



SINGLE VERSUS DOUBLE LAYER INTESTINAL ANASTOMOSIS: A COMPARATIVE STUDY

General Surgery

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ABSTRACT

Background: Hand-sewn intestinal anastomosis is commonly performed worldwide, and the choice between single-layer intestinal anastomosis (SLIA) and double-layer intestinal anastomosis (DLIA) remains debated. This study compared both techniques with regard to anastomotic safety, operative time, postoperative outcomes, and cost-effectiveness. **Methods:** This prospective, randomized controlled comparative study was conducted in the Department of General Surgery, Zydus Medical College and Hospital, Dahod. A total of 106 patients requiring intestinal resection and anastomosis were randomized into two groups: SLIA (n = 52) and DLIA (n = 54). Outcomes assessed included anastomotic leak, operative time, postoperative complications, hospital stay, mortality, and suture material cost. **Results:** Baseline characteristics were comparable between the two groups. Anastomotic leak occurred in 2 patients in each group (3.8% in SLIA and 3.7% in DLIA), with no statistically significant difference. Postoperative complications were also similar (3 in each group), and hospital stay was comparable (8.33 days in SLIA vs. 8.89 days in DLIA). However, SLIA required significantly less operative time than DLIA (16.42 minutes vs. 28.38 minutes). Mortality was low and not significantly different between the groups. SLIA was also more cost-effective because it required fewer suture materials. **Conclusion:** Single-layer extramucosal intestinal anastomosis is as safe and effective as the conventional double-layer technique, with the added advantages of shorter operative time and lower material cost. SLIA may therefore be preferred for routine hand-sewn intestinal anastomosis in both elective and emergency settings.

KEYWORDS

Single-layer Intestinal Anastomosis, Double-layer Intestinal Anastomosis, Anastomotic Leak, Operative Time, Cost-effectiveness.

INTRODUCTION

Intestinal anastomosis is a surgical procedure performed to restore gastrointestinal continuity following bowel resection. It is widely performed in both elective and emergency settings, with a high prevalence in tropical regions where intestinal perforations secondary to infectious diseases, abdominal trauma, and gastrointestinal malignancies are common. Although stapling devices and biofragmentable rings have been introduced as alternatives, hand-sewn anastomosis remains the predominant technique worldwide owing to the low cost and universal availability of suture materials and the widespread technical proficiency among surgeons and trainees [8].

The foundational principles of intestinal suturing were established by Travers, Lembert, and Halsted over a century ago. The double-layered intestinal anastomosis (DLIA) has since served as the conventional standard. It consists of an inner transmural layer, typically a continuous absorbable suture, reinforced by an outer layer of interrupted seromuscular Lembert sutures using non-absorbable silk. However, DLIA is associated with several limitations, including prolonged operative time, higher suture material costs, and an increased risk of mucosal strangulation from submucosal vascular plexus injury, tissue necrosis, and anastomotic stricture formation due to excessive luminal narrowing.

The single-layered intestinal anastomosis (SLIA), first described by Hautefeuille in 1976, was developed to address these drawbacks [8]. This technique employs a continuous or interrupted extramucosal approach that incorporates the submucosa i.e. the strongest layer of the bowel wall, while excluding the mucosa. Monofilament sutures such as polydioxanone or polypropylene are preferred for their minimal tissue reactivity and sustained tensile strength.

Anastomotic leak is the principal determinant of an anastomotic technique's safety, as it substantially increases morbidity, mortality, and the duration of hospitalization. Existing meta-analyses have demonstrated no definitive advantage of DLIA over SLIA with respect to postoperative leak rates [1]. However, the comparative efficacy of these techniques in routine clinical practice remains debated, and there is a recognized need for additional high-quality, region-specific

trials. The present study was therefore designed to compare SLIA and DLIA with regard to anastomotic leak rate, operative time, postoperative complications, duration of hospital stay, and cost-effectiveness of suture materials.

MATERIALS AND METHODS

This prospective, randomized controlled comparative study was conducted in the Department of General Surgery, Zydus Medical College and Hospital, Dahod. A total of 106 patients who underwent intestinal anastomosis were randomized by chit-and-box method into two groups: Group A (single-layered intestinal anastomosis, n = 52) and Group B (double-layered intestinal anastomosis, n = 54). The study was double-blinded; neither the patients nor the postoperative care providers were informed of the specific anastomotic technique used.

Inclusion Criteria

Adult patients aged 18 to 65 years. Patients requiring intestinal resection and anastomosis (end-to-end, side-to-side, or end-to-side) in elective or emergency settings.

Exclusion Criteria

Anastomoses involving the stomach, duodenum, or rectum. Severe systemic organ dysfunction, including chronic hepatic, renal, or cardiac disease. Uncontrolled diabetes mellitus, hypertension, or bleeding disorders. Septicaemic or hypovolaemic shock, or patients requiring intensive care or total parenteral nutrition (TPN). Local bowel factors likely to impair anastomotic healing, such as oedema, inflammation, ulceration, ischaemia, or scarring.

