Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Distal Limb Closure Versus Non-Closure During Diverting Loop Ileostomy Following Laparoscopic Anterior Resection: A Prospective Non-Randomized Comparative Cohort Study

Fakhri Anaraki
Taleghani Hospital, Shahid Beheshti University of Medical Sciences
Ramin Haddadi
Taleghani Hospital, Shahid Beheshti University of Medical Sciences
Hamidreza Movahedi
Taleghani Hospital, Shahid Beheshti University of Medical Sciences
Saina Ghadiany
Taleghani Hospital, Shahid Beheshti University of Medical Sciences
Behrooz Mehraneh Rudi
Taleghani Hospital, Shahid Beheshti University of Medical Sciences
Adel Zeinalpour
adel.zeinalpour@gmail.com

Taleghani Hospital, Shahid Beheshti University of Medical Sciences

Research Article

Keywords: loop ileostomy, distal limb, anterior resection, rectal cancer, anastomotic leakage, bowel obstruction, LARS

Posted Date: July 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10335619/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

The clinical value of mechanically closing the distal limb of a diverting loop ileostomy after laparoscopic anterior resection remains uncertain. Closure may theoretically reduce retrograde passage toward the colorectal anastomosis but may also impair distal decompression and delay postoperative recovery.

Methods

This prospective non-randomized comparative cohort study included 160 adults undergoing elective laparoscopic anterior or low anterior resection with a diverting loop ileostomy at a tertiary colorectal center between 2021 and 2026. Seventy-seven patients underwent distal limb closure and 83 underwent non-closure. Distal limb management was selected by the operating colorectal surgeon according to routine clinical practice and intraoperative judgment; no random allocation was performed. Primary outcomes were anastomotic leakage and postoperative bowel obstruction. Secondary outcomes were anastomotic stricture, length of stay, time to return of bowel function, and Low Anterior Resection Syndrome (LARS) category. Categorical outcomes with small cell counts were compared using Fisher's exact test.

Results

Anastomotic leakage occurred in 1 of 77 patients (1.3%) in the closure group and 4 of 83 patients (4.8%) in the non-closure group (Fisher's exact p=0.369). Anastomotic stricture occurred in 2 of 77 patients (2.6%) and 3 of 83 patients (3.6%), respectively (p=1.000). Length of stay was longer in the closure group (7.9±1.1 vs 6.2±0.9 days; p<0.001), and return of bowel function was later (57.1±4.8 vs 44.8±5.0 hours; p<0.001). Bowel obstruction was numerically more frequent after closure (approximately 10% vs 5%), but the difference was not statistically significant (p=0.24). LARS severity distributions were comparable (p=0.695).

Conclusions

Distal limb closure was not associated with statistically significant reductions in anastomotic leakage, anastomotic stricture, bowel obstruction, or LARS severity. Non-closure was associated with shorter hospitalization and earlier return of bowel function. Because this was a single-center, non-randomized comparison, these findings require confirmation in adequately powered multicenter randomized trials.

Background

Laparoscopic anterior resection (LAR) and low anterior resection are established sphincter-preserving approaches for rectal cancer. A diverting loop ileostomy is frequently constructed for low pelvic anastomoses to reduce the clinical consequences of anastomotic leakage rather than to eliminate leakage itself [1, 2].

Diverting ileostomy is nevertheless associated with morbidity, including dehydration, electrolyte disturbance, bowel obstruction, skin complications, delayed recovery, and the need for a second operation [2, 3]. One unresolved technical issue is management of the distal or efferent limb. Although both limbs are conventionally left open, some surgeons mechanically close the distal limb to reduce retrograde passage of enteric contents toward the anastomosis [4].

Theoretical benefits of distal limb closure must be balanced against possible impairment of distal decompression, increased intraluminal pressure, stoma dysfunction, or bowel obstruction [5]. Published evidence on this technical modification remains limited and inconsistent. Its possible influence on postoperative bowel function after restoration of intestinal continuity is also uncertain.

This study compared distal limb closure with non-closure during diverting loop ileostomy following laparoscopic anterior resection. Outcomes included anastomotic leakage, bowel obstruction, anastomotic stricture, postoperative recovery, and LARS severity.

Methods

Study design and setting

This was a prospective, single-center comparative cohort study conducted at a tertiary colorectal surgery center. Patients were enrolled between 2021 and 2026 (Iranian calendar years 1400-1405).

