

# Is Two the Magic Number? Evaluating the Efficacy and Safety of Two-Stitch Laparoscopic Repair for Small Duodenal Perforations

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**Abstract:** **Background:** Duodenal ulcer (DU) perforations have historically been managed by several surgical techniques, including Graham's patch, Cellan-Jones repair, or in complicated or recurrent cases definitive ulcer surgery (e.g., truncal vagotomy and pyloroplasty). The traditional Cellan-Jones repair for perforated duodenal ulcers involves placing three interrupted sutures reinforced with an omental patch. However, in small ulcers ( $\leq 5$  mm), placing multiple sutures may result in excessive tissue tension or suture overlap, potentially impairing healing. This study evaluated the outcomes of a simplified two-stitch laparoscopic repair for small duodenal perforations. **Objective:** To evaluate the efficacy, safety, postoperative leak rate, need for re-exploration, complications, 30-day mortality, and recurrence rates associated with two-stitch laparoscopic repair in patients with small duodenal perforations ( $\leq 5$  mm). **Methods:** This retrospective single-center cohort study analyzed 62 adult patients who underwent laparoscopic two-stitch repair of small duodenal perforations ( $\leq 5$  mm) between January 2014 and December 2023. Clinical data were gathered from operative reports, inpatient medical records, and outpatient follow-ups. The primary outcome was the efficacy and safety of two-stitch laparoscopic repair; secondary outcomes included postoperative leak rate, re-exploration, complications (e.g., wound infections or intra-abdominal collections), length of hospital stay, 30-day mortality, and recurrence at six-and twelve-month follow-up. **Results:** A total of 62 patients (mean age:  $50.2 \pm 13.1$  years; range: 21–77 years) underwent laparoscopic two-stitch closure. The mean ulcer diameter was  $3.0 \pm 1.5$  mm (range: 1–5 mm). All procedures were completed laparoscopically with no conversions to open surgery. No postoperative leaks, suture-line dehiscence, or mechanical failures necessitating re-exploration were observed. There were no major complications (e.g., wound infections or intra-abdominal abscess) and no 30-day mortality. The mean operative time was  $62 \pm 14$  minutes, and the mean hospital stay was  $4.6 \pm 1.3$  days. At six-and twelve-month follow-ups, no ulcer recurrence was detected at the original perforation site. **Conclusion:** This retrospective analysis indicates that a standardized two-stitch laparoscopic repair for small duodenal perforations ( $\leq 5$  mm) is highly effective, demonstrated by a zero postoperative leak rate and an absence of ulcer recurrence at one year. By avoiding suture overcrowding, the technique simplifies the surgical procedure while maintaining optimal healing conditions. Further prospective, multicenter investigations are warranted to validate these findings and refine suture strategies in the management of small duodenal perforations.

**Keywords:** Duodenal ulcer perforation, laparoscopic repair, two-stitch technique, omental patch, minimally invasive surgery

## 1. Introduction

Duodenal ulcer (DU) perforation remains a critical surgical emergency, posing significant challenges despite advancements in medical therapy, such as proton pump inhibitors (PPIs) and enhanced *Helicobacter pylori* eradication regimens [1]. Historically, open surgical methods like Graham's patch, introduced in 1937 [2], and the Cellan-Jones technique, described in 1929 [3], have been widely utilized. These techniques typically involve placing multiple interrupted sutures, reinforced by omental tissue, to securely close the perforation and prevent peritoneal contamination. However, the advent and increased adoption of minimally invasive surgery (MIS) have encouraged surgeons to shift towards laparoscopic methods due to documented advantages like reduced postoperative pain, fewer wound complications, and accelerated patient recovery [4, 5].

Despite the increasing adoption of laparoscopic surgery, there is ongoing debate regarding the optimal suture technique for small DU perforations ( $\leq 5$  mm). Traditional approaches advocate multiple sutures; however, recent evidence suggests that excessive suturing in very small defects may increase local ischemia and tissue tension, potentially elevating complication risks [6]. As an alternative, a simplified two-stitch technique, combined with omental reinforcement, has emerged as a promising strategy, aiming to achieve secure closure with fewer sutures and

reduced tissue tension [6, 7]. While initial reports on this minimalistic approach have shown promising outcomes—indicating low recurrence rates and minimal postoperative complications—some surgeons still question its efficacy, particularly in patients with significant peritoneal contamination or compromised tissue integrity [8, 9].

