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Original Research Article

A Comparative Study of Stapled versus Hand-Sewn Bowel Anastomosis in Patients Undergoing Bowel Surgery: Safety, Operative Efficiency, Hospital Stay, and Cost Analysis

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ABSTRACT

Background: Bowel anastomosis is a fundamental component of gastrointestinal surgery, and the choice between stapled and hand-sewn techniques may significantly influence surgical outcomes. This study compared the two techniques with respect to anastomotic safety, operative efficiency, postoperative recovery, hospital stay, and overall treatment cost.

Methods: A single-centre, hospital-based observational comparative study was conducted over 18 months at JSS Medical College, Mysuru, involving 40 adult patients undergoing bowel resection and anastomosis. Patients were allocated into stapled (n=20) and hand-sewn (n=20) groups. Baseline demographic and clinical characteristics, operative details, anastomotic leak, anastomosis duration, postoperative bowel recovery, hospital stay, treatment cost, and 30-day postoperative outcomes were evaluated and compared.

Results: Both groups were comparable regarding baseline characteristics, including age (47.6 ± 13.4 vs 49.8 ± 12.9 years), sex distribution (65.0% vs 60.0% males), symptom duration, comorbidities, and laboratory parameters. Acute abdomen was the indication for surgery in 75.0% of patients in both groups, while revision ileostomy-related pathology accounted for 25.0%. Small bowel pathology predominated, with segmental small bowel resection performed in 50.0% and 55.0% of stapled and hand-sewn cases, respectively. Side-to-side anastomosis was significantly more common in the stapled group (65.0% vs. 25.0%, p=0.025). Stapled anastomosis demonstrated significantly shorter anastomosis duration (24.6 ± 5.8 vs. 35.9 ± 8.7 minutes, p<0.001), earlier return of bowel sounds by postoperative day 3 (85.0% vs. 50.0%, p=0.041), lower anastomotic leak rate (0.0% vs. 25.0%, p=0.042), and shorter hospital stay (7.1 ± 2.1 vs. 10.4 ± 4.2 days, p=0.004). However, overall treatment cost was significantly higher with stapled anastomosis (₹85,240 vs. ₹68,430, p=0.001). No 30-day mortality was observed.

Conclusion: Stapled bowel anastomosis was associated with superior short-term clinical outcomes, including reduced anastomotic leak, shorter operative time, faster postoperative recovery, and shorter hospital stay compared with hand-sewn anastomosis, although it incurred higher treatment costs.

Keywords: Stapled Anastomosis, Hand-Sewn Anastomosis, Anastomotic Leak, Bowel Surgery, Operative Time, Hospital Stay, Treatment Cost.

INTRODUCTION

Intestinal anastomosis is a fundamental reconstructive procedure in gastrointestinal surgery performed to restore bowel continuity following resection of diseased, injured, or non-viable intestine. It can be constructed using either hand-sewn suturing or mechanical stapling, both of which are widely employed in elective and emergency bowel surgeries.[1] The choice of technique depends on factors such as the site of anastomosis, bowel calibre, tissue quality, degree of contamination, operative access, urgency of surgery, and surgeon experience.[2]

The primary objective of any bowel anastomosis is to achieve a tension-free, well-vascularized, watertight, and accurately apposed intestinal continuity while minimizing postoperative complications. Hand-sewn extramucosal anastomosis is traditionally favored for reducing tissue necrosis and luminal narrowing, whereas stapled anastomosis offers advantages of technical ease, reproducibility, reduced bowel handling, and shorter operative time, particularly in anatomically confined spaces. However, stapling is associated with increased procedural cost and its superiority in clinical outcomes remains uncertain.[3-5]

Anastomotic leak is the most serious complication following bowel anastomosis because of its association with sepsis, reoperation, prolonged hospitalization, stoma formation, and increased mortality. It is defined by the International Study Group of Rectal Cancer as a defect at the anastomotic site causing communication between the intra- and extraluminal compartments.[6] Although leak rates vary according to the type and location of anastomosis, they remain a major determinant of postoperative morbidity, mortality, hospital stay, and healthcare expenditure.[7,8] Multiple patient- and surgery-related factors-including malnutrition, hypoalbuminemia, sepsis, anaemia, diabetes, steroid use, smoking, obesity, prior irradiation, and poor tissue perfusion-can adversely affect anastomotic healing despite adherence to sound surgical principles.[9]

Previous studies comparing stapled and hand-sewn anastomoses have reported conflicting results. While some have demonstrated lower leak rates or shorter operative duration with stapling,[10] others have found comparable outcomes regarding anastomotic leak, postoperative morbidity, and mortality.[11] These inconsistent findings indicate that the optimal technique remains context-dependent.

