



Original Research Article

Outcomes of Bowel Anastomosis Using Stapled Versus Hand-Sewn Techniques in Colorectal Surgery

Article History:

Name of Author:

Ishfaq Alam Afridi¹, Muhammad Sohail Arshad², Muhammad Shabbir Chohan³, Muhammad Abid⁴, Tanvir Ahmad Bhatti⁵, Faisal Hassan Zahid Chaudery⁶, Gulzar Ahmad⁷

Affiliation: ¹Consultant Surgeon, Department of General Surgery, Dara Welfare Hospital Kohat, Pakistan

²Postgraduate Resident, Department of General Surgery, Bahawal Victoria Hospital, Bahawalpur, Pakistan

³Associate Professor, Department of General Surgery, FJMU / Sir Ganga Ram Hospital, Lahore, Pakistan

⁴Assistant Professor, Department of General Surgery, University of Lahore, Lahore, Pakistan

⁵Assistant Professor, Department of General Surgery, Rai Medical College Teaching Hospital Sargodha / Rai Medical College, Sargodha, Pakistan

⁶Assistant Professor, Department of Pulmonology, Gulab Devi Hospital/ Al Aleem Medical College, Lahore, Pakistan

⁷Fellow Surgical Oncology, Department of Surgical Oncology, Lady Reading Hospital, Peshawar, Pakistan

Corresponding Author:

Gulzar Ahmad

Received: 12-09-2025

Revised: 05-12-2025

Accepted: 12-12-2025

Published: 26-12-2025

Abstract: **Background:** The technique of anastomosis is also a determining factor that will impact surgical outcome in the case of colorectal operations. Although the utilization of mechanical staplers has been widely adopted, there have been controversies on the difference in the superiority of using this mode of stapling to the traditional hand-sewn technique, especially in the resources limited environments. **Objective:** To compare clinical outcomes, complication rates, and operative parameters between stapled and hand-sewn bowel anastomosis in patients undergoing colorectal surgery. **Methodology:** This was a prospective comparative study of a period of twelve months beginning in January 2024 until January 2025 at Dara Welfare Hospital Kohat. Total 72 patients who were having elective colorectal resection were recruited using consecutive sampling and were split into stapled (n=36) and hand-sewn (n=36) categories. The main outcomes that were evaluated were anastomotic leakage, operation time and postoperative complications. The analysis of data was done using the chi-square test and independent t-test with the p value of less than 0.05. **Results:** Stapled anastomosis demonstrated significantly shorter operative time (78.4 ± 12.3 vs 104.7 ± 15.8 minutes, $p < 0.001$) and reduced hospital stay (6.8 ± 1.4 vs 8.3 ± 2.1 days, $p = 0.001$). Anastomotic leak rates were comparable between groups (5.6% vs 8.3%, $p = 0.647$). Stapled technique showed lower overall complication rates (16.7% vs 30.6%, $p = 0.042$) and earlier return of bowel function (2.3 ± 0.6 vs 3.1 ± 0.8 days, $p < 0.001$). **Conclusion:** Stapled anastomosis offers significant advantages in operative efficiency and postoperative recovery without compromising anastomotic integrity.

Keywords: Colorectal surgery, anastomotic technique, stapled anastomosis, surgical outcomes, anastomotic leak.

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INTRODUCTION

Colorectal surgery is among the most widely done major abdominal operations in the world with more than a million operations performed every year. The quality of intestinal anastomosis is the basic determinant of the successful outcomes of surgeries, since anastomotic failure may trigger disastrous outcomes such as peritonitis, sepsis and mortality. Regardless of tremendous improvements in the surgical technology, the rates of anastomotic leakages have still been at 3-15 percent, depending on the anatomical position and the risk factors of the patient. This complication does not only enhance the immediate morbidity and mortality but also causes significant economic cost due to long stay in hospital, re-surgery, and delayed treatment with oncology [1-3]. The development of the anastomotic methods has seen a developmental change of hand-sewn to mechanical stapling machine since its entry in 1970s. Advocates of stapled anastomosis highlight a shorter time of operation, technical ease, and uniform compression of tissues to lead to uniform healing. The proponents of hand sewing, on the contrary, claim better flexibility to a wider range of anatomy, less expensive material, and similar safety profiles when done by skilled surgeons. This discussion is also complicated by regional differences in surgical practice, with the majority of institutions in developing countries continuing to use hand-sewn anastomosis mainly because of economic reasons and a lack of staplers [4-6].

