

Efficacy of Whipple Procedure with Stapled Bowel Anastomosis: A Safe and Efficient Surgical Approach

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ABSTRACT

Background: The anastomosis is the most important part of the surgery as it requires the correct joining of two viable bowel surfaces without tension. Anastomosis of bowel stapled has become a standard procedure in surgery, and it has been found to be more efficient and predictable. This study aims to describe our approach to stapled gastrojejunostomy and jejunojejunostomy in Whipple's procedure and evaluate the associated clinical outcomes

Methodology: This retrospective study was conducted from December 2018 to June 2025 on pancreaticoduodenectomy procedures performed by a single surgeon at two institutions. A total of 116 patients who received a stapled anastomosis were included in the study. The data was obtained from existing records, including patient demographics (age and gender), surgical details (such as procedure duration), and post-operative complications, with a focus on anastomotic bleeding and leakage.

Results: A total of 116 patients underwent stapled gastrojejunostomy and entero-enterostomy, including 68 men (58.6%) and 48 women (41.4%). The mean age at the time of surgery was 52 years (± 13.93 SD), with a range of 19 to 78 years. There were 3 incidences (2.59%) of bleeding at the site of anastomosis in stapled gastrojejunostomy patients which was confirmed by endoscopy and managed with endo-therapy. There was no incidence of anastomosis leak in stapled anastomosis patients. The average time required to complete the anastomosis using a stapling device was 10 minutes (± 1 SD).

Conclusion: In regions with limited stapler utilization, our experience with stapled anastomosis in Whipple surgery highlights its safety, efficiency, and favorable clinical outcomes. The technique was associated with a low incidence of anastomotic complications, no leakage, and minimal bleeding, all managed endoscopically. Additionally, stapler use significantly reduced anastomosis time, enhancing surgical efficiency.

Introduction

Stapled anastomosis has significantly advanced gastrointestinal surgery, providing benefits in operative efficiency, consistency, and reduced complication rates compared to traditional hand-sewn techniques.¹ The Whipple procedure, a complex pancreaticoduodenectomy, requires multiple anastomoses, increasing the risk of complications such as anastomotic leakage, hemorrhage, and delayed gastric emptying.² Although the use of stapled anastomosis is common in colorectal and upper gastrointestinal surgery, its use in Whipple surgery has not been well-assessed, particularly in areas where access to stapling devices is limited. Since the introduction of surgical staplers in the early 20th century, they have significantly developed to provide uniform tension distribution, accurate tissue approximation, and minimized ischemic risk at anastomotic sites.³ Comparison of stapled and hand sewn procedures in pancreatic and biliary surgeries have shown mixed

outcomes. Certain studies state that there is no significant difference in the postoperative complications but some studies indicate that stapling could lower the chances of anastomotic failure and intraoperative bleeding.^{4,5}

Regardless of these benefits, the use of staplers is not uniform across the globe because of the restrictions in cost and availability. The main purpose of the proposed study is the determination of the viability, safety, and efficiency of stapled gastrojejunostomy and jejunojejunostomy during Whipple surgery in an area with a low history of stapler use. This study will help to add to the growing body of evidence on the effectiveness of staplers in complex gastrointestinal reconstruction by evaluating postoperative complications, including anastomotic leaks and bleeding.⁶

The debate over the best anastomotic method in pancreaticoduodenectomy has experienced a fresh surge in recent years, specifically in terms of the rate of delayed gastric emptying (DGE) which is one of the most common and debilitating complications following Whipple surgery. A retrospective study of 1,077 consecutive patients showed that stapled gastrojejunostomy was independently related to an increased occurrence of clinically relevant DGE relative to hand-sewn anastomosis (17.2 vs. 8.8, $P = 0.001$), and it was also related to increased rates of upper gastrointestinal bleeding [7]. In contrast, a Mayo Clinic technical report comparing a double-fired ($n=243$) stapled gastrojejunostomy technique in 243 open Whipple surgeries found the device to be non-inferior to hand-sewn anastomosis in terms of DGE rates, but with a much lower median operative time (248 vs. 370 minutes, $P < 0.001$) [8]. These contradictory results indicate the complexity of anastomotic decision-making in pancreaticoduodenectomy and that results may depend on technical differences, patient selection, and institutional volume and not necessarily the modality itself.