Aims and Objectives

The study aimed to compare stapled and hand-sewn bowel anastomosis in patients undergoing bowel surgery with respect to safety, operative efficiency, duration of hospital stay, and overall cost. The primary objective was to compare the safety of the two techniques by evaluating the incidence of anastomotic leak. The secondary objectives were to compare the intraoperative duration of anastomosis, length of hospital stay, and the overall cost associated with stapled and hand-sewn bowel anastomosis.

MATERIALS AND METHODS

Study Design

This was a single-centre, hospital-based, observational comparative study conducted in the Departments of General Surgery and Surgical Gastroenterology at Jagadguru Sri Shivarathreeshwara (JSS) Medical College and Hospital, Mysuru, Karnataka, India. The study was carried out over a period of 18 months, from May 2024 to December 2025. It included patients presenting with features of acute abdomen who underwent bowel resection and anastomosis during the study period.

Inclusion and Exclusion Criteria

The study included patients aged ≥18 years presenting with features of acute abdomen and those requiring revision ileostomy necessitating bowel resection and anastomosis, who provided written informed consent to participate. Patients with hypoalbuminemia, inflammatory bowel disease, or a pre-existing jejunostomy tube in situ, as well as those unwilling to provide written informed consent, were excluded from the study.

Sample Size Calculation

The sample size for the present single-centre observational comparative study was calculated for comparison between two groups, namely stapled and hand-sewn bowel anastomosis, using a standard formula for comparison of two independent means:

$$n = \frac{(Z_\alpha + Z_\beta)^2 \times \sigma^2}{d^2}$$

Where n is the required sample size in each group, Z_α is the standard normal deviate corresponding to the type I error, Z_β is the standard normal deviate corresponding to the

desired power, σ is the assumed standard deviation of the outcome variable, and d is the minimum clinically meaningful difference to be detected between the two groups.

Bangaru et al. evaluated operative and postoperative outcomes in stapled versus hand-sewn gastrointestinal anastomosis.[12] For the present study, the assumptions used were: two-sided alpha error of 5% (Z_α=1.96), power of 80% (Z_β=0.84), expected standard deviation σ=1.43, and a clinically worthwhile difference d=0.9. Substituting these values,

$$n = \frac{(1.96 + 0.84)^2 \times (1.43)^2}{(0.9)^2} = 19.8$$

Which was rounded to 20 participants per group. Thus, the total sample size was 40 participants, with 20 patients in the stapled anastomosis group and 20 patients in the hand-sewn anastomosis group.

Data Collection Procedure

Patients admitted to the departments of general surgery and surgical gastroenterology with features of acute abdomen or requiring revision ileostomy with bowel resection and anastomosis were screened according to the predefined inclusion and exclusion criteria. After obtaining written informed consent, eligible patients were enrolled using a non-probability convenience (purposive) sampling technique and were managed with either stapled or hand-sewn anastomosis based on the operating surgeon's intraoperative judgment, technical feasibility, and patient affordability. Baseline demographic, clinical, laboratory, and operative details were recorded using a predesigned case record form. Intraoperative data included the indication for surgery, type and site of bowel resection, anastomotic technique, and duration of anastomosis. Patients were monitored throughout their hospital stay for postoperative recovery and complications, particularly anastomotic leak, while the duration of hospital stay and total in-hospital treatment cost were documented from hospital records. All patients were followed for up to 30 postoperative days through outpatient visits or telephone follow-up to identify any delayed complications, readmissions, or re-interventions.

Statistical Analysis

Data were entered into Microsoft Excel and analysed using IBM SPSS Statistics for Windows, Version 27.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequencies and percentages. Normality was assessed using the Shapiro–Wilk test. Comparisons between the stapled and hand-sewn groups were performed using the independent-samples *t*-test or Mann–Whitney *U* test for continuous variables, and the chi-square test or Fisher's exact test for categorical variables, as appropriate. The primary outcome was the incidence of anastomotic leak, while intraoperative anastomosis duration, length of hospital stay, and overall treatment cost were evaluated as secondary outcomes. A *p* value of <0.05 was considered statistically significant.

