COMPARISON OF EFFICACY BETWEEN LINEAR VERSUS PURSE STRING SKIN CLOSURE AT LOOP ILEOSTOMY REVERSAL

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ABSTRACT

OBJECTIVES

This study aimed to compare postoperative surgical site infection (SSI) rates and LOS between linear and purse-string skin closure during loop ileostomy reversal.

METHODOLOGY

This randomized controlled trial was conducted in the Department of General Surgery at MTI-HMC Peshawar from Jun 22 2020, to Jul 1 2025. patients fulfilling the inclusion criteria, undergoing stoma reversal, were enrolled to either linear (Group A) or PS (Group B) wound closure groups, while 63 patients with stoma site infection (TLC >11,000/L with fever) were excluded from the sample size (Figure 1: CONSORT Flow Diagram). Length of hospital stay was recorded, and patients were followed for 30 days to assess for SSI. This trial was registered in Clinical Trials with NCT # NCT07573423.

RESULTS

A total of 252 patients were randomized equally into two groups (126 per group). SSI occurred in 47 (37.3%) in Group A (Linear Skin Closure - LSC), compared with 9 (7.14%) in Group B (Purse String Closure - PS) ($p<0.001$). Mean hospital stay was significantly shorter in group B (4.1±1.1) compared to group A (4.5±1.6) ($p<0.001$).

CONCLUSION

Purse-string skin closure following loop ileostomy reversal was significantly associated with a lower rate of SSI compared with linear skin closure. In addition, the LOS was shorter with purse-string closure, suggesting that it is a safe and recommended technique for routine use to reduce post-operative wound complications.

KEYWORDS: *Loop Ileostomy Reversal, Post-SSIs, Linear Skin Closure, Purse String Skin Closure*

INTRODUCTION

A temporary ileostomy is frequently performed in colorectal and emergency gastrointestinal surgeries to protect the distal anastomosis and reduce the consequences of anastomotic leakage.[1,2]Although stoma closure is regarded as a relatively minor surgical procedure, complications such as surgical site infection (SSI) remain common, with reported incidence rates ranging from 4% to 22.2% across various studies.[1,3,4] this makes the wound infection a significant cause of post-operative morbidity, prolonged hospitalization, increased healthcare costs, delayed recovery, and reduced patient satisfaction.[2,5] The pathogenesis is multifactorial; bowel contents in contact with the skin and prolonged gut flora contamination are the major obvious etiological factors of wound infections after ileostomy reversal.[6] Various techniques have been described for skin closure after stoma reversal, with linear closure and purse-string closure (PS) being the most commonly practiced.[6,7] Literature shows that the baseline and operative characteristics did not differ significantly between the conventional and PS closure of the wound after ileostomy.[2] This suggests that differences in outcomes are attributable to the method of closure itself rather than patient or operative factors.[8] Conventional linear closure involves primary approximation of the wound edges, whereas PS closure leaves a small central gap between two sutures that allows for drainage, potentially reducing colonization and SSI risk.[2,5] Purse-string closure has been associated with lower SSI rates and fewer scars in some studies, while conventional linear closure (LC) remains widely used due to its simplicity and familiarity among surgeons, with a higher SSI rate and good cosmesis.[6] we warrant comparative evaluation and need for evidence-based practice in given burden of SSI. Despite the growing body of international evidence, local data comparing LC and PS skin closure remain limited. Evaluating the effectiveness of either technique in our population is important for identifying the optimal

approach to reduce post operative complications and improve patient outcomes. Therefore, this study is conducted to compare the outcomes of purse-string skin closure and conventional linear skin closure in stoma-reversal wounds. This will be used as a reference for adopting one technique for the closure of the skin after stoma reversal to decrease the occurrence of SSI, improve cosmesis, and lower the cost of hospital stay.

METHODOLOGY

This randomized controlled trial was conducted at Hayatabad Medical Complex, Peshawar, from Jun 22 2020, to Jul 1 2025, with ethical approval from the Hayatabad Medical Complex ethical committee. This trial was registered in Clinical Trials with NCT # NCT07573423. All eligible participants were recruited consecutively and then randomly allocated to either the LC group or the PS closure group using block randomization. The sample size was calculated for a dichotomous outcome in this two-group RCT with anticipated incidences of previously reported SSI rates of (42.5%) in the LC closure group and 7.5% in the PS closure group.[6] The confidence interval of 95%, 1:1 allocation ratio, and a power of 0.8 (β = 0.2), ensuring sufficient sensitivity to detect the large expected difference while keeping risks of Type I and Type II errors within conventional limits. The sample size was calculated
using the formula:

$$n = \left(\frac{Z\alpha}{2} + Z\beta\right)^2 \times \frac{p1(1-p1) + p2(1-p2)}{(p1-p2)^2}$$