Surgical staplers use in low- and middle-income countries (LMICs) has been disproportionately low relative to high-income contexts, due to cost-prohibitive prices of devices, limited supply chains, and an inadequate infrastructure of surgical training.⁹ In Pakistan, and in most LMICs, lack of institutional data on high-tech surgical devices, including stapling tools, introduces a major gap in evidence-based practice and makes it hard to promote its implementation in regular surgical practice. New literature in resource-constrained environments indicates that even small investments in surgical technology can have significant benefits in operative efficiency and patient safety, especially with high-complexity procedures like pancreaticoduodenectomy.¹⁰ The use of a modified stapled pancreaticogastrostomy procedure using a tri-row linear stapler showed a statistically significant lower postoperative rates of pancreatic fistulas than the traditional pancreaticojejunostomy, further confirming the changing role of stapler technology in reconstruction after Whipple surgery.¹¹ The current research was thus conducted to record our experience of institutional practice in stapled gastrojejunostomy and jejunojejunostomy during the Whipple procedure, in order to assess the clinical outcomes by which this technology is associated, and also provide a base of evidence that could guide the later use of this technology in similar regional and national contexts.

Methodology

This retrospective study was conducted at two tertiary care surgical institutions in Pakistan, spanning a period

of seven years from December 2018 to June 2025. All pancreaticoduodenectomy procedures included in this study were performed by a single consultant hepatobiliary surgeon (FH), ensuring consistency in operative technique across both institutions and throughout the entire study period. Ethics approval was taken from the Institutional Review Board (IRB) at both participating institutions. The study was conducted in compliance with the principles of the Declaration of Helsinki, given the retrospective nature of the study and the complete anonymisation of all patient data.

Over this interval, a total of 177 patients underwent pancreaticoduodenectomy for malignant tumors of the pancreatic head and distal biliary tree. Of these, 116 patients (65.5%) who underwent stapled enteric anastomosis, during Whipple procedure, were included in the final analysis. Patients who underwent pylorus-preserving pancreaticoduodenectomy with hand-sewn anastomotic reconstruction, those with incomplete medical records or inadequate postoperative follow-up data were excluded from the study.

Patient data were retrospectively retrieved from electronic medical records maintained at both participating institutions. The variables collected included patient demographics (age and sex), operative details (specifically the duration of stapled anastomosis), and postoperative outcomes, with primary focus on anastomotic-related complications, namely anastomotic leakage and anastomotic site hemorrhage. Anastomotic bleeding was defined as clinically evident upper gastrointestinal hemorrhage confirmed on endoscopy within the postoperative period and requiring endoscopic or interventional management. Anastomotic leakage was defined as radiologically or clinically confirmed disruption of the gastrointestinal anastomosis necessitating active intervention. All patients underwent a classic Whipple procedure with stapled reconstruction of the gastrojejunostomy and entero-enterostomy. The pancreatic anastomosis was fashioned as a duct-to-mucosa pancreaticojejunostomy and the biliary anastomosis as a hepaticojejunostomy, both performed using conventional hand-sewn techniques. For the stapled gastrojejunostomy, a gastrotomy was created at the greater curvature of the stomach and a corresponding enterotomy was made in a jejunal loop positioned two feet distal to the hepaticojejunostomy. The two openings were approximated in an ante-colic fashion and secured with a Vicryl 3/0 stay suture, following which a Covidien® GIA linear 60 mm stapler was introduced and fired under controlled tension. A standardized one-minute settling time was observed after stapler deployment and prior to its removal,

allowing adequate tissue compression and haemostasis at the staple line. The residual common enterotomy was subsequently closed with a Prolene 3/0 continuous running suture. The stapled entero-enterostomy was performed using an identical technique at an appropriate distance distal to the gastrojejunostomy.