RESULTS

Variable	Stapled (n=20)	Hand-Sewn (n=20)	p Value
Age (years)	47.6 ± 13.4	49.8 ± 12.9	0.600
Male sex	13 (65.0)	12 (60.0)	1.000
Duration of symptoms (hours)	31.4 ± 14.8	34.6 ± 16.1	0.517
Diabetes mellitus	4 (20.0)	5 (25.0)	1.000
Hypertension	5 (25.0)	6 (30.0)	1.000
Smoking history	4 (20.0)	5 (25.0)	1.000
Previous abdominal surgery	6 (30.0)	5 (25.0)	1.000
Hemoglobin (g/dL)	11.6 ± 1.5	11.2 ± 1.7	0.435
Total leukocyte count (×10³/μL)	12.9 ± 4.1	13.7 ± 4.6	0.565
Serum creatinine (mg/dL)	1.00 ± 0.26	1.07 ± 0.30	0.435
Serum albumin (g/dL)	3.84 ± 0.28	3.74 ± 0.24	0.233

Table 1. Baseline Demographic, Clinical Characteristics and Laboratory Profile

Table 1 illustrates the baseline demographic characteristics, comorbidities, and laboratory parameters of the two study groups. No statistically significant differences were observed, indicating that both groups were comparable before surgery.

Variable	Stapled	Hand-Sewn	p Value
Abdominal pain	20 (100)	20 (100)	NA
Vomiting	13 (65)	14 (70)	1.000
Abdominal distension	10 (50)	12 (60)	0.751
Obstipation	9 (45)	11 (55)	0.752
Fever	5 (25)	6 (30)	1.000
Clinical peritonitis	7 (35)	8 (40)	1.000
Perforation peritonitis	5 (25)	6 (30)	1.000
Intestinal obstruction	10 (50)	9 (45)	1.000
Revision ileostomy pathology	5 (25)	5 (25)	1.000
Acute abdomen	15 (75)	15 (75)	1.000

Table 2. Clinical Presentation, Diagnosis and Indication for Surgery

Table 2 demonstrates that presenting symptoms, underlying diagnoses, and indications for bowel resection were similarly distributed between stapled and hand-sewn groups without statistically significant differences.

Variable	Stapled	Hand-Sewn	p Value
Segmental small bowel resection	10 (50)	11 (55)	1.000
Right hemicolectomy	5 (25)	4 (20)	1.000
Left colectomy/Sigmoidectomy	4 (20)	4 (20)	1.000
Low colorectal resection	1 (5)	1 (5)	1.000
End-to-end	5 (25)	10 (50)	0.191
Side-to-side	13 (65)	5 (25)	0.025*
End-to-side	2 (10)	5 (25)	0.407
Anastomosis duration (minutes)	24.6 ±5.8	35.9 ±8.7	<0.001*

Table 3. Operative Characteristics and Anastomotic Technique

Table 3 shows the operative characteristics and anastomotic configuration. Side-to-side anastomosis was significantly more common in the stapled group, while stapled anastomosis significantly reduced operative time compared with hand-sewn anastomosis.

Technique		N (%)
Stapled group	Linear stapler	18 (90)
	Circular stapler	2 (10)
Hand-sewn group	Single-layer extramucosal	13 (65)
	Double-layer	7 (35)

Table 4. Technique-Specific Distribution

Table 4 illustrates the distribution of surgical techniques used in both groups. Linear staplers were predominantly employed in stapled anastomosis, whereas single-layer extramucosal suturing was the preferred hand-sewn technique.

Variable	Stapled	Hand-Sewn	p Value
Return of bowel sounds by POD3	17 (85)	10 (50)	0.041*
Postoperative fever	2 (10)	7 (35)	0.127
Persistent tachycardia	3 (15)	9 (45)	0.082
Abdominal distension	4 (20)	10 (50)	0.096
Clinical peritonitis	0	4 (20)	0.106
SSI	1 (5)	5 (25)	0.182
Re-intervention	0	4 (20)	0.106
Discharged without complication	18 (90)	11 (55)	0.031*

Table 5. Early Postoperative Clinical Outcomes

Table 5 observes better early postoperative recovery among patients undergoing stapled anastomosis, with significantly earlier return of bowel function and a higher proportion of uncomplicated discharges.

