

Outcomes of Purse-string versus Conventional Linear Suture Closure of the Skin Wound Following Ileostomy Reversal

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ABSTRACT

Objective: Intestinal stomas are made in a variety of settings and their reversal is also a routine surgery. Due to their clean contaminated nature, there is a high risk of surgical site infection post-operatively. The objective of this study is to determine the difference in outcomes in two different techniques of skin closure after stoma reversal

Methods: The study was conducted at department of general surgery, Pakistan Institute of Medical Sciences, Islamabad over a period of six months. Seventy-one patients who underwent ileostomy reversal surgery in an elective setting were assigned two groups randomly: 34 in Group A and 37 in Group B. The group A patients underwent purse string closure for stoma site skin wound whereas patients in group B underwent conventional linear closure. Time taken for surgery was noted and the patients were followed over one month period for development of any surgical site infection or dog-ear deformity.

Results: The incidence of surgical site infection was 8.8% in the purse string closure group compared to 43.2 % in the linear closure group. Seven patients in group B developed dog ear deformity whereas no such case was noted in Group A.

Conclusions: Purse string closure is an effective and applicable technique for the closure of skin wounds after stoma reversal surgery. It is comparatively better in terms of prevention of surgical site infection as well as dog ear deformity in the closure of skin wounds after ileostomy reversal.

Key words: Purse string suture, linear suture, ileostomy reversal, intestinal stoma, surgical site infection.

Authors' Contribution:

^{1,2}Conception; Literature research; manuscript design and drafting; ^{3,4,5}Critical analysis and manuscript review; ^{5,6,7}Data analysis; Manuscript Editing.

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Introduction

As with stoma construction or any other surgical procedure, stoma reversal surgeries are also prone to complications, studies have observed these complications in the range of 2% to 33% of cases.¹ The burden of this post-operative morbidity significantly impacts the healthcare economy. A patient who has undergone reversal may suffer from complications such as surgical site infection, bowel

obstruction, ileus, and entero-cutaneous fistula.² To deal with the problem at hand and to reduce the overall morbidity and rate of infection at the surgical site, multiple protocols and techniques have been implemented in the pursuit of improving patient outcome.³ One such methodology is to change the suturing technique of skin closure after stoma reversal.⁴ It was initially proposed by Banerjee and colleagues that after approximating the fascial layer, a purse string suture approximation of

subcutaneous fat with a small residual defect left in the skin would optimize the postoperative outcomes when compared to simple conventional linear closure. Banerjee has argued that the residual opening, left intentionally, acts as a channel for the drainage of any retained fluid or blood; there are fewer chances of seroma formation and hence it minimizes the possibility of SSI.⁵ Ileostomy reversal is a routinely conducted procedure in patients who are initially managed by ileostomy as part of damage control after late presentation with perforations or undergoing intestinal resection. After the closure of the fascial layer, it is still argued which technique of closure of the sub-cutaneous layer would lead to the most optimum post-operative results. Stoma closure may lead to surgical site infections, varying operative times, readmission rates, and in a minority of cases mortality too. Hence, it is warranted that studies are conducted to devise strategies to improve the outcomes of patients. A recent study in India favored the usage of the purse string suturing technique over linear closure in terms of SSI.⁶ This study was reaffirmed by other international studies as well. However, some studies argued otherwise and reported no significant differences. Currently, there is minimal evidence in literature from Pakistan that would compare both techniques. Being a developing country with poor healthcare infrastructure and limited resources there is still a huge number of patients in Pakistan who present late in the emergency department with intestinal perforations secondary to complicated Typhoid or Tuberculous infection.

A significant proportion of these patients undergo ileostomy formation as part of damage control and subsequently stoma reversal once their acute phase of illness has settled. With this clinical background, we conducted the present study to compare outcomes in patients undergoing either purse-string or linear skin closure after stoma reversal to find out which method is superior so that we can adopt it in our clinical practice.