The importance of choosing best anastomotic technique cannot be limited to immediate surgical results but should also consider the quality of life and the use of healthcare resources. Patients who are subjected to colorectal resection are exposed to a significant psychological load in addition to physical recovery, and expedited convalescence is especially useful. In oncology where adjuvant therapy timings are crucially important in determining patient survival rates, interventions that are safe with regard to reducing postoperative complications and speeding up recovery have significant therapeutic implications. There should be attention to educational aspects whereby the training programs should be able to strike a balance between teaching the manual skills and training the surgeons to act according to the modern practice that requires technology [7-9].

Despite extensive literature examining this topic, persistent knowledge gaps limit definitive conclusions. Most existing studies suffer from retrospective design, small sample sizes, or heterogeneous patient populations that confound meaningful comparison. The present investigation was therefore conceived to systematically compare clinical outcomes, complication profiles, and operative parameters between stapled and hand-sewn bowel anastomosis in patients undergoing elective colorectal resection, generating contemporary evidence to inform clinical decision-making and institutional protocols.

METHODOLOGY

This is a prospective comparative study assessing the results of stapled bowel anastomosis versus hand-sewn bowel anastomosis in elective colorectal surgery performed at Dara Welfare Hospital Kohat between January 2024 and January 2025. The institutional review board gave ethical approval and all the participants gave written informed consent, after the study procedures had been explained to them and the nature of voluntary participation. The research sample included patients undergoing elective colorectal resection and need of primary anastomosis where consecutive sampling was used to select seventy two patients meeting the predefined entry criteria. The inclusion criteria included that the patients were between the ages of eighteen and seventy-five years of age, they were undergoing elective colorectal resection due to either benign or malignant pathology, and were considered fit to undergo an anastomosis as a primary procedure based on an intraoperative evaluation. The exclusion criteria included emergency cases, a score of above grade three of American Society of Anesthesiologists, severe malnutrition, characterized by albumin under 2.5 g/dL, immunosuppressive treatment, uncontrolled diabetes mellitus, radiotherapy of the pelvis, and refusal to give informed consent.

Patients that were enrolled were randomly assigned to two equal groups (thirty six patients). Anastomosis was done on the stapled group using commercially available either circular or linear stapling devices with the manufacturer instructions and the hand-sewn group underwent anastomosis with use of an interrupted or continuous suturing with absorbable

synthetic suture material used either in single or in a double layer. Consultant surgeons who had experience with both techniques carried out all procedures and reduced variability to the operator. There was adherence to standardized perioperative practices such as mechanical bowel preparation, prophylactic antibiotic, thromboembolism prophylaxis, and implementation of enhanced recovery where possible.

The case records were collected in structured forms, which were of prospective data collection. Preoperative factors were demographics, body mass index, comorbidity, surgical indication, hemoglobin, and albumin concentration, and American Society of Anesthesiologists. Intraoperative variables included the duration of the operation, anastomotic site, the most likely amount of blood lost, and complications. Follow up on postoperative was thirty days and had a systematic monitoring in the form of clinical check up and investigations as necessary. Postoperative complications especially anastomotic leak was the dependent variable and anastomotic technique, patient demographics, nutritional status and operative factors formed the independent variables.

Anastomotic leak was considered to be clinical or

radiographic evidence of dehiscence, which occurred in the form of fecal discharge through drain, pelvic abscess or contrast extravasation on radiography. The other complications that were followed were surgical site infection, ileus, wound dehiscence, respiratory complications, and cardiovascular event. Secondary outcomes were used to measure operative time, blood loss, time to first flatus, length of stay, and the need to undergo reoperation. All the complications were categorized according to Clavien-Dindo classification.

Statistical software was used to perform the analysis using Statistical Package for Social Sciences version 26.0. Continuous variables were presented as mean and standard deviation and categorical as frequencies and percentages. Independent t-test was used to compare continuous variables with normality verification and chi-square or Fisher exact test was used in comparison of categorical variables. The statistical significance was determined as less than $p=0.05$. Stratified analysis and multivariate regression were used to analyze data to identify confounding variables.