Where:

Zα/2 = 1.96 (for 95% confidence interval)
Zβ = 0.84 (for 80% power)
p1 = 0.425 (SSI rate in LC closure group)
p2 = 0.075 (SSI rate in PS closure group)

Substituting the values in the above equation:

$$n = (1.96 + 0.84)^2 \times \frac{[(0.425 \times (1-0.425)) + (0.075 \times (1-0.075))]}{(0.425-0.075)^2} = 7.84 \times 0.31375 / 0.1225 = 2.4596 / 0.1225 = 20.08 \approx 21$$

Although the statistical minimum required sample size was 42 (21 per group) based on the two-proportion formula, the study enrolled 252 patients to increase the precision of the effect, improve external validity, and strengthen statistical robustness. Patients aged 18-65 years undergoing elective loop ileostomy reversal were included. Patients with active infection in the stoma site, immunosuppression, chronic steroid therapy, severe malnutrition, uncontrolled diabetes mellitus, pregnancy, or those not planned for reversal were excluded to minimize bias. patients fulfilling the inclusion criteria, undergoing stoma reversal, were enrolled to either linear (Group A) or PS (Group B) wound closure groups, while 63 patients with stoma site infection (TLC >11,000/L with fever) were excluded from the sample size (Figure 1: CONSORT Flow Diagram). Demographic characteristics, including age, gender, and pre-existing comorbidities such as hypertension and diabetes, were systematically recorded on a standardized pro forma. Hypertension was a previously diagnosed condition requiring antihypertensive medication, and diabetes was a known case managed with antidiabetic therapy. All participants received initial management in accordance with hospital protocol and were monitored throughout the hospital stay. Post-discharge, they were followed for 30 days to identify any SSI. All the data were collected by the researcher and his team themselves and recorded in the predesignated proforma as annexure II, ensuring consistency and accuracy in documentation. Statistical Package for Social Sciences (SPSS) version 23 was used for data entry and analysis. Mean ± SD for quantitative variables like age and duration of hospital stay. Frequency and percentages were reported for qualitative variables such as gender, diabetes, hypertension, ASA status, and SSI. Both groups were compared in terms of hospital stay using an independent-samples t-test at the 5% level of significance, and SSI rates were compared using the chi-square test at the same threshold. All findings were presented visually through graphs and charts to enhance clarity and interpretability.

RESULTS

A total of 252 patients undergoing elective ileostomy reversal were enrolled and randomized equally into Group A (Linear Skin closure, n = 126) and Group B (PS skin closure, n = 126).

Figure 1:CONSORT Flow Diagram.