Methodology

The study took place at the General Surgery Department of Pakistan Institute of Medical Sciences, Islamabad after taking approval from the ethical review board. The patients were recruited over six-month period. The sample size was calculated by the WHO sample size calculator. The parameters taken were Level of Significance = 5%, Power of test = 80%, Anticipated population proportion (surgical site infections in purse string closure) $p_1 = 15\%$, anticipated population proportion (surgical site infections in linear closure) $p_2 = 45\%$. The sample size turned out to be 38 in each group and a total of 76 patients were included in the study. Two-stage sample selection technique was used. In first stage selection of patients was done according to selection/inclusion criteria. Non-probability Consecutive Sampling was done. In second stage randomized lottery method was used for assigning patients to either groups A or B. After being apprised and informed about the study's procedures, willing patients who provided written consent were included in the study.

Patients on the elective list for ileostomy reversal, older than 18 years who gave consent were included in the study. Presence of greater than one stoma, colostomy, Diabetes Mellitus, renal failure, skin wound larger than 5 cm, patients taking steroid or immunosuppressive medications at the time of surgery were excluded. The patients in Group A had a purse string closure of the skin wound after stoma reversal whereas Group B patients underwent linear skin closure. The basic demographics such as age, gender, and reason for stoma formation were noted on a self-designed Proforma. The patients scheduled for surgery underwent the same preoperative management following hospital protocol. The patients were shifted to a liquid diet a day before surgery and then advised NPO 8 hours before surgery. After the stoma was repaired and the fascial layer closed, the sub-cuticular layer was closed with the purse string suture technique in patients

assigned to group A and conventional linear closure in patients assigned to group B. For all the procedures same surgical team was involved. After the surgery patients were followed up and a track was kept regarding which patients developed a surgical site infection, the period between the time of surgery and when the patient developed SSI, the total length of stay at the hospital, the need for readmission for management of the SSI, length of stay on readmission, and lastly dog-ear deformity. The follow-up period was one month. Data were analyzed using SPSS software version 25. The quantitative numerical variables like age, operative time, time taken to diagnose an SSI, the initial length of hospital stay, and readmission LOS were analyzed as mean and standard deviation. As per the study objective, the incidence of SSI was compared in both arms of this trial using the chi-square/ Fischer exact test.

Results

In this study, the total number of patients inducted was 76, of which 5 were lost to follow up so the data was compiled from 71 patients. Our sample population comprised 46 male and 25 female patients (i.e. 64.8% and 35.2% respectively P-Value=0.49), there was no statistically significant difference noted based on the gender of the patient. The patients were weighed at the time of admission for reversal surgery and their BMIs were calculated, the mean BMI in our sample population was 23.8. None of the patients were classified as overweight, and the BMIs of patients in both groups were comparable. The study population's median age was 36.86, with SD of 13.839.

Three of 34 patients (8.82%) in Group A developed SSI compared to 16 of 37 patients (43.2%) in Group B (p<0.01) as shown in Table 1. None of the patients in group A developed dog ear deformity compared to 7 of 37 patients (18.91%) in group B (p<0.001) as shown in Table 2.

Table 1: Frequency of surgical site infection in PSC and LC

			SII		Total	P Value Chi-square
			No SSI	SSI Noted		
Group	Purse String Closure (PSC)	Count	31	3	34	< 0.01
		% within group	91.2%	8.8%		
	Linear Closure (LC)	Count	21	16	37	
		% within group	56.8%	43.2%		
Total		Count	52	19	71	
		% within group	73.2%	26.8%	100%	

Table 2: Frequency of dog ear deformity in PSC and LC

			Dog ear deformity		Total	P Value Chi-square
			No	Yes		
Group	Purse String Closure (PSC)	Count	34	0	34	< 0.001
		% within group	100%	0%		
	Linear Closure (LC)	Count	30	7	37	
		% within group	81.1%	18.9%		
Total		Count	64	7	71	
		% within group	90.1%	9.9%	100%	