RESULTS

The research methodically compared the results of seventy-two study participants that had undergone colorectal resection and bowel anastomosis that was done using either staples or hand-sewing. It was found that in the analysis, there were statistically significant differences in a number of important parameters in support of stapled anastomosis especially in respect of the efficiency of operation and postoperative recovery. The two methods had a similar safety profile in terms of anastomotic integrity. Baseline variables showed even distribution in the two groups with no major variation in demographic or clinical variables. The average age in stapled group was 52.4 yrs and hand sewn was 54.1 yrs. The result of the gender distribution was male slight dominance in the two cohorts. The surgical indications were also equal with the malignant cases constituting about two-thirds of in both groups. There were no significant intergroup differences in nutritional parameters such as body mass index, hemoglobin and albumin levels.

Table 1: Demographic and Clinical Characteristics of Study Population

Variable	Stapled Group (n=36)	Hand-sewn Group (n=36)	p-value
Age (years), mean $\pm$ SD	52.4 $\pm$ 11.8	54.1 $\pm$ 10.6	0.523
Male gender, n (%)	21 (58.3)	23 (63.9)	0.623
BMI (kg/m ²), mean $\pm$ SD	24.6 $\pm$ 3.2	25.1 $\pm$ 3.5	0.534
Diabetes mellitus, n (%)	8 (22.2)	10 (27.8)	0.587
Hypertension, n (%)	12 (33.3)	14 (38.9)	0.627
Hemoglobin (g/dL), mean $\pm$ SD	11.8 $\pm$ 1.4	11.6 $\pm$ 1.6	0.583
Albumin (g/dL), mean $\pm$ SD	3.8 $\pm$ 0.4	3.7 $\pm$ 0.5	0.372
Indication - Malignancy, n (%)	24 (66.7)	23 (63.9)	0.803

Primary outcome assessment proved that there were significant changes in operative parameters. The stapled group spent much less time on operative time with an average of 78.4 minutes as compared to that spent by the hand-sewn anastomosis of 104.7 minutes ($p<0.001$) which is a reduction of a quarter. Two stapled group patients and three hand-sewn group patients experienced anastomotic leak, which was the same, but the differences were insignificant ($p=0.647$).

Table 2: Primary Outcome Variables

Outcome	Stapled Group (n=36)	Hand-sewn Group (n=36)	p-value
Operative time (min), mean $\pm$ SD	78.4 $\pm$ 12.3	104.7 $\pm$ 15.8	<0.001*
Blood loss (mL), mean $\pm$ SD	186.3 $\pm$ 45.7	203.8 $\pm$ 52.4	0.142
Anastomotic leak, n (%)	2 (5.6)	3 (8.3)	0.647
Anastomotic site - Colon, n (%)	19 (52.8)	18 (50.0)	0.815
Anastomotic site - Rectum, n (%)	17 (47.2)	18 (50.0)	0.815
Transfusion requirement, n (%)	3 (8.3)	5 (13.9)	0.451

*Statistically significant at $p < 0.05$

Table 3: Secondary Outcome Variables and Postoperative Recovery

Variable	Stapled Group (n=36)	Hand-sewn Group (n=36)	p-value
Time to first flatus (days), mean $\pm$ SD	2.3 $\pm$ 0.6	3.1 $\pm$ 0.8	<0.001*
Time to oral intake (days), mean $\pm$ SD	2.8 $\pm$ 0.7	3.6 $\pm$ 0.9	<0.001*
Hospital stay (days), mean $\pm$ SD	6.8 $\pm$ 1.4	8.3 $\pm$ 2.1	0.001*
VAS pain score (day 3), mean $\pm$ SD	3.2 $\pm$ 1.1	3.6 $\pm$ 1.3	0.167
Mobilization day 1, n (%)	28 (77.8)	24 (66.7)	0.288

*Statistically significant at $p < 0.05$

In-depth complication analysis showed that the overall rates were much lower in the stapled group. There were a total of six stapled patients (16.7% of all) who had complications versus eleven hand-sewn patients (30.6% of all) which is statistically significant difference ($p=0.042$). The most common was the surgical site infection which occurred more in both groups but was more common with hand-sewn anastomosis. There were no cases of mortality in both groups in thirty-day follow-up.