This study specifically evaluates the safety, efficacy, and clinical outcomes associated with a standardized two-stitch laparoscopic repair reinforced with an omental patch in patients presenting with duodenal perforations of 5 mm or less. The research sought to address both short- and long-term measures of success, specifically: the incidence of suture-line leakage within the first two weeks after surgery, the occurrence of wound infections or intra-abdominal abscesses, the need for surgical re-intervention due to mechanical failures, and the comparison of operative times and anesthetic durations against historical data from traditional laparoscopic or open methods. Another crucial endpoint involved assessing both 30-day mortality and the recurrence of duodenal ulceration at the repair site during six- and twelve-month follow-up intervals.

By thoroughly examining these parameters, the study aimed to clarify whether the reduced complexity of a two-stitch approach could maintain high levels of procedural safety and clinical efficacy. Additionally, the design considered patient selection factors, including duodenal perfusion status and

relevant comorbidities, to delineate the circumstances in which this simplified technique might offer the greatest benefit. Moreover, the successful adoption of a two-stitch approach may offer significant clinical and economic benefits, especially in resource-limited settings where advanced laparoscopic equipment or extensive training might be constrained [5, 11]. Nonetheless, effective application depends greatly on patient selection criteria, meticulous perioperative management-including thorough peritoneal lavage, appropriate use of drains, and diligent postoperative monitoring-as well as the surgeon's proficiency with laparoscopic techniques [8, 9, 11]. As laparoscopic procedures continue to evolve, clarifying optimal strategies for small DU perforations could help standardize care, minimize unnecessary complexity, and promote wider adoption of minimally invasive surgery across diverse healthcare environments [11, 12].