The primary outcome measures were the incidence of postoperative anastomotic leakage and anastomotic site bleeding, while the secondary outcome was the mean operative time required to complete the stapled anastomosis, serving as a surrogate indicator of technical efficiency. All the collected data was entered and analyzed through IBM SPSS Statistics, Version 26.0. Continuous variables, including patient age and anastomosis time, were summarised as means with standard deviations, while categorical variables, including sex distribution and complication rates, were expressed as absolute frequencies and percentages. Chi-square test was applied to analyze qualitative data and Independent sample t-test for quantitative data. P-value < 0.05 was considered significant.

Results

Over the interval of 7 years, a total of the total 177 patients underwent pancreaticoduodenectomy for the tumors of pancreas and distal biliary system. Among them, 116 patients (65.5%) underwent stapled anastomosis, with 112 patients (96.6%) undergoing a Classic Whipple's procedure and 4 patients (3.4%) undergoing a Total Pancreatectomy [Figure 1].

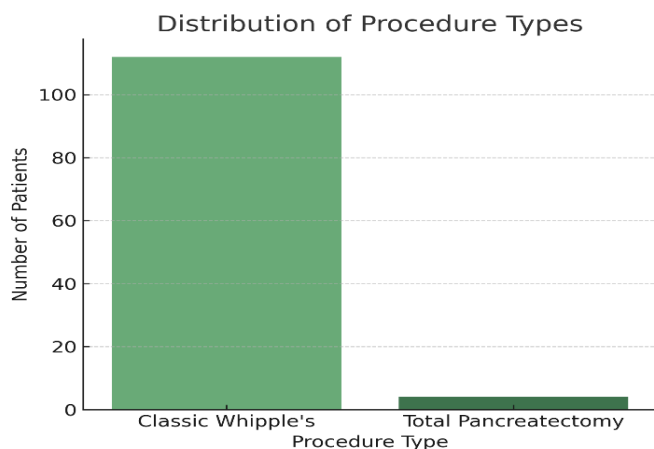


Figure 1. The bar chart illustrates the distribution of procedure types.

A total of 116 patients who underwent pancreaticoduodenectomy with stapled gastrojejunostomy and entero-enterostomy were included in the final analysis. The cohort demonstrated a male predominance, with 68 males (58.6%) and 48 females (41.4%). The mean age was 52 ± 13.93 years, ranging from 19 to 78 years. The majority of patients

were clustered in the 51–60 years' age group (30.17%), followed by 61–70 years (24.14%) and 31–40 years (18.10%) (Table 1).

The stapled anastomosis technique demonstrated high operative efficiency. The mean time required to construct the gastrojejunostomy and entero-enterostomy was 10 ± 1 minutes. Postoperative outcomes reflected a favorable safety profile. No cases of anastomotic leakage were observed (0%). Anastomotic site bleeding occurred in 3 patients (2.59%), all of which were successfully managed with endoscopic intervention without the need for surgical re-exploration. In addition to primary anastomotic outcomes, key postoperative recovery parameters were assessed. Delayed gastric emptying (DGE) was observed in 14 patients (12.1%), while overall postoperative morbidity was documented in 21 patients (18.1%). The mean length of hospital stay was 9 ± 3 days, indicating satisfactory postoperative recovery in the majority of cases (Table II).

Further analysis of patients with anastomotic bleeding demonstrated that all cases were minor, confirmed endoscopically, and effectively treated with endoscopic therapy. No patient required re-operation, and no mortality attributable to anastomotic complications was recorded as shown in (Table III).

Table I: Baseline Demographic Characteristics and Age Distribution. (n = 116)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	68	58.6
	Female	48	41.4
Age (years)	Mean $\pm$ SD	52 ± 13.93	
	Range	19 – 78	
Age Groups	19 – 30	7	6.03
	31 – 40	21	18.10
	41 – 50	18	15.53
	51 – 60	35	30.17
	61 – 70	28	24.14
	71 – 78	7	6.03
Total		116	100.0

Overall, the findings demonstrate that stapled bowel anastomosis in pancreaticoduodenectomy is associated with consistent technical performance and favorable clinical outcomes, characterized by absence of anastomotic leakage, low incidence of manageable bleeding, acceptable postoperative morbidity, and a reasonable duration of hospital stay.