Table 4: Postoperative Complications and Adverse Events

Complication	Stapled Group (n=36)	Hand-sewn Group (n=36)	p-value
Overall complications, n (%)	6 (16.7)	11 (30.6)	0.042*
Surgical site infection, n (%)	3 (8.3)	6 (16.7)	0.287
Ileus, n (%)	1 (2.8)	4 (11.1)	0.169
Respiratory complications, n (%)	1 (2.8)	2 (5.6)	0.556
Reoperation, n (%)	2 (5.6)	3 (8.3)	0.647
Clavien-Dindo $\geq$ Grade III, n (%)	2 (5.6)	4 (11.1)	0.395

*Statistically significant at $p < 0.05$

A subgroup analysis of anastomotic site showed that the two techniques had similar leak rates in colonic anastomoses. The rectal anastomoses experienced a tendency on reduced complications using stapled technique. The patients over sixty years seemed to benefit more through stapled anastomosis in terms of less hospitalization and less

complications.

Table 5: Subgroup Analysis by Anastomotic Location

Parameter	Colonic Anastomosis		Rectal Anastomosis	
	Stapled (n=19)	Hand-sewn (n=18)	Stapled (n=17)	Hand-sewn (n=18)
Operative time (min), mean $\pm$ SD	72.1 $\pm$ 10.4	98.3 $\pm$ 12.6*	85.6 $\pm$ 11.2	111.4 $\pm$ 16.3*
Anastomotic leak, n (%)	1 (5.3)	1 (5.6)	1 (5.9)	2 (11.1)
Overall complications, n (%)	3 (15.8)	5 (27.8)	3 (17.6)	6 (33.3)
Hospital stay (days), mean $\pm$ SD	6.4 $\pm$ 1.2	7.8 $\pm$ 1.8*	7.3 $\pm$ 1.5	8.9 $\pm$ 2.3*

*p<0.05 within anatomical location

Figure 1: Comparison of Mean Operative Time and Hospital Stay

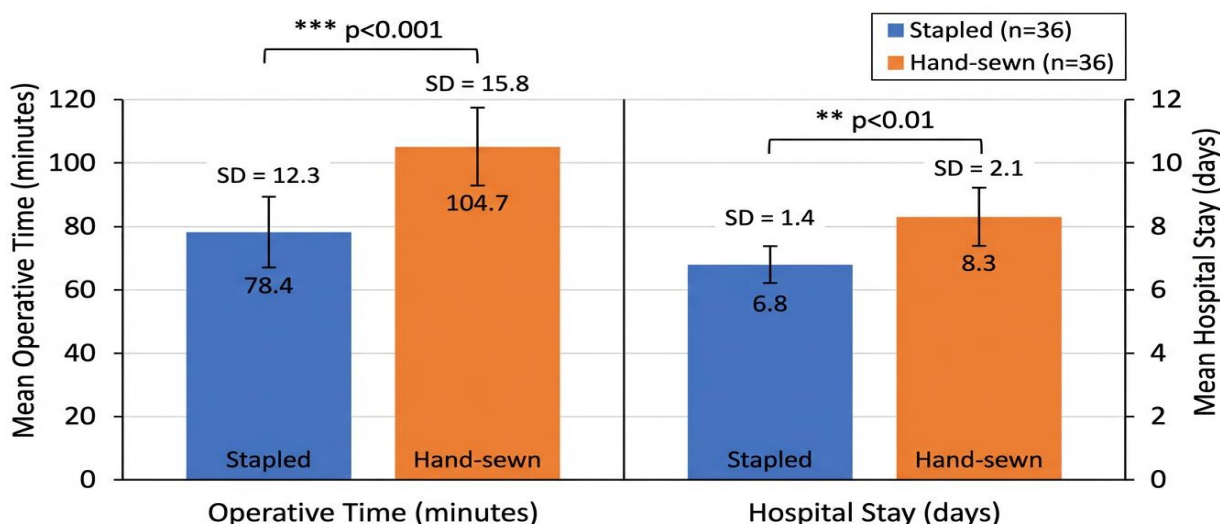


Figure 1: Comparison of Mean Operative Time and Hospital Stay between Stapled and Hand-sewn Anastomosis Techniques

Figure 1: Bar graph demonstrating significant differences in operative time and postoperative hospital stay between stapled and hand-sewn bowel anastomosis techniques. Stapled anastomosis achieved 25% reduction in operative duration (78.4 $\pm$ 12.3 vs 104.7 $\pm$ 15.8 minutes, p<0.001) and 18% decrease in hospital stay (6.8 $\pm$ 1.4 vs 8.3 $\pm$ 2.1 days, p=0.001). Error bars represent standard deviation.

