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# Prospective Comparative Study of Interrupted Single-Layer versus Double-Layer Bowel Anastomosis

**Poojan B. Shah[1], Dinesh Prasad[2], Chintankumar Patel[3]**

[1, 2, 3]Department of General Surgery, Surat Municipal Institute of Medical Education and Research (SMIMER), Surat, Gujarat, India
Corresponding Author Email: *poojanshah1710[at]gmail.com*

**Abstract:** ***Background: Bowel anastomosis is essential for restoring gastrointestinal continuity, and optimal suturing technique remains debated. Purpose: This study compares interrupted single-layer and conventional double-layer bowel anastomosis regarding operative efficiency and postoperative outcomes. Methods: A prospective comparative study was conducted on 70 patients undergoing bowel anastomosis, randomized into single-layer (n=35) and double-layer (n=35) groups. Outcomes included operative time, anastomotic leak, return of bowel function, and hospital stay. Results: Operative time was significantly shorter in the single-layer group (18.0 ± 2.39 minutes) compared to the double-layer group (28.57 ± 2.28 minutes; p < 0.0001). Time to bowel function recovery and hospital stay were also significantly reduced. Leak rates were comparable (2.9% vs 4.3%; p > 0.05). Conclusion: Interrupted single-layer anastomosis provides equivalent safety with improved efficiency and faster recovery, supporting its use in routine and resource-limited settings.***

**Keywords:** anastomotic leak, bowel anastomosis, double-layer closure, gastrointestinal surgery, intestinal suturing techniques, operative time, postoperative outcomes, prospective study, randomized study, single-layer suturing, surgical outcomes

## 1. Introduction

Bowel anastomosis is a fundamental surgical procedure performed to restore gastrointestinal continuity following resection or repair of diseased or traumatized intestinal segments [1-3]. It is an essential component of both emergency and elective abdominal surgeries for conditions such as perforation peritonitis, trauma, malignancy, inflammatory bowel disease, and congenital anomalies.

Various techniques of intestinal anastomosis have been developed over time, with interrupted single-layer and conventional double-layer methods being the most commonly practiced [4,5]. Early clinical and experimental studies have evaluated the safety and effectiveness of these techniques in gastrointestinal surgery [6,7].

Several systematic reviews and meta-analyses have demonstrated that there is no significant difference in major postoperative outcomes between single-layer and double-layer anastomosis, particularly in terms of anastomotic leak rates [8,9].

The evolution of intestinal anastomosis techniques has been influenced by historical surgical advancements. Early descriptions and refinements of anastomotic techniques were documented in classical surgical literature [10]. Halsted emphasized the importance of the submucosal layer in maintaining anastomotic strength and healing [11]. With further advancements, the introduction of surgical stapling devices revolutionized gastrointestinal surgery by improving consistency and reducing operative time [12]. Additionally, studies comparing different suturing techniques, such as interrupted and continuous methods, have contributed to refining surgical practice [13].

Despite these advancements, anastomotic leak remains one of the most serious complications following bowel surgery, contributing significantly to morbidity, mortality, and healthcare costs [14-17]. Various factors such as patient comorbidities, surgical technique, and tissue perfusion influence anastomotic healing [18].

More recent clinical studies continue to compare single-layer and double-layer techniques, especially in resource-limited settings, to determine the most efficient and safe approach [19]. While prior meta-analyses have addressed this comparison on a global scale, the present study adds regional clinical context from a tertiary care center in western India, where the disease spectrum- including tuberculosis, trauma, and malignancy- presents unique operative challenges.

Therefore, the present prospective comparative study was undertaken to evaluate and compare operative duration, postoperative complications, and hospital stay between interrupted single-layer and conventional double-layer bowel anastomosis techniques in a tertiary care center.

## 2. Materials and Methods

This prospective randomized study was conducted in the Department of General Surgery at a tertiary care center over a period of 01/05/2024 to 30/04/2025. A total of 70 patients (N = 70) undergoing primary bowel repair or resection and anastomosis were included in the study. Patients were randomly allocated into two groups using a random

allocation method (computer-generated random number list). Allocation concealment was achieved using sealed opaque envelopes, and due to the nature of the surgical intervention, blinding was not applied to the operating surgeon; however, outcome assessors were blinded to group allocation where feasible.

