaction scale used to measure patient satisfaction, an overall total score ranged from 6 to 30, with 6 representing the worst results and 30 representing the best outcome. The mean patient satisfaction score was 18.5 for the PSSC group and 14.8 for the PC group, with a statistically significant difference between the two groups in favor of group 2, which used the purse-string closure technique, as shown in Fig. 5.

Figure 3

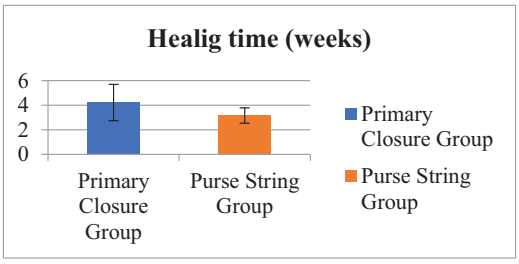
Post-primary repair wound dehiscence and seroma formation.

Discussion

The effectiveness of several traditional procedures for wound closure following stoma reversal in reducing SSI has been evaluated and compared by either fully or partially wound closure; however, the least SSI occurring in wounds allowed to heal by secondary intention [3]. Moreover, conventional wound closure after stoma reversal may cause patient discomfort with wound discharge and ugly scar development [2,5].

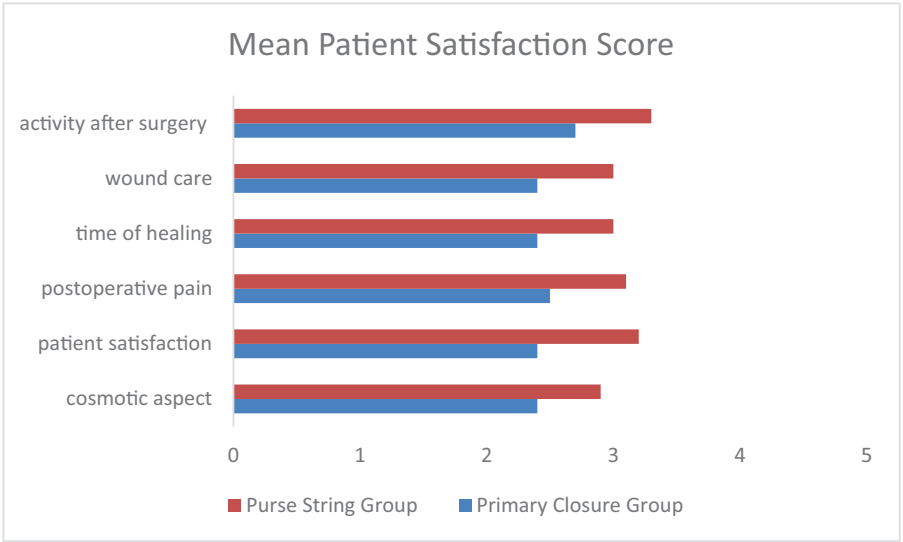
To overcome these problems, alternative methods of skin closure during stoma reversal have been proposed using a purse-string subcuticular absorbable suture to close the skin. In the PSSC for stoma reversal, space is often left in the middle of the wound, between 1 and 2 cm, which improves the drainage of wound fluids. This central hole guarantees exudate drainage and permits irrigation of wounds. With time, it heals through secondary intention with a little circular scar remaining after the minor skin imperfection has healed, as is the case with drain sites. It still leaves a

Figure 4



Comparison between primary closure group and purse-string group according to healing time 'weeks.'

Figure 5



Comparison between the primary closure group and purse-string group according to the mean patient satisfaction score.

neatly granulating incision that is only a small portion of its original size [3,9]. In contrast, the PC may require enlarging the incision into an ellipse to prevent dog-ear, and if the wound becomes infected, sutures must be taken out to drain the exudates, and for a successful wound outlet, the wounds must often be laid exposed. As a result, managing wounds is painful, time consuming, expensive, and horrifying, as compared with PSSC [10,11].