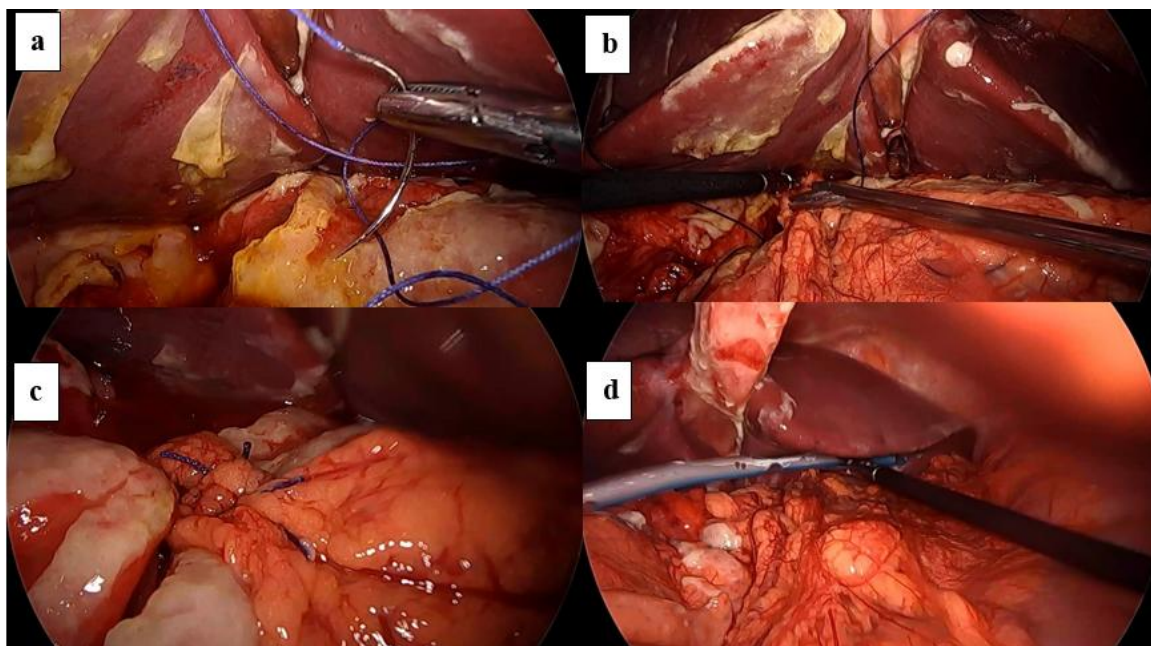
## 2.Methods

This single-center retrospective cohort study was conducted by the Department of General Surgery at KAHER's J. N. Medical College, Belagavi, evaluating patients presenting with duodenal perforations of  $\leq 5$  mm diameter between January 2014 and December 2023. Institutional review board approval was obtained, and patient confidentiality was maintained throughout. Patients aged 18 years or older with radiologic or intraoperative confirmation of small ( $\leq 5$  mm) duodenal perforations who underwent laparoscopic two-stitch repair were included. Those with perforations larger than 5 mm, hemodynamic instability necessitating emergent laparotomy, concomitant gastrointestinal perforations, significant cardiopulmonary compromise or malignancy, and incomplete medical records were excluded to maintain homogeneity and reduce confounding factors.

Electronic medical records, operative logs, and follow-up documentation were reviewed to collect demographic,

clinical, operative, and postoperative data. Variables assessed included patient demographics, clinical presentation details, imaging findings, perforation location and size, operative duration, laparoscopic techniques, postoperative complications, hospital stay, mortality, and recurrence rates. All procedures were performed by experienced laparoscopic surgeons following a standardized two-stitch technique. After establishing pneumoperitoneum, thorough peritoneal lavage with warm saline was carried out. Perforations were closed with two interrupted non-absorbable sutures placed transversely to minimize luminal narrowing, reinforced by an omental patch. Repair integrity was verified intraoperatively using air insufflation or methylene blue tests, followed by selective drain placement. Postoperative care included intravenous antibiotics, analgesics, PPIs, early mobilization, and gradual resumption of oral intake. Follow-up visits occurred at regular intervals up to one year, with selective endoscopic evaluation. Follow-up visits occurred at regular intervals up to one year, with selective endoscopic evaluation.

Data were analyzed using standard statistical software, calculating descriptive statistics such as means and standard deviations for continuous variables and frequencies for categorical outcomes. Primary endpoints included postoperative leak rate, complications, and mortality; secondary endpoints focused on hospital stay length and ulcer recurrence at six-and twelve-month intervals. Outcomes were compared with published benchmarks from laparoscopic and open DU perforation repairs, with statistical significance defined as  $p < 0.05$ , although rigorous hypothesis testing was limited by the study's retrospective, non-comparative design. Figure 1 illustrates the stepwise laparoscopic repair technique, including perforation identification, omental patch application, defect closure, and drain placement.



**Figure 1:** Figure 1. Stepwise laparoscopic repair of duodenal perforation: (a) Identification of the perforation on the anterior duodenal wall; (b) Omentum positioned over the defect with interrupted sutures; (c) Completed closure with omental reinforcement; and (d) Final drain placement in the subhepatic space

### 3.Results

A total of 62 patients met the inclusion criteria, each presenting with duodenal perforations of 5 mm or less in diameter. The mean age of the patients was  $50.2 \pm 13.1$  years, ranging from 21 to 77 years, with men comprising 68% of the cohort and women 32%. Hypertension (22%), diabetes

mellitus (18%), and chronic NSAID use (10%) were the most frequently observed comorbid conditions. The time from symptom onset to hospital admission ranged between 6 to 48 hours. Among the cohort, 46 patients (74%) had a previous history of peptic ulcer disease, with 28 (45%) having undergone prior medical therapy for *Helicobacter pylori* infection or chronic acid suppression therapy, as shown in Table 1.

**Table 1:** Patient Demographics & Clinical Characteristics

Variable	Value
Mean Age (years)	$50.2 \pm 13.1$ (Range: 21–77)
Gender	Male: 42 (68%)   Female: 20 (32%)
Hypertension	14 (22%)
Diabetes Mellitus	11 (18%)
Chronic NSAID Use	6 (10%)
History of Peptic Ulcer Disease	46 (74%)
Prior <i>H. pylori</i> Therapy	28 (45%)

Intraoperative assessments revealed that 55 perforations (89%) were located in the first part (D1) of the duodenum, while the remaining 7 (11%) were found in the second part (D2). The mean perforation size recorded was  $3.0 \pm 1.5$  mm, with the majority (58%) measuring between 2 and 4 mm. The mean operative time, measured from skin incision to closure,

was  $62 \pm 14$  minutes, with anesthetic duration averaging  $70 \pm 15$  minutes. Mild to moderate peritoneal contamination was encountered in 40 patients (65%), necessitating thorough peritoneal lavage with 2–3 liters of warm saline, as outlined in Table 2.