A sample size of 35 per group was determined based on a prior study reporting a 10-minute difference in operative time between techniques (SD approximately 3 minutes), using an alpha level of 0.05 and a power of 80%, yielding a minimum of 30 patients per group; 35 were recruited per group to account for possible attrition.

The study included patients undergoing jejunal, ileal, or colonic resection and anastomosis, including cases of stoma closure and resections for both benign and malignant conditions. Patients requiring re-exploration, re-anastomosis, gastric or rectal anastomosis, stapled anastomosis, or those with duodenal ulcer perforation were excluded from the study.

All procedures were performed under general anesthesia following standard surgical protocols. In Group A, an interrupted single-layer sero-submucosal anastomosis was performed using PDS 3-0 RB sutures. In Group B, a conventional double-layer technique was used, consisting of an inner continuous full-thickness layer with Vicryl 3-0 RB and an outer interrupted seromuscular Lembert layer with Silk 3-0 RB sutures.

Postoperatively, patients were monitored for the return of bowel function, assessed by bowel sounds, passage of flatus, and stool; drain output (volume and character); pain and wound status; and any signs suggestive of anastomotic disruption. Follow-up assessments were conducted on postoperative days 1, 3, and 7, and subsequently at 1 month and 3 months.

The primary outcomes assessed were the anastomotic leak rate and duration of hospital stay. Secondary outcomes included operative time, postoperative ileus, wound infection, drain output characteristics, and need for re-exploration.

Data were analyzed using SPSS version 26.0 (IBM Corp., USA). Continuous variables were expressed as Mean ± Standard Deviation (Mean ± SD) and compared using the Independent t-test (t-value reported). Categorical variables were expressed as frequency and percentage (N, %) and compared using the Chi-square test ($\chi^2$ value) or Fisher's Exact test. A p-value < 0.05 was considered statistically significant.

## 3. Results

**Table 1:** Demographic and Baseline Clinical Characteristics

| Variable | Category | Group A (n=35) | Group B (n=35) | Total (n=70) | $\chi^2$ value | p-value |
|---|---|---|---|---|---|---|
| Age Group (years) | 18–20 | 1 (2.9%) | 1 (2.9%) | 2 (2.9%) | — | >0.05 |
| | 21–30 | 7 (20%) | 6 (17.1%) | 13 (18.6%) | — | >0.05 |
| | 31–40 | 11 (31.4%) | 9 (25.7%) | 20 (28.6%) | — | >0.05 |
| | 41–50 | 7 (20%) | 13 (37.1%) | 20 (28.6%) | — | >0.05 |
| | 51–60 | 9 (25.7%) | 6 (17.1%) | 15 (21.4%) | — | >0.05 |
| Gender | Male | 22 (62.9%) | 22 (62.9%) | 44 (62.9%) | 0 | >0.05 |
| | Female | 13 (37.1%) | 13 (37.1%) | 26 (37.1%) | — | >0.05 |
| Comorbidities | Present | 12 (34.3%) | 9 (25.7%) | 21 (30%) | — | >0.05 |
| | Absent | 23 (65.7%) | 26 (74.3%) | 49 (70%) | — | >0.05 |
| Addiction | Present | 12 (34.3%) | 9 (25.7%) | 21 (30%) | — | >0.05 |
| | Absent | 23 (65.7%) | 26 (74.3%) | 49 (70%) | — | >0.05 |

*Data presented as frequency and percentage (n,%). Chi-square test used. $p < 0.05$ = statistically significant.*

Table 1 demonstrates the majority of patients in both groups were between 31–50 years of age, and males constituted approximately two-thirds of each group. Comorbidities and addiction habits were similarly distributed between groups, with no statistically significant differences in age, gender, comorbidity burden, or addiction history ($p > 0.05$). This comparable baseline distribution minimizes confounding influences, allowing reliable attribution of postoperative outcomes to the anastomotic technique [3].