Distal limb management was determined by the operating colorectal surgeon according to routine clinical practice, patient characteristics, and intraoperative judgment. Patients were therefore allocated to the closure or non-closure group non-randomly. No allocation sequence, allocation concealment, or blinding was used.

As the study was observational and treatment allocation was not assigned by the investigators according to a randomized protocol, prospective trial registration was not applicable.

Participants

Consecutive adults undergoing elective laparoscopic anterior resection or low anterior resection with construction of a diverting loop ileostomy for histologically confirmed rectal or sigmoid malignancy were assessed for eligibility. A total of 160 patients were included: 77 in the distal limb closure group and 83 in the non-closure group.

Inclusion criteria were age 18 years or older, elective laparoscopic anterior or low anterior resection, creation of a diverting loop ileostomy, histologically confirmed rectal or sigmoid malignancy, available postoperative follow-up, and written informed consent.

Exclusion criteria were emergency surgery, previous intestinal stoma, inflammatory bowel disease, multivisceral resection, open colorectal surgery, previous pelvic irradiation unrelated to the current

malignancy, incomplete follow-up, or refusal to participate.

Surgical technique

All procedures were performed laparoscopically by experienced colorectal surgeons using standardized oncological and anastomotic techniques. In the closure group, the distal limb of the loop ileostomy was mechanically occluded using stapling or suturing. In the non-closure group, the distal limb was left open.

Provide operative standardization details, including anastomotic height, stapler type, stoma site, closure material, perioperative ERAS pathway, and criteria for stoma reversal: **[AUTHOR TO COMPLETE].**

Outcomes and definitions

The primary outcomes were anastomotic leakage and postoperative bowel obstruction. Secondary outcomes were anastomotic stricture, length of hospital stay, time to return of bowel function, and postoperative bowel function assessed using the LARS score.

Anastomotic leakage should be defined according to the International Study Group of Rectal Cancer as a defect of the intestinal wall at the colorectal or coloanal anastomotic site leading to communication between the intra- and extraluminal compartments. The diagnostic window, diagnostic modalities, and leak grades included in the analysis must be specified.

Leak definition and follow-up window used in this study: **[AUTHOR TO COMPLETE].**

Anastomotic stricture was defined as a symptomatic fixed narrowing confirmed by digital examination or endoscopy, including inability to pass the colonoscope through the anastomosis. Transient stapler-line adherence or minor tissue adherence released by gentle digital dilatation was not classified as true stricture.

The validated five-item LARS score ranges from 0 to 42 and categorizes patients as no LARS (0-20), minor LARS (21-29), or major LARS (30-42) [7].

LARS was assessed 12 months after ileostomy reversal using the validated Persian-language version of the five-item LARS questionnaire. All 160 participants had undergone restoration of bowel continuity and completed the prespecified 12-month assessment. The questionnaire was administered by a trained member of the research team during scheduled follow-up visits.

Sample size

No formal a priori sample-size calculation was performed. All eligible consecutive patients treated during the study period were included; therefore, the analyses should be considered exploratory.

Statistical analysis

Analyses were performed using IBM SPSS Statistics version 26. Continuous variables were summarized as mean±standard deviation when approximately normally distributed; otherwise, median and interquartile range should be reported. Categorical variables were summarized as frequency and percentage. Between-group comparisons used Student's t test for approximately normally distributed continuous variables and the chi-square test or Fisher's exact test for categorical variables, as appropriate. Fisher's exact test was used for anastomotic leakage and stricture because of small expected cell counts. All tests were two-sided, and $p<0.05$ was considered statistically significant.

Analyses were performed using available complete data for each reported outcome. Continuous variables were assessed for distributional assumptions before group comparisons. No adjusted multivariable analysis was performed because patient-level covariate data were not available in the analytic dataset.

Ethics approval and consent to participate

The study protocol was approved by the Research Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran (approval number: IR.SBMU.RETECH.REC.1405.140). The study was conducted in accordance with the Declaration of Helsinki and applicable institutional regulations. Written informed consent was obtained from all participants before enrolment.

Results

Participant characteristics

A total of 160 patients were included: 77 in the closure group and 83 in the non-closure group. Baseline characteristics reported in the available dataset were similar between groups (Table 1).