Table II: Operative and Postoperative Outcomes. (n = 116)

Variable	Value
Mean anastomosis time (minutes)	10 ± 1
Anastomotic bleeding	3 (2.59%)

Anastomotic leakage	0 (0%)
Delayed gastric emptying (DGE)	14 (12.1%)
Overall morbidity	21 (18.1%)
Length of hospital stay (days)	9 ± 3

Table III: Management and Outcomes of Anastomotic Bleeding (n = 3)

Parameter	Value
Diagnosis method	Endoscopy (100%)
Management	Endoscopic therapy
Need for re-operation	0 (0%)
Mortality related to bleeding	0 (0%)

Discussion

In our study, the results of stapled anastomosis were evaluated in 116 patients with Whipple surgery, and the outcome showed that the number of complications is low, especially the anastomotic leakage and bleeding. There were no cases of anastomotic leaks, which is consistent with the prior studies indicating that stapling offers a solid tissue approximation and eliminates the chances of leakage.⁶ The incidence of anastomotic site bleeding in three patients (2.59%) was successfully managed endoscopically, further supporting the safety of stapled anastomosis in minimizing severe hemorrhagic complications.¹² One of the main benefits that were witnessed in our research was that there was a substantial reduction in the time of anastomosis of an average of 10 minutes. This is in line with earlier studies that reveal that stapled anastomosis can speed-up the reconstruction process and lead to reduced operative times in relation to hand-sewn methods.^{4,13} Since Whipple surgery is a complex procedure, it is important to minimize the duration of operation to reduce blood loss and stress in the operating room. Although meta-analyses have established no significant difference in major postoperative complications between stapled and hand-sewn anastomoses, our results are added to the accumulating evidence that stapled methods are effective in complex surgeries.^{4,14} More specifically, a recent study proposed that stapled gastrojejunostomy can be linked to the reduced rate of delayed gastric emptying, which needs to be investigated further in our context.⁵

Surgeon experience is a key factor in the success of stapled anastomosis. In this research, one experienced surgeon carried out all procedures, which presents a risk of performance bias. But this uniformity aids in maintaining consistency in the method and minimizes variability of surgical results. To further confirm these results, multi-centered data and randomized trials of comparison of stapled and hand-sewn methods in Whipple surgery should be included in future research.

The results of the current study also have to be viewed in the context of the general picture of postoperative morbidity after pancreaticoduodenectomy, especially in terms of delayed gastric emptying (DGE) which was identified in 14 of our subjects (12.1%) which is a rate that is relatively favourable to the international figures of 15 to 30%.¹⁵ The relatively lower DGE rate in our series may in part reflect the technical characteristics of the stapled side-to-side gastrojejunostomy configuration employed, which has been shown in comparative studies to facilitate more physiological gastric drainage and reduce traction-related dysmotility at the anastomotic site.¹⁶ The overall postoperative morbidity rate of 18.1% and mean hospital stay of 9 ± 3 days recorded in this study are consistent with outcomes reported from high-volume centres in similar operative contexts, suggesting that acceptable standards of perioperative care can be achieved in resource-limited settings when a standardised technique is rigorously applied.¹⁷ These outcomes are particularly meaningful in the context of Pakistan's surgical landscape, where high-complexity pancreatic surgery is concentrated in a limited number of tertiary institutions, and where the availability of postoperative critical care and interventional endoscopy both of which were critical in managing the three cases of anastomotic bleeding in this cohort cannot be taken for granted across the broader healthcare system.¹⁸

The present study further highlights the potential role of stapled anastomosis in advancing the safety and reproducibility of pancreaticoduodenectomy in low and middle income countries (LMICs), where operative efficiency is of particular strategic importance given constrained theatre time, limited instrumentation, and high patient turnover demands. A mean anastomosis time of 10 ± 1 minutes represents a clinically meaningful reduction compared to hand-sewn reconstruction, which typically requires 25 to 45 minutes per anastomosis, and this time saving directly reduces cumulative anaesthetic exposure, intraoperative blood loss, and associated physiological stress in an already high risk surgical population.¹⁹

The economic argument for stapler adoption in LMICs, while complex, is increasingly supported by cost effectiveness analyses demonstrating that the upfront device cost is offset by reductions in complication-driven resource utilization, prolonged intensive care admission, and repeat surgical intervention.²⁰ As minimally invasive pancreatic surgery including laparoscopic and robotic-assisted pancreaticoduodenectomy gains gradual traction in select Pakistani centres, the foundational competency in stapled anastomosis documented in this study will

serve as an essential technical prerequisite for safe transition to these platforms.²¹ Collectively, the evidence presented reinforces the case for a structured, evidence-guided policy of stapler integration into pancreatic surgical practice in Pakistan, supported by dedicated training programmes, institutional auditing of outcomes, and prospective multicentre collaboration to generate the higher-level evidence that this field currently lacks.