Variable	Stapled	Hand-Sewn	p Value
Anastomotic leak	0 (0)	5 (25)	0.042*
No leak	20 (100)	15 (75)	0.042*
Grade A leak	0	1	-
Grade B leak	0	2	-
Grade C leak	0	2	-
Re-laparotomy	0	2	-

Table 6. Anastomotic Leak and Management

Table 6 illustrates the primary study outcome. Anastomotic leak occurred only in the hand-sewn group and was statistically significant. Among affected patients, two required relaparotomy for Grade C leaks.

Outcome	Stapled	Hand-Sewn	p Value
Anastomosis duration (minutes)	24.6 ±5.8	35.9 ±8.7	<0.001*
Hospital stay (days)	7.1 ±2.1	10.4 ±4.2	0.004*
Overall treatment cost (₹)	85,240 ±16,580	68,430 ±13,220	0.001*
Readmission within 30 days	0	2 (10)	0.487
Re-exploration within 30 days	0	2 (10)	0.487
Late leak	0	1 (5)	1.000
Mortality	0	0	1.000

Table 7. Comparison of Secondary Outcomes and 30-Day Follow-Up

Table 7 summarizes the secondary outcomes and 30-day follow-up findings. Stapled anastomosis was associated with significantly shorter operative time and hospital stay but incurred a higher treatment cost. No mortality occurred in either group during follow-up.

DISCUSSION

The present study compared stapled and hand-sewn bowel anastomosis in patients undergoing intestinal resection and demonstrated that both groups were comparable with respect to baseline demographic, clinical and laboratory characteristics, minimizing the influence of confounding variables on postoperative outcomes. Mean age (47.6 ± 13.4 vs. 49.8 ± 12.9 years), sex distribution, comorbidities, serum albumin, leukocyte count and operative indications were similar between the stapled and hand-sewn groups. Such comparability is important because factors including malnutrition, diabetes, systemic infection and emergency surgery are recognized predictors of impaired anastomotic healing, as reported by Xu & Kong and Zarnescu et al.[13,14] Likewise, the predominance of small bowel resections and comparable operative indications in both groups enhances the validity of the comparison. Similar observations regarding the influence of operative site and bowel characteristics on anastomotic outcomes have been described by Kshirsagar et al.[11]

A major finding of the present study was the significantly shorter anastomotic construction time with stapled anastomosis (24.6 ± 5.8 vs. 35.9 ± 8.7 minutes; p<0.001). This is consistent with Mitra et al., who reported anastomosis times of 23.92 and 33.14 minutes for stapled and hand-sewn techniques, respectively,[15] while Arunkumar et al. also demonstrated significantly reduced operative duration with stapled anastomosis.[16] Liu et al. similarly observed shorter operative times in patients undergoing gastrointestinal tumour surgery using stapling devices. **(17)** The reduced operative time is likely attributable to standardized tissue approximation and reduced manual suturing.

Postoperative recovery was superior in the stapled group. Return of bowel sounds by postoperative day 3 was significantly higher following stapled anastomosis (85.0% vs. 50.0%; p=0.041), indicating faster recovery of bowel function. Similar findings were reported by Liu et al., who demonstrated earlier gastrointestinal recovery after stapled anastomosis,[17] while Sai Viswanth et al. observed earlier oral feeding (2.31 ± 0.74 vs. 4.27 ± 0.67 days) and shorter hospital stay (9.50 ± 2.18 vs. 12.38 ± 2.12 days) with stapled techniques.[18] Correspondingly, the present study showed a significantly higher uncomplicated discharge rate in the stapled group (90.0% vs. 55.0%; p=0.031), with fewer