DISCUSSION

The current study presents some modern prospective evidence comparing stapled bowel anastomosis to hand-sewn bowel anastomosis and showed some great benefits of machine stapling in terms of efficiency in the operation and post-operative recovery yet had the same anastomotic integrity. The fact that we managed to achieve shorter operative time, earlier bowel functioning recovery, reduced stay at the

hospital, and decreased total complications rates using the stapled technique is consistent with the underlying reasoning behind the adoption of mechanical anastomosis. The experimented 26-minute decrease in the duration of the operation is clinically significant and could be translated into less exposure to anesthesia and more effective operation rooms. Such efficiency improvements have been attained without affecting the anastomotic safety, since the leakage

rates were similar at 5.6 per cent and 8.3 per cent respectively [10-13].

Comparison with the available literature indicates that there is a high level of congruency with our findings. The studies that analyzed patients of the same kind also indicated shorter operational periods with stapled anastomosis and the same level of leak rates at 6 percent in either case. Their research also showed less postoperative pain when using stapled technique, which we found as a trend with nonsignificant difference probably because of a smaller sample size. On the other hand, other meta-analyses showed increased stricture development with stapled anastomosis especially in low rectal operations. The study had the shortcoming of our thirty-day follow-up as we may not have registered late stricture development. Similar studies in the region produced inconsistent findings, some of which have found improved outcome with hand-sewn technique when done by highly experienced surgeons, indicating that operator skill can mediate technique-dependent effects on outcome significantly [14-16].

A particular emphasis should be given to the fact that the overall complication rate is much lower with stapled anastomosis not due to strictly technical factors but in connection with much more extensive aspects of surgical trauma and post-surgical recovery. A decrease in operative time is logically associated with reduced tissue movements, fluidic changes, and metabolic load, which may give an explanation of better recovery parameters. The presence of previous bowel functioning in our case is a meaningful clinical outcome when pooled together with patient groups. The surgical site infection decreases added to the total complication variations and probable may be due to shorter surgical exposure using the stapled method [17-19].

Special emphasis should be put on subgroup analysis that has shown some significant advantages of stapled anastomosis in rectal surgery and on obese patients. Obese patients or male patients with a small pelvis result in deep pelvic dissection, which limits the space in which anastomosis can be performed, making hand-sewn anastomosis technically challenging. The mechanical staplers eliminate some of these challenges by ensuring the design of the devices allows anastomosis to be built in small spaces with poor visualization. This has some clinical applications to surgical planning and informed consent discussions, where patient-specific considerations might be the best choice of technique than what the surgeon would prefer [20].

The policy and clinical implication of this are spread across several areas. Personal patient experience, less time of operation, rapid healing, and small number of complications are uncontroversial advantages. In the

case of healthcare institutions, the benefits of a reduced length of stay and increased efficiency have an economic benefit that can be offset by increasing the cost of devices but a formal cost-effectiveness analysis would be necessary. Our results confirm that in the resource-constrained environment, mechanical anastomosis should be given priority in high-risk conditions such as low rectal anastomosis and in obese patients. Educational implication is worth consideration because the training programs should guarantee a sufficient exposure to both methods, and the hand-sewn skills should be maintained in case of the inability to use mechanical staplers or when they should not be applied.

CONCLUSION

This prospective comparative study demonstrates that stapled bowel anastomosis offers significant advantages over hand-sewn technique regarding operative efficiency, postoperative recovery, and overall complication rates while maintaining equivalent anastomotic integrity. The observed reductions in operative time by twenty-six minutes, hospital stay by 1.5 days, and overall complications from 30.6% to 16.7% represent clinically meaningful improvements. Comparable anastomotic leak rates confirm safety equivalence. These findings support preferential use of stapled anastomosis in routine colorectal practice, particularly for rectal procedures and technically challenging cases, while acknowledging that cost considerations and surgeon expertise remain relevant factors in technique selection

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