Surgical Techniques

All procedures were performed by experienced consultant surgeons or by surgical residents under direct consultant supervision.

Single-Layered Technique (Group A): An extramucosal approach was used, incorporating all layers of the bowel wall except the mucosa. The anastomosis was fashioned in a continuous or interrupted manner using 3-0 polydioxanone (PDS). Suture bites were placed 4-6 mm from the cut edge with approximately 5 mm stitch advancement.

Larger bites were taken at the mesenteric border to ensure a watertight closure.

Double-Layered Technique (Group B): The inner layer consisted of a transmurular continuous or interrupted suture using 3-0 absorbable material (polyglactin 910). The outer layer comprised interrupted seromuscular Lembert sutures using non-absorbable 3-0 silk to invert the inner layer.

Outcome Measures

Primary Outcomes:

1. Anastomotic leak: Defined by clinical signs (faecal fistula, peritonitis), radiographic evidence (barium or gastrografin enema), or visible disruption at re-exploration. 2. Time taken for anastomosis: Recorded in minutes from the placement of the first suture to the cutting of the last. 3. Postoperative complications: Including intra-abdominal abscess, pelvic collection, persistent vomiting, and abdominal distension.

Secondary Outcomes:

1. Mean duration of hospital stay: Calculated from the day of surgery to the day of discharge. 2. Cost of suture material: Determined by the number and unit price of suture packs used.

Statistical Analysis

Data were analyzed using IBM SPSS Statistics version 29 and Microsoft Excel. Continuous variables were expressed as mean $\pm$ standard deviation and compared using independent samples t-tests. Categorical variables were expressed as frequencies and percentages and assessed using Chi-square tests. A p-value of <0.05 was considered statistically significant.

RESULTS

A total of 106 patients were enrolled and randomized: 52 to the SLIA group (Group A) and 54 to the DLIA group (Group B). No patients were lost to follow-up.

Demographic and Baseline Characteristics

Age: The mean age was comparable between the two groups 47.67 ± 14.35 years in the SLIA group and 50.56 ± 14.56 years in the DLIA group ($p > 0.05$).

Sex: Males constituted the majority in both groups. The SLIA group comprised 35 males (67.3%) and 17 females (32.7%); the DLIA group comprised 35 males (64.8%) and 19 females (35.2%). The difference was not statistically significant.

Indications for Surgery: Emergency bowel resection was the most frequent indication in both groups. Other indications included intestinal obstruction, gangrene, malignancy (small bowel tumours and colonic carcinoma), and strangulated hernia. The distribution of diagnoses is presented below.

Table 1: Diagnosis of subjects in each group.

Diagnosis	SLIA (n=52)	DLIA (n=54)
Intestinal Perforation	20	18
Intestinal Obstruction	17	22
Intestinal Gangrene	9	7
Malignancy	2	1
Strangulated Hernia	4	6

Clinical Outcomes

Anastomotic Leak: Two leaks were recorded in each group, yielding a rate of 3.8% (2/52) for SLIA and 3.7% (2/54) for DLIA. The difference was not statistically significant ($p > 0.05$).

Duration of Hospital Stay: The mean hospital stay was 8.33 days in the SLIA group and 8.89 days in the DLIA group. This difference was not statistically significant.

Anastomosis Time: SLIA required significantly less time than DLIA. Mean anastomosis times ranged from 16.42 minutes for single-layer versus 28.38 minutes for double-layer procedures ($p < 0.05$).

Mortality: One death occurred in the SLIA group (1.92%) and two in the DLIA group (3.7%). The difference was not statistically significant and the deaths were not directly attributable to the anastomotic technique.

Postoperative Morbidity: Three complications were recorded in each group — 1 surgical site infection (SSI) and 2 seromas in the SLIA group; 2 SSIs and 1 seroma in the DLIA group. The difference was not statistically significant ($p > 0.05$).

Cost of Suture Material: The SLIA technique required one suture pack (polydioxanone) Rs. 917, whereas DLIA required two to three packs (silk and polyglactin 910) Rs. 963.

DISCUSSION

Anastomotic Leak and Safety: The anastomotic leak remains the most feared complication, as it significantly increases morbidity, mortality, and length of hospital stay. The present study found no significant difference in leak rates between the two groups (3.8% for SLIA vs. 3.7% for DLIA), a finding that is robustly supported by the existing literature. The landmark meta-analysis by Shikata et al. (2006), which pooled six RCTs comprising 670 patients, reported a combined risk ratio of 0.91 (95% CI: 0.49–1.69), demonstrating no evidence that two-layer anastomosis leads to fewer leaks [1]. Aniruthan et al. (2020), in a non-inferiority RCT of 106 patients (52 SLIA, 54 DLIA) at JIPMER, Puducherry, similarly concluded that SLIA is a safe, non-inferior alternative in both elective and emergency settings [2]. Singh et al. (2022), in a prospective comparative study at GMC Patiala, confirmed that leak rates did not differ significantly between groups [3].