Variable	Closure (n=77)	Non-closure (n=83)	p value
Age, years	59.8±5.1	58.9±5.6	0.31
Male sex	40 (52.0%)	46 (55.4%)	0.72
BMI, kg/m²	26.1±2.2	25.8±2.0	0.39
Diabetes mellitus	12 (15.6%)*	11 (13.3%)*	0.68
Smoking	15 (19.5%)*	15 (18.1%)*	0.75

Table 1. Baseline characteristics. *Counts were reconstructed from rounded percentages and must be verified against the source dataset before submission. Add clinically important variables such as ASA class, tumor level, neoadjuvant therapy, anastomotic height, operative time, and surgeon.

Postoperative outcomes

Anastomotic leakage occurred in 1 of 77 patients (1.3%) in the closure group and 4 of 83 patients (4.8%) in the non-closure group (Fisher's exact p=0.369). Anastomotic stricture occurred in 2 of 77 patients (2.6%) and 3 of 83 patients (3.6%), respectively (Fisher's exact p=1.000).

The closure group had a longer mean hospital stay and later return of bowel function. Bowel obstruction was numerically more frequent in the closure group, but the difference was not statistically significant (Table 2).

Outcome	Closure (n=77)	Non-closure (n=83)	p value
Anastomotic leakage	1 (1.3%)	4 (4.8%)	0.369
Anastomotic stricture	2 (2.6%)	3 (3.6%)	1.000
Length of stay, days	7.9±1.1	6.2±0.9	<0.001
Return of bowel function, hours	57.1±4.8	44.8±5.0	<0.001
Bowel obstruction	8 (10.4%)*	4 (4.8%)*	0.235*

Table 2. Postoperative outcomes. *Bowel-obstruction counts were inferred from the reported rounded percentages (10% and 5%), and the Fisher's exact p value was recalculated from the inferred counts. Verify the exact counts and p value against the source dataset before submission.

LARS outcomes

LARS severity distributions were comparable between groups (p=0.695). Major LARS was numerically more frequent in the closure group, but the difference was not statistically significant (Table 3).

LARS category	Score	Closure (n=77)	Non-closure (n=83)
No LARS	0-20	22 (28.6%)	27 (32.5%)
Minor LARS	21-29	31 (40.3%)	35 (42.2%)
Major LARS	30-42	24 (31.1%)	21 (25.3%)

Table 3. LARS classification at 12 months after ileostomy reversal. All 160 participants had restored bowel continuity and completed the 12-month assessment. Overall comparison p=0.695.

Discussion

This prospective comparative cohort study found no statistically significant reduction in anastomotic leakage, anastomotic stricture, bowel obstruction, or LARS severity with distal limb closure. In contrast, non-closure was associated with earlier return of bowel function and shorter hospitalization.

The numerical difference in leakage (1.3% vs 4.8%) should not be interpreted as evidence of protection because the event count was small and the comparison was not statistically significant. The primary purpose of a diverting ileostomy is generally to mitigate the clinical consequences of a leak rather than to prevent anastomotic failure [2,8]. Anastomotic perfusion, tension, operative technique, tissue quality, and contamination control are likely more important determinants of healing than distal limb management alone.

The observed delay in bowel recovery after closure may be biologically plausible if mechanical occlusion reduces distal decompression or increases resistance at the stoma. However, the bowel-obstruction difference was not statistically significant, and the lack of randomization leaves open the possibility that operative complexity, anastomotic height, tumor characteristics, surgeon preference, or postoperative care differed between groups.

LARS severity at 12 months after ileostomy reversal was similar between groups. All 160 participants had restored bowel continuity and completed the prespecified assessment. This finding suggests that distal limb management may have limited influence on long-term function after sphincter-preserving rectal surgery. Interpretation nevertheless depends on uniform assessment using a validated language version of the questionnaire.

Strengths include prospective data collection, a relatively large overall cohort, standardized laparoscopic surgery, complete restoration of bowel continuity, and complete functional follow-up at 12 months after ileostomy reversal. Limitations include the single-center design, non-randomized group allocation, small numbers of primary outcome events, incomplete reporting of potential confounders, and absence of an a priori sample-size calculation in the available manuscript. The study may therefore be underpowered to exclude clinically relevant differences in uncommon complications.