**Table 2:** Operative Duration

| Group | N | Mean (minutes) | Std. Deviation | t-value | p-value |
|---|---|---|---|---|---|
| Single Layer (A) | 35 | 18 | 2.39 | 18.93 | <0.0001 |
| Double Layer (B) | 35 | 28.57 | 2.28 | | |

*Data presented as Mean ± SD. Independent t-test used. $p < 0.05$ = statistically significant.*

Operative duration for the interrupted single-layer technique was significantly shorter compared to the conventional double-layer closure (18.0 ± 2.39 minutes vs. 28.57 ± 2.28 minutes; $t = 18.93$, $p < 0.0001$). This reduction highlights the technical simplicity and faster execution time of the single-layer method, resulting in shorter anaesthesia exposure and potentially improved intraoperative stability, especially in emergency or hemodynamically compromised patients.

**Table 3:** Return of Bowel Function

| Parameter | Group A Mean ± SD | Group B Mean ± SD | t -value | p-value |
|---|---|---|---|---|
| First flatus (days) | 2.8 ± 0.8 | 3.6 ± 1.1 | 3.48 | <0.05 |
| First oral intake (days) | 3.2 ± 1.1 | 4.1 ± 1.3 | 3.13 | <0.05 |

*Data presented as Mean ± SD. Independent t-test used. $p < 0.05$ = statistically significant.*

Return of bowel function was significantly faster in the single-layer group. The mean time to first flatus was lower in Group A compared to Group B (2.8 ± 0.8 vs. 3.6 ± 1.1 days; $t = 3.48$, $p < 0.05$). Similarly, the mean time to first oral intake was shorter in the single-layer group (3.2 ± 1.1 vs. 4.1 ± 1.3 days; $t = 3.13$, $p < 0.05$). These findings suggest that reduced tissue handling and minimized bowel wall ischemia with the single-layer technique facilitate earlier restoration of gastrointestinal motility [6,7,8].

Anastomotic leak rates were low and comparable between the two groups, with 2 patients (2.9%) developing leaks in the single-layer group and 3 patients (4.3%) in the double-layer group. The difference was statistically insignificant ($p = 0.651$), indicating that the simpler, faster single-layer technique does not compromise anastomotic integrity. These results align with current evidence suggesting that both techniques are equally effective in maintaining bowel continuity and preventing postoperative leakage [5,8,9].

Patients with comorbidities experienced a higher rate of anastomotic leakage (3 out of 21; 14.3%) compared to those without comorbidities (2 out of 49; 4.1%). Although this trend suggests that systemic illnesses such as diabetes, hypertension, and chronic addictions may impair tissue healing and negatively impact anastomotic integrity, the association did not reach statistical significance ($p = 0.155$) [14,15,16].

A consistent reduction in postoperative drain output was observed in the single-layer group throughout the recovery period, indicating reduced serosal trauma and inflammatory exudation associated with the interrupted single-layer technique. This earlier resolution of intra-abdominal fluid collection reflects more favorable healing dynamics, supporting quicker recovery and potentially earlier drain removal.

**Table 4:** Hospital Stay Duration

| Group | N | Mean (days) | Std. Deviation | t-value | p-value |
|---|---|---|---|---|---|
| Single Layer (A) | 35 | 8.8 | 3.03 | 3.51 | <0.001 |
| Double Layer (B) | 35 | 11.71 | 3.85 | | |

*Data presented as Mean ± SD. Independent t-test used. $p < 0.05$ = statistically significant.*

The duration of hospital stay was significantly reduced in the single-layer group compared to the double-layer group (8.8 ± 3.03 vs. 11.71 ± 3.85 days; $t = 3.51$, $p < 0.001$). This reduction reflects faster recovery of bowel function, lower postoperative morbidity, and improved healing with the interrupted single-layer technique. Shorter hospital stay benefits patient comfort, early return to routine activity, and reduces overall healthcare resource utilization [17,18].