**Table 2:** Perforation Characteristics & Intraoperative Findings

Parameter	Value
Perforation Location	
D1 (First part of duodenum)	89% (n=55)
D2 (Second part of duodenum)	11% (n=7)
Mean Perforation Size (mm)	$3.0 \pm 1.5$ (Range: 1–5 mm)
Peritoneal Contamination (Mild–Moderate)	40 (65%)

No significant hemorrhage or extensive necrosis necessitating conversion to open surgery was observed, and all cases were completed laparoscopically without technical failure. The mean operative time was  $62 \pm 14$  minutes, with an average anesthetic duration of  $70 \pm 15$  minutes. Peritoneal

lavage using 2–3 liters of saline was performed in all cases. Prophylactic drain placement was utilized in 77% of patients, and the mean hospital stay was  $4.6 \pm 1.3$  days, as detailed in Table 3.

**Table 3:** Operative and Perioperative Outcomes

Parameter	Value
Mean Operative Time (minutes)	$62 \pm 14$
Mean Anaesthetic Duration (minutes)	$70 \pm 15$
Peritoneal Lavage Volume	2–3 Liters
Drain Placement	48 (77%)
Mean Hospital Stay (days)	$4.6 \pm 1.3$ (Range: 3–8)

Postoperative outcomes demonstrated a zero percent postoperative leak rate, as no patient experienced suture-line dehiscence or leakage. Prophylactic closed-suction abdominal drains were placed in 48 patients (77%), typically removed around postoperative day 4. Early postoperative complications were minor and included superficial port-site

infections in two patients (3.2%), both resolving promptly with conservative treatment, and one patient (1.6%) who developed a small intra-abdominal fluid collection managed successfully by ultrasound-guided aspiration and antibiotics. No patients required re-exploration due to mechanical failure of the repair, as summarized in Table 4.

**Table 4:** Postoperative Complications & Short-Term Outcomes

Complication	Incidence
Port-site Infection	2 (3.2%)
Small Fluid Collection	1 (1.6%)
Suture-Line Leak	0%
Re-exploration Required	0%
30-Day Mortality	0%



Follow-up completion was excellent, with 97% and 94% of patients returning at six months and one year, respectively. Clinical evaluations and selective endoscopic examinations revealed no ulcer recurrences at the original repair site during either follow-up interval. Four patients reported intermittent dyspeptic symptoms at the one-year follow-up; however, endoscopic investigations showed only mild gastritis or unrelated functional gastrointestinal conditions. Adherence

to proton pump inhibitor therapy for the recommended 8–12 weeks was approximately 85%. No deaths occurred within the 30-day postoperative period. Two patients died from unrelated causes—one from myocardial infarction and another due to complications of a cerebrovascular event—more than twelve months after surgery, and were thus excluded from the primary analysis, as indicated in Table 5.

**Table 5: Follow-Up Completion & Ulcer Recurrence**

Follow-Up Period	Completion Rate	Ulcer Recurrence
6 Months	97% (n = 60)	0%
12 Months	94% (n = 58)	0%

## 4. Discussion

The present study provides a detailed analysis of clinical outcomes following a two-stitch laparoscopic repair technique for small duodenal perforations ( $\leq 5$  mm). The findings reveal a zero percent postoperative leak rate, no need for surgical re-exploration, and no mortality within 30 days. Additionally, the mean operative time was  $62 \pm 14$  minutes, and the mean duration of hospital stay was  $4.6 \pm 1.3$  days. These outcomes compare favourably with historical data on both laparoscopic and open surgical repairs, suggesting that a minimal-suture approach effectively achieves secure closure without increasing the risk of complications [1, 4, 6].