In conclusion, our study demonstrates that stapled anastomosis in Whipple surgery is a safe and efficient alternative to hand-sewn techniques, particularly in resource-limited settings. The absence of anastomotic leaks, the minimal rate of bleeding complications, and the reduced operative time highlight the potential benefits of this technique. More extensive prospective studies are required to make stapled anastomosis a routine practice in pancreaticoduodenectomy.

Conclusion

Pancreaticoduodenectomy was found to be a safe and effective reconstructive procedure, with no incidences of anastomotic leakage, a low incidence of bleeding at 2.59% all managed endoscopically, and a median anastomosis time of 10 ± 1 minutes. The overall morbidity of 18.1, DGE rate of 12.1, and average hospital stay of 9 + 3 days are in line with international standards, affirming that high-quality results are feasible in resource-constrained environments. To the best of our knowledge, this is the first study from Pakistan documenting the outcomes of stapled anastomosis in Whipple surgery. Future multicentre studies should be encouraged to confirm these results and make stapled anastomosis a standard practice in pancreaticoduodenectomy.

References

- Hajibandeh, S., Hajibandeh, S., Khan, R. M. A., et al. Stapled anastomosis versus hand-sewn anastomosis of gastro/duodenojejunostomy in pancreaticoduodenectomy: A systematic review and meta-analysis. *Int J Surg.*, 2017; 48:1-8. DOI:10.1016/j.ijsu.2017.09.071.
- Okamoto, H., Yamamoto, A., Kawashima, K., & Fukasawa, T. Simpler and safer anastomosis by pancreaticogastrostomy using a linear stapler after pancreaticoduodenectomy. *Medicine (Baltimore)*, 2024. DOI:10.1097/MD.00000000000034321.
- Vanstraelen, S., Coosemans, W., Depypere, L., et al. Real-life introduction of powered circular stapler for esophagogastric anastomosis: cohort and propensity matched score study. *Diseases of the Esophagus*, 2023; 36(5). DOI:10.1093/dote/doac073.
- Sato, N., Yabuki, K., Kohi, S., Mori, Y., et al. Stapled gastro/duodenojejunostomy shortens reconstruction time during pylorus-preserving pancreaticoduodenectomy. *World Journal of Surgery*, 2019. DOI:10.1007/s00268-019-04912-6.
- Fiorentini, G., Zironda, A., Fogliati, A., Warner, S., & Cleary, S. The "double-fired" gastro-jejunostomy as a form of improved efficiency during Whipple procedure. *HPB*, 2024. DOI:10.1016/j.hpb.2024.01.003.
- Jiang, N., Zhang, L., Jiang, L., et al. A reinforced suture method for stapled gastrointestinal anastomosis to reduce gastrointestinal hemorrhage during Whipple operation in laparoscopy. *Annals of Surgical Oncology*, 2022. DOI:10.1245/s10434-022-12495-4.
- Mohammed S, Van Buren li G, McElhany A, Silberfein EJ, Fisher WE. Delayed gastric emptying following pancreaticoduodenectomy: Incidence, risk factors, and healthcare utilization. *World J Gastrointest Surg.* 2017 Mar 27;9(3):73-81.
- Fu Z, Gao S, Wu X, Qin J, Dang Z, Wang H, et al. Hand-sewn gastrojejunal anastomosis reduces delayed gastric emptying after pancreaticoduodenectomy: A single-center retrospective clinical study of 1,077 consecutive patients. *Surgery.* 2024 Apr;175(4):1140-6.