**Table 5:** Final Post-operative Outcomes

| Outcome | Group A (n=35) | Group B (n=35) | $\chi^2$ value | p-value |
|---|---|---|---|---|
| Asymptomatic | 33 (94.3%) | 32 (91.4%) | 0.22 | 0.645 |
| Re-exploration required | 2 (5.7%) | 3 (8.6%) | | |
| Mortality | 0 | 0 | | |

*Data presented as frequency and percentage (n,%). Chi-square/Fisher's Exact test used. $p < 0.05$ = statistically significant.*

Postoperative outcomes were comparable between the two groups. The proportion of asymptomatic patients was similar in both groups (94.3% vs. 91.4%), and the difference was not statistically significant ($\chi^2 = 0.22$, $p = 0.645$). There were no mortalities reported in either group. These findings confirm that both single-layer and double-layer anastomosis techniques are safe and effective, with comparable overall clinical success and low rates of postoperative complications requiring surgical intervention.

## 4. Discussion

The present study compared interrupted single-layer versus conventional double-layer bowel anastomosis, while ensuring demographic comparability between groups to eliminate confounding influences. The mean age was nearly identical between the two groups (40.17 vs. 40.46 years), closely matching observations from Kumar et al. [2] (38.7 vs. 34.4 years), Rommel Singh et al. [1] (38.6 vs. 34.6 years), and Nitin Nangare et al. (41.4 vs. 41.3 years). These similarities indicate that bowel anastomosis is predominantly required in the middle-aged population, reflecting the higher incidence of trauma, inflammatory bowel diseases, tuberculosis, and malignancies during this phase of life.

Gender distribution was identical in both arms (62.9% males and 37.1% females), consistent with male predominance reported across comparative studies [1,2,19]. Disease etiology varied: terminal ileal tuberculosis was most common in Group A (18.57%), whereas colon carcinoma predominated in Group B (15.71%). Variations across studies are observed in the literature, likely reflecting regional differences in disease burden.

Operative duration findings strongly favored the single-layer technique, with mean completion time of 18.0 ± 2.39 minutes compared to 28.57 ± 2.28 minutes in the double-layer arm ($p < 0.0001$). This is consistent across all comparative studies-Kumar et al. [2] (19.54 vs. 28.12 min), Rommel Singh et al. [3] (19.57 vs. 30 min), and Nangare et al. [19] (19.04 vs. 28.8 min). The reduced time relates to fewer sutures, less tissue manipulation, and a simpler technique, offering clinical advantage particularly in compromised patients where prolonged anesthesia increases risk.

Leak rate is the most critical surgical outcome. In this study, leakage rates were low and statistically non-significant (2.9% vs. 4.3%; p = NS), consistent with previous reports: Kumar et al. [2] (0% vs. 3.8%), Khan et al. [5] (6% vs. 12%), and Nangare et al. [19] (2% vs. 4%). These findings challenge the previously held assumption that double-layer closure provides superior anastomotic security. Excess suture bulk and ischemia from double-layer techniques may actually predispose to complications [6,7,8].

Postoperative outcomes, including faster return of bowel movements and reduced drain output, suggest reduced tissue handling and lower serosal inflammation in single-layer closures. Shorter hospital stay in Group A (8.8 vs. 11.71 days; $p < 0.001$) mirrors trends reported by Kumar et al. [2] and Nangare et al. [19]. Final postoperative recovery was excellent in both groups — 94.29% vs. 91.43% asymptomatic with low re-exploration rates and no mortality, confirming equivalent safety and efficacy of both methods.

## 5. Conclusions

This prospective comparative study demonstrates that interrupted single-layer bowel anastomosis is comparable in safety to the conventional double-layer technique, with significantly reduced operative time and shorter hospital stay. These findings suggest that the single-layer approach is an efficient alternative in appropriate clinical settings. Further large-scale studies are recommended to validate these results across diverse patient populations.

### Additional Information

**Author Contributions**

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.
Concept and design: Poojan B. Shah, Dinesh Prasad, Chintankumar Patel
Acquisition, analysis, or interpretation of data: Poojan B. Shah
Drafting of the manuscript: Poojan B. Shah
Critical review of the manuscript for important intellectual content: Dinesh Prasad, Chintankumar Patel
Supervision: Dinesh Prasad, Chintankumar Patel

**Disclosures**

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Surat Municipal Institute of Medical Education and Research Institutional Ethics Committee issued approval IEC/SMIMER/IN/NO-02.

Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue.

Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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