Historically, management of perforated duodenal ulcers involved open surgical techniques, notably Graham's patch and the Cellan-Jones method, both relying on multiple interrupted sutures reinforced by omental tissue [2, 3]. These traditional open methods have proven effective but typically involve longer operative times, increased postoperative pain, and prolonged hospitalization compared to minimally invasive approaches. While the open Cellan-Jones repair remains the gold standard for duodenal perforation repair, attempts to replicate this in laparoscopic surgery have been met with technical difficulties [4, 5]. Challenges such as limited maneuverability, intracorporeal knot tying, and maintaining precise suture placement under laparoscopic vision make multi-suture techniques like the three-stitch repair more complex in minimally invasive settings. Various modifications, including the omental patch technique, circumferential knotting of the omentum around the defect, and reinforced suturing, have been introduced to mitigate concerns regarding leakage. However, growing clinical experience from recent studies suggests that a two-stitch repair is sufficient to effectively seal the defect and prevent postoperative leaks, offering a more straightforward and efficient approach without compromising safety.

The central concern in minimally invasive duodenal ulcer repair is maintaining secure tissue approximation without creating undue tension or ischemia. Traditional laparoscopic approaches using multiple sutures may inadvertently lead to tissue crowding and impaired perfusion at the repair site, especially in small defects [6, 7]. In contrast, the two-stitch approach examined in this study appears to minimize such risks. Our findings align with prior studies, which suggest that minimal-suture techniques reduce mechanical stress and enhance tissue viability [6, 10].

Additionally, in conventional three-stitch repairs, different suture materials are often used for the middle stitch to prevent misidentification during knot tying, adding an extra step to the procedure. While this approach helps in suture differentiation, it may increase operative complexity and prolong surgical time. By eliminating the need for a middle stitch and the associated material distinction, the two-stitch technique simplifies the repair process, allowing for a more efficient and technically straightforward procedure. The complete absence of postoperative leaks or mechanical failures in the current cohort strongly supports the hypothesis that two strategically placed stitches, reinforced by omental tissue, are sufficient for secure closure without compromising safety.

Effective intraoperative management, particularly meticulous peritoneal lavage and selective prophylactic drainage, likely contributed to the low complication rate observed in this cohort. Previous research underscores the importance of thorough peritoneal irrigation in reducing postoperative infections and fluid collections, particularly given the contaminated nature of perforated ulcers [1, 8, 9]. Furthermore, although the routine use of prophylactic drains remains controversial in laparoscopic duodenal ulcer repairs, selective drain placement in this study may have facilitated early detection and management of fluid collections, as evidenced by the low incidence of postoperative complications [11, 12]. The absence of severe complications such as intra-abdominal abscesses or re-exploration due to leakage emphasizes the importance of meticulous surgical technique and perioperative management.

The study's favourable long-term outcomes, characterized by the absence of ulcer recurrence at the original site during the six- and twelve-month follow-ups, align well with existing literature reporting recurrence rates below 2% in similarly selected patient populations undergoing laparoscopic repair [6, 9, 10]. High adherence (approximately 85%) to postoperative proton pump inhibitor therapy likely supported mucosal healing and prevention of recurrence.

Despite these positive findings, the retrospective, single-center nature of this study limits broad generalizability, and future prospective randomized trials would further strengthen the evidence base. Nonetheless, this analysis provides robust clinical support for the use of a simplified two-stitch laparoscopic technique in carefully selected patients, suggesting that fewer sutures can effectively reduce operative

complexity and enhance recovery without compromising the safety and durability of the duodenal repair [5, 8, 10].

## 5. Conclusion

This study demonstrates that two-stitch laparoscopic repair is an effective, safe, and technically simplified approach for managing small duodenal perforations ( $\leq 5$  mm). The results—zero postoperative leaks, no need for surgical re-exploration, minimal complications, no 30-day mortality, and no ulcer recurrence at six and twelve months—support its reliability. Compared to traditional multi-suture techniques, the two-stitch method offers shorter operative times, reduced hospital stays, and faster recovery, making it a practical alternative in laparoscopic duodenal ulcer management.

The success of this approach is attributed to careful patient selection, meticulous peritoneal lavage, precise laparoscopic technique, and appropriate postoperative management, including early oral intake, effective analgesia, and proton pump inhibitor therapy. While these findings highlight the advantages of a simplified suturing approach, the study's retrospective, single-center nature necessitates further prospective, multicenter trials to confirm its broader applicability. Wider adoption of two-stitch laparoscopic repair could streamline surgical practice, enhance patient outcomes, and optimize healthcare resource utilization, offering a safe and efficient solution for duodenal perforation management.

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