In this current study, 52 patients were randomly divided into two groups, including 27 patients in the control group, which underwent the PC technique (group 1) and 25 patients in a study group, which underwent the PSSC technique (group 2). According to demographic and preoperative data, the groups in our research did not differ statistically.

We considered assessing patients' preoperative BMI because wound healing can be severely hampered by obesity. Owing to the increasing subcutaneous fat, surgery may be challenging. This was supported by a study done by Kaiser *et al.* [12], about the morbidity and mortality following the closure of an ileostomy, which found that obesity affected the outcome of any procedure of stoma closure. In the current study, the mean BMI was comparable between both groups. DM also has a significant effect on how well wounds heal. Regarding the existence of DM, there was no statistically significant difference between the two groups in our study.

Due to difficulties such as skin maceration and developed adhesions at the stoma site, delayed reversion and the stoma type frequently make surgery challenging and more liable for complications, as macerated skin takes longer to recover from wounds, especially with high-output ileostomies [13]. The mean time for stoma reversal was 19.28 weeks in Reid *et al.* [13] and 17.71 weeks in Lee *et al.* [14]. We found in our study that the duration between fashioning a stoma and its closure was 16.52 ±4.14 and 17.32±4.92 (weeks) among groups 1 and 2, respectively, with no statistically significant difference between both groups. Regarding the type of the stoma, no statistically significant difference between both groups according to stoma type either colostomy or ileostomy.

It is well established that adjuvant or neoadjuvant therapy affects wound healing. A total of 13 (48.1%) patients received neoadjuvant or adjuvant therapy in group 1 compared with 12 (48.0%) patients of group 2, with no statistical significance between both groups.

Our study showed a statistically significant difference in the frequency of wound complications in the PC group compared with the PSSC group, especially seroma, which was highly significant between both groups, with 44.4% of patients in the PC group developing seroma that required drainage, whereas no cases of seroma were found in the PSSC group. Ten (37%) patients of group 1 had wound infection in contrast to three (12%) patients of group 2, which was statistically significant. The study by Reid *et al.* [13] found that the purse-string closure significantly reduced the risk of SSI following linear skin closure for stoma reversal from 39 to 7%.

Many authors suggest primary wound closure healing is quicker than PSSC healing; this is only the case if the wounds were not infected or complicated [15]. On the contrary, many reviews confirmed and showed the healing period in PSSC is much shorter [16,17]. This matched our results, as healing time was statistically significant between both groups with prolonged healing time among the primary closure group (4.22±1.48 weeks) compared with the purse-string group (3.16±0.62 weeks).

Regarding the incidence of incisional hernia during the follow-up period following stomal reversal, there were no statistically significant differences between both groups, but there were four cases in the primary closure group versus one case in the PSSC group. We believe that the weakness of the abdominal wall brought on by SSI is an easy explanation for the prevalence of an incisional hernia in patients with linear skin closure who had SSI.

The scar cosmesis was evaluated using a visual scale in the study by Marquez *et al.* [18] study and was comparable between the two groups. On the contrary, a four-point scale was used to evaluate patient satisfaction in the study by Williams *et al.* [19] study; in contrast to the linear closure group, they concluded that patients with PSSC were quite happy (70 vs. 20%). In their study, Klink *et al.* [20] also evaluated patient satisfaction, which strongly favors the purse-string closure group.

In the current study, patient satisfaction was assessed by the six-point patient satisfaction scale [3], which showed more patient satisfaction in the PSSC group than the PC group regarding the cosmetic aspect, postoperative pain, healing time, wound care, and activity after surgery. We believe the cause behind this result was that with the purse-string closure, wounds healed by secondary intension, with a

smaller scar that filled the purse-string gap, whereas with a linear closure, the lengthy incision and many sutures result in poor cosmesis and widen the scar, especially with the high rate of wound infection and seroma formation.

Conclusion

PSSC technique for wound closure after stomal reversal is an easy procedure with lower SSI and lower wound complication rate with shorter healing time and more patient satisfaction than the PC technique. We recommend this closure technique in all stomal reversals.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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