There was no statistically significant difference between the mean time for skin closure in purse string versus linear closure; 8.62 min vs 8.54 min (P-value=0.774). In patients that developed surgical site infection, the meantime taken to diagnose SSI was significantly less in the purse string closure group (16.00 hours vs 37.13 hours, P-value< 0.01) as shown in Table 3. The difference noted in the length of stay of patients at the hospital postoperatively was also significant; 2.15 days in Group A vs 2.62 days in Group B (p-value < 0.01) as shown in Table 4. Out of the patients that developed SSI, two patients needed re-hospitalization for management of the infection, both patients belonged to the linear closure group. None of the patients had to undergo

major surgery at re-admission. No mortality was noted in both groups.

Table 3: Mean time taken for diagnosis of surgical site infection

	Surgical Technique	N	Mean time Hours	Standard Deviation	P Value (t-test)
Time taken to diagnose SSI Hours	Purse String Closure (PSC)	3	16.00	2.00	< 0.01
	Linear Closure (LC)	16	37.13	6.53	

Table 4: Mean length of stay at hospital

	Surgical Technique	N	Mean Days	Standard Deviation	P Value (t-test)
Length of stay at hospital Days	Purse String Closure (PSC)	34	2.15	0.359	< 0.01
	Linear Closure (LC)	37	2.62	0.639	

Discussion

Stoma reversal is a routinely performed surgery and is associated with a considerable incidence of post-op infection and cosmetic deformity. The key objective of this study was to compare the outcomes of linear closure and purse-string closure techniques in ileostomy reversal surgery. Of the total sample size, 37 patients underwent linear closure and 34 patients had a purse string closure. The incidence of surgical site infection (SSI) was significantly lower in the purse string closure group (3 of 34, 8.82%) compared to the linear closure group (16 of 37, 43.2%) (P-value < 0.01). Additionally, dog-ear deformity was observed in 7 of 37 linear closure cases, whereas none of the purse string closure patients developed this deformity (18.91% vs 0%), indicating a significant difference (p-value < 0.001). The purse string closure technique allows the wound

to heal by secondary intention, creating a small portal for the drainage of exudate from the wound and subcutaneous tissue. This approach is particularly beneficial given the clean contaminated nature of the surgery. As the scab forms and covers the opening, it significantly reduces tissue scarring since the area for healing is smaller. When the small scar matures, it contracts further, resulting in a final scar much smaller than the initial opening. In contrast, linear closure elongates the stoma opening wound to form an elliptical border, resulting in a larger scar.

Moreover, attempting to close a circular/elliptical wound in a linear fashion poses a risk for dog-ear deformity, further compromising cosmesis.⁷ The linear closure of surgical wounds with no gaps in between the stitches does not allow the evolving infected fluid and pus to drain out, hence it takes a longer time to diagnose SSI, which can only be picked up clinically at much advanced stage. This fact was shown in our study where the time to diagnose SSI was significantly shorter in the purse string closure group as compared to linear closure patients (16.00 hours vs 37.13 hours, P-value < 0.01). The increased frequency of SSI in the linear closure group along with more time taken to diagnose the infection is reflected by their prolonged length of stay in the hospital when compared to the purse string closure group (2.62 days vs 2.15 days, p-value < 0.01). In a study conducted in Pakistan by Ali D et al, the incidence of surgical site infection was found to be lower in the purse string closure group (2, 5.4%) compared to the linear closure group (8, 22.8%) (p=0.023).⁸ Similarly, Lodhi et al., reported a lower rate of infection in the purse string closure group (10%, n=3) compared to the Linear closure group (36.67%, n=11) (P value 0.01).⁹ This is in agreement with the findings of our study that showed more favourable outcome in terms of SSI for purse string closure patients. More robust evidence of better outcomes regarding SSI after purse string closure of ileostomy reversal comes from meta-analysis by Sajid *et al.*, that showed a significantly

reduced risk of surgical site infection (OR, 0.10; 95% CI: 0.03, 0.33; $z = 3.78$; $P < 0.0001$) when the ileostomy wound was closed using the Purse String Closure technique.¹⁰ Similar outcomes are shown by two more recent meta-analysis studies on this issue by Rondelli *et al.*, and Luo *et al.*^{11,12} As previously highlighted, employing the purse-string closure technique proves to be a remarkably effective strategy in averting any potential dog-ear deformities within the wound. The distinct advantage lies in the significantly smaller size of the purse-string wound compared to its linear closure counterpart.

