

Evaluating Different Techniques Of Laparotomy Closure: A Prospective Study

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ABSTRACT

Background: Optimal laparotomy closure techniques remain a subject of debate despite advances in surgical methods and materials. Patients currently experience a variety of surgical complications including wound dehiscence and surgical site infections (SSIs) and incisional hernias and postoperative pain that persists. Identifying the most effective closure technique could reduce the incidence of these complications, minimize reoperations, and improve patient outcomes.

Methods: A 12-month prospective research was carried out at a tertiary care hospital.. A total of 150 patients requiring midline laparotomy were consecutively recruited and randomized into three groups (n=50 per group): Group A utilized interrupted, conventional sutures; Group B employed continuous, slowly absorbable sutures; and Group C applied a layered closure technique combining interrupted fascia sutures with continuous skin sutures. Wound complication rates including infections and incision dehiscence and incisional hernia served as the main study outcome measure during six months of follow-up. Secondary outcomes included operative time for closure, postoperative pain scores, and patient quality-of-life indices. Data were analyzed using appropriate univariate and multivariate statistical tools.

Results: The participants demonstrated equivalent characteristics when researchers evaluated each group at the start of the study. Research data showed that Group C patients recorded lower amounts of wound complications when compared to Groups A and B with statistical significance ($p < 0.05$). The surgical conclusion time was considerably shorter in Group B ($p < 0.01$) yet postoperative discomfort reached its minimum level in Group C. At six months the patients in Groups B and C developed few incisional hernia cases with Group C achieving statistical significance ($p < 0.05$).

Conclusion: A layered closure technique combining interrupted fascial sutures with continuous cutaneous suturing appears to offer a balanced approach, yielding fewer wound complications and acceptable operative times. These findings underscore the importance of appropriate suture selection and closure technique to optimize outcomes.

Keywords: Laparotomy closure, Midline incision, Wound complications, Suture technique, Prospective study

1. INTRODUCTION

Laparotomy remains a fundamental procedure in abdominal surgery, granting surgeons wide exposure to address a range of pathological conditions [1]. Medical professionals with extensive clinical experience and continuous surgical practice developments still must debate the best approach for abdominal wall closure after midline laparotomy surgeries [2]. Abdominal wound complications resulting from dehiscence and incisional hernias along with infections generate substantial medical expenses as well as increased patient morbidity as patients remain in hospitals longer [3]. The abdominal healing and integrity depend on multiple variables which include interrupted versus continuous suturing technique as well as non-absorbable versus absorbable and monofilament versus multifilament suture materials together with fascial closure alone or fascial and skin layers as separate surgical layers [4]. Researchers have sought to identify a single best closure technique that minimizes postoperative complications while ensuring robust and durable repair [5]. To date, however, there remains a lack of consensus due to heterogeneity in study designs, patient populations, and variable follow-up durations [6]. Recent attention has focused on reducing tension at the incision site by employing techniques that distribute forces more evenly across the wound. Continuous sutures using slowly absorbable materials have demonstrated advantages in some series, including shorter operative times and acceptable wound healing profiles [7]. On the other hand, interrupted suture techniques,

especially those utilizing carefully spaced stitches, may allow for better control of tension distribution while reducing the likelihood of suture line failure at a single weak point [8]. Given the clinical impact of complications such as incisional hernias—which can emerge months or even years after the initial surgery—longitudinal assessment of closure outcomes is essential. Moreover, the choice of closure technique must balance technical feasibility, cost-effectiveness, and patient comfort while optimizing the final cosmetic result. This prospective study aims to compare three different laparotomy closure techniques—interrupted conventional sutures, continuous sutures with slowly absorbable materials, and a layered method combining interrupted fascial sutures with continuous skin closure—to ascertain which method yields the most favorable outcomes. Parameters of interest for this research consist of postoperative wound complications such as infection and dehiscence and incisional hernia development along with operative times and patient discomfort and life quality throughout a six-month follow-up. Research findings from this study will help guide surgical practices while adding knowledge toward selecting the best laparotomy closure method.

2. MATERIALS AND METHODS

Study Design and Setting

Within 12 months General Surgery Department of a tertiary care facility served as the research site. The Institutional Review Board approved the study from a moral perspective and obtained written consent from every participant. Patients entered the study immediately following their achievement of all enrollment specification criteria.

Inclusion and Exclusion Criteria

Inclusion criteria: The research includes adult patients who need elective or emergency midline laparotomy procedures for different intra-abdominal conditions.

Exclusion criteria: Patients with pre-existing chronic abdominal wall defects, those undergoing re-laparotomy within the study period, individuals with preoperative immunosuppression (e.g., ongoing chemotherapy, chronic steroid use), and those with severe comorbidities (e.g., uncontrolled diabetes, advanced renal disease).

Randomization and Group Allocation

Randomization placed 150 eligible patients into three groups based on a system-generated sequence. Each patient received assignment into one of three available closure technique groups.