postoperative complications including fever, abdominal distension and surgical site infection. The most clinically significant finding was the complete absence of anastomotic leaks in the stapled group compared with a 25.0% leak rate in the hand-sewn group (p=0.042). This supports the potential safety advantage of stapled anastomosis. Roy et al. similarly demonstrated lower leak rates with stapled anastomosis (2.31% vs. 6.15%; pooled OR 0.46),[19] while Liu et al. also reported reduced leakage following stapled gastrointestinal reconstruction.[17] However, evidence remains inconsistent. Naumann et al. concluded that current evidence is insufficient to recommend either technique universally in emergency surgery,[20] whereas Nordholm-Carstensen et al. reported higher leak rates following stapled ileocolic anastomosis (5.4% vs. 2.4%; adjusted OR 2.91).[10] These conflicting findings indicate that anastomotic integrity depends not only on technique but also on tissue vascularity, tension, contamination, surgeon experience and patient-related factors.

Among the five leak cases in the present study, CT imaging detected peri-anastomotic collections in four patients, while two required relaparotomy. Leak severity included one Grade A, two Grade B and two Grade C leaks according to the International Study Group of Rectal Cancer classification.[6] Similar diagnostic and management approaches have been recommended by Tsai et al., emphasizing the importance of CT imaging and staged intervention for anastomotic leaks.[21]

The hospital stay was significantly shorter in the stapled group (7.1 ± 2.1 vs 10.4 ± 4.2 days; p=0.004), reflecting earlier recovery and fewer postoperative complications. Hammond et al. reported that anastomotic leaks substantially increase hospital stay, readmissions and overall healthcare expenditure,[22] supporting the findings of the present study where readmission, radiological intervention and re-exploration occurred only in the hand-sewn group.

Despite these clinical advantages, stapled anastomosis incurred significantly higher treatment costs than hand-sewn anastomosis (₹85,240 ± 16,580 vs. ₹68,430 ± 13,220; p=0.001), primarily because of the cost of stapling devices. Similar findings have been reported by Haridoss et al. and Sai Viswanth et al., who observed improved operative efficiency with stapled techniques but higher procedural expenditure.[23,18] Nevertheless, the reduction in postoperative complications and shorter hospitalization may improve overall cost-effectiveness in healthcare settings where complication-related expenses are substantial.

The present study demonstrates that stapled bowel anastomosis provides significant advantages in operative efficiency, earlier postoperative recovery, reduced anastomotic leak rates and shorter hospital stays compared with hand-sewn anastomosis, although these benefits are associated with increased procedural cost. These findings support the selective use of stapled anastomosis where resources permit, while emphasizing that patient selection, operative circumstances and surgical expertise remain essential determinants of successful outcomes.

Limitations

The present study has certain limitations. It was a single-centre observational study with a relatively small sample size (40 patients; 20 in each group), which may have limited the ability to detect differences in infrequent outcomes such as re-exploration, readmission, and mortality. Allocation to stapled or hand-sewn anastomosis was based on surgeon preference, intraoperative findings, and patient affordability rather than randomization, introducing potential selection bias. The study population was heterogeneous with varying indications, anatomical sites, and anastomotic configurations, which may have influenced operative and postoperative outcomes. In addition, the small number of anastomotic leaks precluded detailed subgroup analysis, follow-up was limited to 30 days, preventing assessment of long-term complications, and the cost analysis included only direct in-hospital expenses without evaluating indirect costs or quality-of-life outcomes.

CONCLUSION

The present study demonstrated that stapled bowel anastomosis provided superior operative efficiency and improved early postoperative outcomes compared with hand-sewn anastomosis, including shorter anastomosis time, earlier return of bowel function, reduced hospital stay, fewer postoperative complications, and a lower incidence of anastomotic leak. Although stapled anastomosis was associated with higher treatment costs, its clinical advantages suggest that it is a safe and effective technique. The choice of anastomotic method should be individualized based on patient factors, surgical

feasibility, surgeon expertise, and resource availability.

Author Contribution

1. Dr. Nithin K.B. -Conceptualization, Investigation, Case Management, Supervision, Writing - Review & Editing.
2. Dr. Aparna Prakash -Data Collection, Patient Management, Writing - Original Draft Preparation.
3. Dr. Mahesh S. Shetty -Data Collection, Patient Management, Writing - Original Draft Preparation.
4. Dr. Girish T.U. -Literature Review, Writing - Original Draft Preparation.
5. Dr. Chandan S. Bhoomkar -Supervision, Project Administration, Writing - Review & Editing.

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