Moreover, as scar naturally contracts, diminution in size becomes more pronounced, culminating in a notably enhanced final cosmetic appearance. Tiwari D noted a statistically significant difference in the Patient and Observer Scar Assessment Scale (POSAS) score between the purse string and linear closure groups, with mean scores of 24.8 and 36.4 respectively (p -value=0.04).¹³ Krenzien *et al.*, reported acceptable cosmetic results with purse string closure, characterized by a smaller scar and decreased tissue elevation, leading to improved patient satisfaction. Ali D observed that patients in the purse string group were more satisfied at 3 months post-surgery than those in the linear closure group ($p=0.001$).⁸ Alvandipour *et al.*, found that patients in the purse string group were more satisfied with the resulting wound scar and its cosmetic appearance at one month and three months post-surgery ($p = 0.043$).¹⁴ Behuria *et al.*, noted that the scar size was smaller and average patient wound satisfaction scores were significantly higher in the purse string closure group.⁶ Bains *et al.* observed that although the mean healing time of the wound in the linear closure group was significantly less than that in the purse string group (10.76 ± 5.68 days and 14.17 ± 2.04 days respectively), the overall total satisfaction score was higher in the purse string group. ($p>0.05$).¹⁵ Gulzar inferred that in the linear closure group, 60% of patients developed a good scar, 20% developed a satisfactory scar, and 20%

developed a poor scar. In contrast, in the purse string closure group, 82% of patients had a good scar and 18% developed a satisfactory scar (p value 0.00). The mean wound length in the groups was 5.14 (SD 1.2978) and 3.8 (SD 1.3095) respectively.¹⁶ In Roy's study, higher patient satisfaction was noted in the purse string closure group. At 3 months follow-up, the patient and observer scar assessment scale (POSAS) score were calculated through a generalized linear model, and the results showed a significantly higher satisfaction rate and better scar cosmesis in the purse string group.¹⁷ These findings align with the final outcome of our study where no dog ear deformity was observed in the purse string closure group. Our study has several limitations that need to be considered. Colostomy closure cases were not included in the study. The cosmetic outcomes, apart from dog ear deformity, including scar length and patient's overall satisfaction with wound scar appearance were not measured as well. The sample size was relatively small, and the study was conducted at a single center, which may limit the generalizability of the results.

Furthermore, potential sources of bias include the non-randomized assignment of patients to the two groups and the loss of patients to follow-up. The direction of the bias is towards an overestimation of the benefits of the purse string closure technique, given that patients with more severe conditions might have been more likely to be assigned to the linear closure group. Despite these limitations, the results provide valuable insights into potential benefits of the purse string closure technique. The significantly lower incidence of SSI and absence of dog-ear deformity in the purse string closure group suggest that this technique may be more effective for ileostomy reversal surgery. However, these results should be interpreted with caution, considering the limitations of the study, the multiplicity of analyses, and the results from similar studies. The generalizability of the study results is limited due to the single-center design and the relatively small sample size. However, the findings

contribute to the growing body of evidence suggesting the potential benefits of the purse string closure technique in ileostomy reversal surgery. Further multicenter, randomized controlled trials with larger sample sizes are suggested to confirm these findings and to assess the applicability of the results to a broader population.

Conclusion

Purse string suture technique is a relatively better alternative for the closure of skin following ileostomy reversal compared to linear closure in terms of SSI. The purse string closure technique also has a better cosmetic outcome. Purse string closure should be adopted as the preferred method for the closure of skin wounds after ileostomy reversal.

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