- Fiorentini G, Zironda A, Fogliati A, Warner S, Cleary S, Smoot R, et al. The "double-fired" gastro-jejunostomy as a form of improved efficiency during Whipple procedure. *HPB (Oxford)*. 2024 Apr;26(4):512-20.
- Okamoto H, Yamamoto A, Kawashima K, Fukasawa T. Simpler and safer anastomosis by pancreaticogastrostomy using a linear stapler after pancreaticoduodenectomy. *Medicine (Baltimore)*. 2024 Nov 8;103(45):e40456.
- Takagi K, Umeda Y, Yoshida R, Fuji T, Yasui K, Kimura J, et al. Surgical techniques of gastrojejunostomy in robotic pancreatoduodenectomy: robot-sewn versus stapled gastrojejunostomy anastomosis. *J Clin Med.* 2023 Jan;12(2):732.
- Murata, Y., Tanemura, A., Kato, H., et al. Superiority of stapled side-to-side gastrojejunostomy over conventional hand-sewn end-to-side gastrojejunostomy in pancreaticoduodenectomy. *Surgical Today*, 2020; 50(1):13-21. DOI:10.1007/s00595-019-01853-4.
- Ghafoor, T., Sabir, S., Tumrani, R., et al. Outcome comparison of stapled versus hand-sewn anastomosis in elective gastrointestinal surgeries. *Pakistan Journal of Health Sciences*, 2022; 3(04):165-170. DOI:10.54393/pjhs.v3i04.154.
- Brillantino, A., Sandoval Sotelo, M. L., Cricri, A. M., et al. Hand-Sewn Versus Stapled Small Bowel Anastomoses in Patients With Secondary Mesenteric Ischemia. *Journal of Surgical Research*, 2023; 281:52-56. DOI:10.1016/j.jss.2022.08.007.
- Fu Z, Gao S, Wu X, Qin J, Dang Z, Wang H, et al. Hand-sewn gastrojejunal anastomosis reduces delayed gastric emptying after pancreaticoduodenectomy: a single-center retrospective clinical study of 1,077 consecutive patients. *Surgery.* 2024 Apr;175(4):1140-1146. doi:10.1016/j.surg.2023.12.001
- Murata Y, Tanemura A, Kato H, Kuriyama N, Azumi Y, Kishiwada M, et al. Superiority of stapled side-to-side gastrojejunostomy over conventional hand-sewn end-to-side gastrojejunostomy for reducing the risk of primary delayed gastric emptying after subtotal stomach-preserving pancreaticoduodenectomy. *Surg Today.* 2020;50(1):13-21. doi:10.1007/s00595-019-01853-4
- Karim SAM, Abdulla KS, Abdulkarim QH, Rahim FH. The outcomes and complications of pancreaticoduodenectomy (Whipple procedure): cross sectional study. *Int J Surg.* 2018 Apr;52:383-387. doi:10.1016/j.ijsu.2018.02.058

18. Ghafoor T, Sabir S, Tumrani R, Malik ZU, Arshad M, Saeed M, et al. Outcome comparison of stapled versus hand-sewn anastomosis in elective gastrointestinal surgeries. *Pak J Health Sci.* 2022;3(04):165–170. doi:10.54393/pjhs.v3i04.154
19. Sato N, Yabuki K, Kohi S, Mori Y, Minagawa N, Tamura T, et al. Stapled gastro/duodenojejunostomy shortens reconstruction time during pylorus-preserving pancreaticoduodenectomy. *World J Gastroenterol.* 2019;25(19):2337–2344. doi:10.3748/wjg.v19.i48.9399
20. Okamoto H, Yamamoto A, Kawashima K, Fukasawa T. Simpler and safer anastomosis by pancreaticogastrostomy using a linear stapler after pancreaticoduodenectomy. *Medicine (Baltimore).* 2024. doi:10.1097/MD.00000000000034321
21. Takagi K, Umeda Y, Yoshida R, Fuji T, Yasui K, Kimura J, et al. Surgical techniques of gastrojejunostomy in robotic pancreatoduodenectomy: robot-sewn versus stapled gastrojejunostomy anastomosis. *J Clin Med.* 2023 Jan;12(2):732. doi:10.3390/jcm12020732