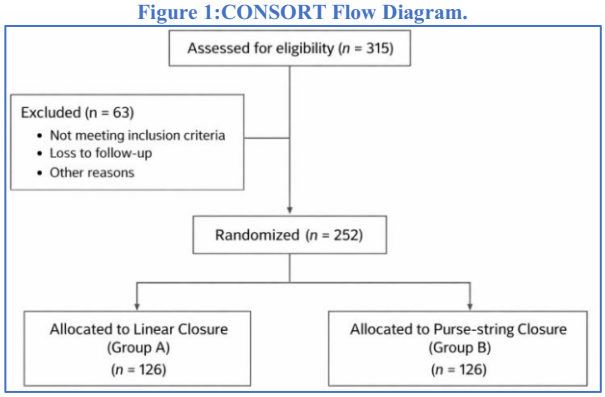


Table 1: Patient's Demographic and Clinical Characteristics

Feature	Subgroup	Linear Closure (Group A) LC n=126(%)	Purse-String Closure (Group B) PS n=126 (%)	Total N=252 (%)	P-value
Gender	Male	57(45.2%)	67(53.2%)	124(49.2 %)	0.209
	Female	69(54.8%)	59(46.8%)	128(50.8 %)	
Age (years)	Mean ± SD	40.7 ± 6.6	45.3 ± 3.3	44.1 ± 9.6	0.333
BMI (kg/m²)	Mean ± SD	24.1 ± 3.3	27.3 ± 2.8	26.2 ± 5.3	0.122
BMI Categories (kg/m²)	Underweight (<18)	4 (3.2%)	2 (1.6%)	6 (2.4%)	0.078
	Normal (18–24.99)	51(40.5%)	48 (38.1%)	99(39.3%)	
	Overweight (25–29.99)	49(38.9%)	46(36.5%)	95(37.7%)	
	Obesity I (30–34.99)	18(14.3%)	13 (10.3%)	31(12.3%)	
	Obesity II (35–39.99)	2 (1.6%)	11(8.7%)	13(5.2%)	
	Extreme Obesity(>40)	2 (1.6%)	6 (4.8%)	8 (3.2%)	
ASA Score	I	45(35.7%)	55(43.7%)	100 (39.7 %)	0.198
	II	81(64.3%)	71(56.3%)	152 (60.3 %)	
Pre-operative	Mean ± SD	3.8 ± 2.2	4.1 ± 1.2	4.0 ± 5.5	0.333
Albumin (g/dL) Comorbidity	Diabetes Mellitus	30(23.8%)	21(16.7%)	51(20.2%)	0.677
	Hypertension	28(22.2%)	15(11.9%)	43(17.1%)	
	Malignancy	1 (0.8%)	1 (0.8%)	2 (0.8%)	
	No Comorbidity	67(53.2%)	89(70.6%)	156 (61.9 %)	

Table 2: Operative Outcome features

Feature	Subgroup	Linear closure LC (Group A) n=126 (%)	Purse-string Closure PS (Group B)n=126 (%)	p-value
Hospital stays	Days	4.5±1.6	4.1±1.1	0.000
Duration of Surgery	Minutes	44.8±4.5	71.4±11.1	0.000
Surgical site infections	Yes No	47 (37.3%) 79 (62.7%)	9 (7.14%) 117 (92.8%)	0.000

Figure 2: Frequency of Surgical site infections in both Groups.

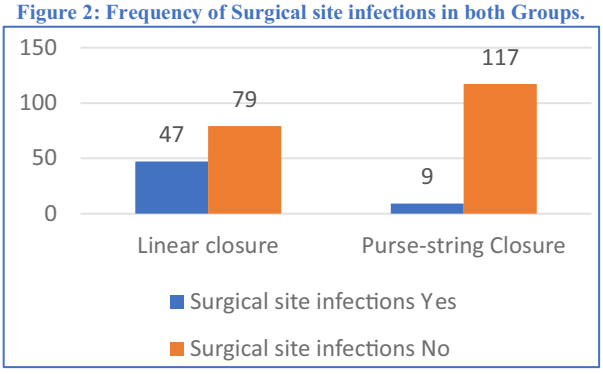
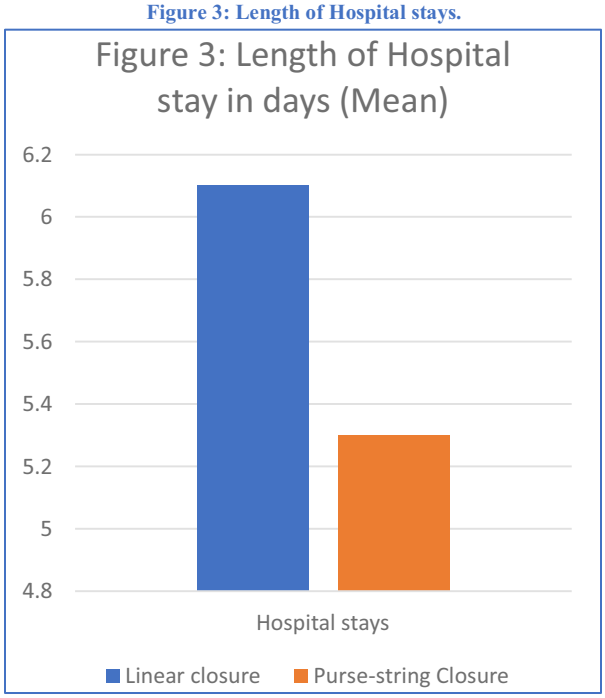


Figure 3: Length of Hospital stays.