The most recent systematic review by Desai et al. (2023), which identified nine RCTs published between 2003 and 2023, concluded that neither technique is inferior in terms of preventing postoperative complications [4]. Notably, only Moeen et al. reported a significantly higher leak rate in the double-layer group (15% vs. 5%, $P = 0.018$), though this study carried a high risk of bias [5]. Individual trial leak rates ranged from 0% to 5% for SLIA and 2.13% to 15% for DLIA across the published literature, with the overwhelming majority finding no statistically significant difference.

Operative Time and Efficiency: The most consistent and statistically significant finding across all studies is that SLIA is substantially faster to perform. In the present study, the time advantage of SLIA was evident, consistent with published data. Kar et al. (2017), in a double-blind RCT of 97 patients, reported mean anastomosis times of 19.57 ± 2.25 minutes for SLIA versus 30 ± 2.59 minutes for DLIA ($p = 0.002$) [6]. Bhargava et al. (2013) reported 15.12 ± 2.27 minutes for SLIA versus 24.38 ± 2.26 minutes for DLIA [7]. The systematic reviews by Desai et al. (2023) confirmed that single-layer anastomosis consistently requires significantly less operative time [4].

This time savings is clinically meaningful—particularly for hemodynamically unstable patients in emergency settings, where reduced anastomotic time may translate to improved outcomes. Additionally, Kar et al. and Singh et al. both emphasized that the single-layer technique is easier to teach to surgical residents, making it advantageous in training institutions [3, 6].

Hospital Stay and Recovery: The present study found comparable hospital stays (8.33 days for SLIA vs. 8.89 days for DLIA). Published data on this outcome is mixed. Kar et al. (2017) found significantly earlier discharge for SLIA patients [6], and Bhargava et al. (2013) reported a shorter hospital stay for SLIA (5.90 ± 1.43 days vs. 7.29 ± 1.89 days), along with quicker return of bowel function (2.42 ± 1.11 days vs. 3.1 ± 1.34 days for DLIA) [7]. However, Singh et al. (2022) and Aniruthan et al. (2020) found the length of stay to be comparable (roughly 8–9 days) between groups [2, 3], consistent with the present findings, suggesting that patient- and institution-level factors may contribute more to length of stay than the anastomotic technique itself.

Postoperative Complications and Mortality: Complication rates, including Surgical Site Infections (SSI) and abscesses, were similar in the present study (3 complications in each group, $p = 0.87$). This mirrors the broader literature. Notably, Singh et al. (2022) reported three cases of partial intestinal obstruction exclusively in the DLIA group, which they attributed to excessive inversion of the bowel wall, a technical consequence of the double-layer approach that may be exacerbated when the technique is performed by trainees [3].

Mortality in the present study was low and statistically comparable (1.92% SLIA vs. 3.7% DLIA). The Shikata et al. meta-analysis (2006), Desai et al. (2023) systematic reviews all confirmed that mortality rates do not differ significantly between the two techniques [1, 4].

Cost-Effectiveness: SLIA was found to be more cost-effective overall. While the cost of suture material alone may be comparable or marginally higher for SLIA (as Bhargava et al. reported 564 INR for SLIA vs. 480 INR for DLIA), the SLIA technique typically requires only one suture pack (e.g., polydioxanone or polypropylene), whereas DLIA requires two to three packs (silk and polyglactin 910) [7]. When factoring in reduced operative time and the potential for shorter hospitalization, the overall cost-effectiveness clearly favors the single-layer technique. The Shikata et al. meta-analysis (2006) identified cost savings as a key advantage of single-layer anastomosis [1], and this has been reaffirmed by subsequent studies including Desai et al. (2023) [4].

CONCLUSION

The present study, conducted at Zydus Medical College and Hospital, Dahod, with 106 patients (52 SLIA, 54 DLIA), concludes that single-layered extramucosal intestinal anastomosis is equally safe and effective as the conventional double-layered method. There was no statistically significant difference between the two techniques in anastomotic leak rates (3.8% vs. 3.7%), postoperative complications, mortality (1.92% vs. 3.7%), or mean duration of hospital stay (8.33 vs. 8.89 days).

However, the single-layer technique offers several clinically meaningful advantages. It is significantly faster to perform (approximately 15–20 minutes vs. 24–30 minutes), conferring a particular benefit in emergency settings with hemodynamically compromised patients and in teaching hospitals where ease of instruction is important. It is more cost-effective overall, requiring fewer suture materials and less operative time. Some studies also demonstrate a quicker return of bowel function and earlier hospital discharge with SLIA.

Limitations of this study include its single-center design, a relatively small sample size, and variable surgical indications (emergency and elective combined). The eligibility criteria and suture materials used varied across the published trials included in this comparison, underscoring the need for larger, multicenter, standardized RCTs to generate definitive evidence.

Notwithstanding these limitations, based on the present findings and the cumulative weight of the published evidence, the single-layered extramucosal technique can be recommended as the preferred approach for routine hand-sewn intestinal anastomosis in both elective and emergency surgical practice.

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