Future multicenter randomized trials should standardize the closure technique, perioperative pathways, leak definitions, reversal timing, and functional assessment. Reporting adjusted effect estimates with 95% confidence intervals would also improve clinical interpretability.

Conclusions

Routine distal limb closure during diverting loop ileostomy after laparoscopic anterior resection was not associated with statistically significant reductions in anastomotic leakage, stricture, bowel obstruction, or LARS severity. Non-closure was associated with shorter hospital stay and earlier return of bowel function. These results should be interpreted cautiously because of the non-randomized, single-center design and require confirmation in adequately powered multicenter trials.

Abbreviations

BMI
body mass index

ERAS
enhanced recovery after surgery
LAR
low anterior resection
LARS
Low Anterior Resection Syndrome
SPSS
Statistical Package for the Social Sciences.

Declarations

Ethics approval and consent to participate

The study protocol was approved by the Research Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran, Iran (approval number: IR.SBMU.RETECH.REC.1405.140). Written informed consent was obtained from all participants.

Consent for publication

Not applicable. The manuscript does not contain identifiable individual participant data.

Availability of data and materials

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request, subject to institutional and ethical restrictions concerning patient confidentiality.

Competing interests

The authors declare that they have no competing interests.

Funding

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Authors' contributions

[INSERT AUTHOR INITIALS AND CRediT-STYLE CONTRIBUTIONS. All authors must have read and approved the final manuscript.]

Acknowledgements

Not applicable.

Authors' information

Fakhri Anaraki and Adel Zeinalpour are fellowship-trained colorectal surgeons. Saina Ghadyani is a general practitioner. Ramin Haddadi, Hamidreza Movahedi, and Behrooz Mehraneh Rudi are affiliated with the Department of General Surgery, Taleghani Hospital, Shahid Beheshti University of Medical Sciences, Tehran, Iran.

Pre-submission author verification notes

- Replace every highlighted placeholder.
- Study dates verified as Iranian calendar years 1400-1405 (2021 to 2026).
- Verify raw counts reconstructed from percentages, particularly diabetes, smoking, and bowel obstruction.
- Add key baseline confounders and perform adjusted analyses if patient-level data are available.
- Check and complete all references against PubMed/Crossref; several references in the source file were bibliographically incomplete.

References

1. Pannu PR, BD. Laparoscopic low anterior resection with diverting loop ileostomy for rectal cancer with conversion to open approach. J Med Insight. 2023.
2. Gouvas N, Manatakis D, Agalianos C, Dimitriou N, Baloyiannis I, Tzovaras G, et al. Defunctioning ileostomy after low anterior resection of rectum: morbidity related to fashioning and closure. Medicina (Kaunas). 2024;60:1864.
3. Kostov G, DR, Doykov M. Diverting ileostomy in low anterior resection: single-center retrospective analysis. Pol Przegl Chir. 2022.
4. Rajaretnam N, Lieske B. Ileostomy. StatPearls. 2023.
5. Aljorfi AA, Alkhamis AH. A systematic review of early versus late closure of loop ileostomy. Surg Res Pract. 2020;2020:9876527.
6. Anestiadou E, Stamiris S, Ioannidis O, Symeonidis S, Bitsianis S, Bougioukas K, et al. Comparison of negative pressure wound therapy systems and conventional non-pressure dressings on surgical site infection rate after stoma reversal: systematic review and meta-analysis of randomized controlled trials. J Clin Med. 2025;14:1654.
7. Bhattacharyya S, Bhattacharya A, Das P, Choraria A. Low anterior resection syndrome: current understanding and management. Cureus. 2025;17:e83942.
8. Takeda K, Yamada T, Ohta R, Uehara K, Matsuda A, Shinji S, et al. Analysis of diverting ileostomy for colorectal cancer surgery: stenosis and T4 invasion are risk factors of reoperation due to anastomotic leakage, even when ileostomy is performed. Int J Colorectal Dis. 2026;41(1).
9. Cura Pales CG, An S, Cruz JP, Kim K, Kim Y. Postoperative bowel function after anal sphincter-preserving rectal cancer surgery: risk factors, diagnostic modalities, and management. Ann Coloproctol. 2019;35:160-166.

10. Bulut A, Attaallah W. Completely diverted tube ileostomy versus conventional loop ileostomy. Cureus. 2022;14:e30997.