DISCUSSION

SSI remains one of the most frequent complications following ileostomy reversal and contributes substantially to post-operative morbidity, prolonged hospitalization, delayed recovery, and increased healthcare costs. The present randomized controlled trial compared LC skin closure and PS skin closure techniques and demonstrated a significant reduction in SSI rates among patients undergoing PS closure. Efforts have been made to reduce SSI following stoma closure by assessing various factors. Types of skin closure techniques, including the PS closure, have recently attracted significant interest because they may have a significant impact on wound healing. Gender distribution in this study did not differ significantly (p=0.209), indicating that sex was unlikely to confound subsequent outcome comparisons. Similarly, the mean age was 40.7 ± 6.6 years in Group A and 45.3 ± 3.3 years in Group B, with no statistical difference (p=0.333), suggesting that both groups represented a similar age profile, mentioned consistent with our findings by D.P.O Leary et al. and Khokhar et al.[10,11] BMI was in the normal or overweight range; the slightly higher obesity proportion in Group B was not statistically significant. Similar findings have been reported by Monawar Shah et al. and Tiwari D et al., who found no notable difference between the PS closing group and the conventional LC skin closing group in terms of demographics, as mentioned.[12,13] ASA was used to assess perioperative risk, which

showed a frequent distribution of patients in class II, with no significant variation. Pre-operative albumin levels, a well-recognized marker of nutritional status, were comparable between the two groups (3.8 ± 2.2 vs 4.1 ± 1.2 g/dl, p=0.333), consistent with previous findings by Sophia Bee Ting et al., who highlighted the predictive value of albumin in surgical outcomes. The distribution of comorbidities, including diabetes mellitus, hypertension, and malignancy, was balanced across groups, with no significant differences (p=0.677). However, there is a significant SSI in diabetic mellitus patient and immunocompromised which is consistent with Sophia Bee et al. and Monawar Shah et al.[12,14] PS closure consistently showed lower rates of SSI compared to LC, which is supported by multiple randomized controlled trials and observational studies like Assad Ameer et al. and Sathasivam Sureshkumar et al.[6,15] This reduction in SSI is likely attributable to the circular design of the PS technique, which facilitates better drainage of wound exudates and reduces tension across the incision line, thereby improving in wound healings.[2,5,6,15] The mechanism of the reduced SSI rate in the PS group is likely related to the unique wound architecture, which leaves central openings between sutures, thereby reducing fluid accumulation and bacterial proliferation, unlike the LC group. This drainage effect may promote improved wound healing and lower infection rates. the shorter hospital stay was observed in patients undergoing PS closure. However, the absolute difference was modest (0.4 days), suggesting faster recovery and fewer post-operative complications, findings similar to those reported by Filippo Carannante et al. and Emil Aga et al.[1,16] This study demonstrates that the purse-string technique requires longer operative time; this trade-off is justified by improved short-term outcomes, particularly the reduction in morbidity associated with wound infections. The present study also demonstrated a longer operative time in the PS group, but this was acceptable when weighed against the substantial reduction in post-operative wound complications. Previous studies have emphasized that SSI following stoma reversal is a major contributor to prolonged hospitalization and increased healthcare costs, making the PS approach a valuable alternative.[1,5,6,12,17,18] Several patient-related factors, including nutritional status, diabetes, smoking status, immunosuppression, and degree of wound contamination, have previously been identified as predictors of SSI. Taken together, these findings confirm that baseline demographic and clinical variables were well matched between the two study arms. This comparability strengthens the validity of subsequent analyses, as differences in operative outcomes can be more confidently attributed to the closure technique rather than underlying patient characteristics.

LIMITATIONS

This study has several limitations, including that it was conducted at a single tertiary care center and that blinding was not feasible due to obvious differences between the techniques. Additionally, several confounding variables, such as smoking status, immunosuppressive therapy, wound contamination grade, and detailed nutritional assessment, were not evaluated. Finally, the prolonged study duration may have introduced temporal variations in surgical practice and perioperative care. This study supports the growing body of evidence favoring PS closure as an effective strategy for reducing SSI following loop ileostomy reversal.

CONCLUSIONS

PS skin closure offers clear advantages in reducing SSI and shortening hospital stay, despite requiring longer operative time. The substantial reduction in wound-related complications supports the use of PS skin closure following ileostomy reversal.

CONFLICT OF INTEREST: None

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Naseeb Ali *- Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Final Approval*

Shahid Munir *- Concept & Design; Data Acquisition; Data Analysis/Interpretation; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

Gohar Ali *- Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Final Approval*

Muhammad Kashif Dawar *- Concept & Design; Data Acquisition; Drafting Manuscript; Supervision; Final Approval*

Muhammad Bilal *- Concept & Design; Data Acquisition; Drafting Manuscript; Critical Revision; Supervision; Final Approval*

Muhammad Shah *- Concept & Design; Data Acquisition; Drafting Manuscript; Supervision; Final Approval*

Muhammad Ayub *- Concept & Design; Data Acquisition; Drafting Manuscript; Supervision; Final Approval*

The authors accept responsibility for all aspects of the work and will ensure that any concerns regarding the accuracy or integrity of any part are properly investigated and resolved.