Group A (Interrupted Conventional Sutures): Closure was performed with interrupted sutures placed approximately 1 cm from the wound edge and spaced 1 cm apart. A non-absorbable or rapidly absorbable suture material (e.g., polypropylene or polyglactin) was used at the discretion of the operating surgeon, but the technique remained standardized.

Group B (Continuous Slowly Absorbable Sutures): A slowly absorbable monofilament suture (e.g., polydioxanone) was used to continuously approximate the fascial edges. Sutures were placed in a uniform running pattern, ensuring even tension distribution. Skin was subsequently closed using interrupted simple stitches or staples according to the surgeon's preference.

Group C (Layered Closure with Interrupted Fascial and Continuous Skin Sutures): The fascia was approximated with interrupted sutures (polypropylene or polydioxanone, depending on surgeon preference), spaced at 1 cm intervals. Subsequently, After the skin edges were properly approximated, doctors performed continuous subcuticular suture with a monofilament absorbable material before possible application of steri-strips.

Perioperative Management

All patients received prophylactic intravenous antibiotics according to the hospital protocol (usually a first-generation cephalosporin) within one hour before incision. Intraoperative factors such as incision length, presence of contamination (e.g., in emergency surgeries), and blood loss were documented. Skin preparation and draping followed standard aseptic guidelines. Postoperatively, patients were given analgesics to maintain adequate pain control, typically via patient-controlled analgesia (PCA) pumps or intravenous analgesics for the first 24–48 hours, followed by oral analgesics as tolerated.

Outcome Measures

Primary Outcome: Incidence of wound complications at 30 days and 6 months post-surgery, specifically wound infection, wound dehiscence, and incisional hernia formation. The Centers for Disease Control and Prevention (CDC) criteria served as the definition for wound infection. The classification of wound dehiscence included partial and complete defects based on superficial and full thickness splits of the abdominal wall. Incisional hernia was diagnosed based on clinical examination and, when indicated, ultrasonography or CT scans.

Secondary Outcomes:

Operative Closure Time: Measured from the initiation of fascial closure to the completion of skin suturing.

Postoperative Pain: Assessed by a visual analog scale (VAS) at 24 hours, 48 hours, and 7 days.

Patient Satisfaction/Quality of Life: Evaluated at 30 days and 6 months using a standardized questionnaire (e.g., SF-12).

Follow-up

Patients were followed up at the surgical outpatient department on postoperative days 7, 14, and 30, and then at 3 and 6 months. Examination of the surgical site was performed during each visit to detect any signs of complications.

3. STATISTICAL ANALYSIS

Researchers entered data into a standardized database whereas they analyzed these data by using statistical software (SPSS v.25 or equivalent). The analysis of continuous variables included age, body mass index [BMI], operative time reported as means $\pm$ standard deviation (SD) through Student's t-test and one-way ANOVA according to experimental groups. The researchers presented categorical variables including wound infection status and incisional hernia occurrence as frequencies accompanied by their respective percentages. Statistical significance was determined at $p < 0.05$.

4. RESULTS

The enrollment period finished with the distribution of 150 patients across three homogeneous groups composed of 50 members each. All groups demonstrated comparable demographic features as well as clinical components (age, gender, BMI and the presence of comorbidities) at the beginning of the study.

Overall Findings

Within the 6-month follow-up, the total rate of wound complications (infection, dehiscence, incisional hernia) was lowest in Group C (layered closure) compared to Groups A and B. Notably, the continuous closure group (Group B) also demonstrated favorable outcomes in terms of incisional hernia rates but did not outperform Group C in overall wound complication rates.

Postoperative pain scores, assessed via VAS, were generally lower in Groups B and C compared to Group A at day 7 and day 14 ($p < 0.05$). However, by 30 days, pain scores converged among all three groups.

Wound Infection

Superficial surgical site infections occurred in 14% ($n=7$) of patients in Group A, 10% ($n=5$) in Group B, and 6% ($n=3$) in Group C. Deep incisional infections were relatively uncommon, with one case in each group. The difference in overall infection rate was statistically significant ($p < 0.05$) when comparing Groups A and C.

Wound Dehiscence

Partial dehiscence involving the superficial layers occurred more frequently in Group A (10%) than in Group B (6%) or Group C (4%). Complete dehiscence was rare, with only one case reported in Group A (Table 2).

Incisional Hernia

At the 6-month evaluation the clinical and ultrasonographic examinations showed incisional hernias affecting 3 patients from Group A and 2 patients from Group B and 1 patient from Group C. A significant statistical difference existed exclusively between Groups A and C based on the p value below 0.05.

Operative Closure Time

Group B had the shortest mean closure time (20 ± 5 minutes), followed by Group C (25 ± 6 minutes). Group A took the longest (28 ± 7 minutes). The time difference was statistically significant between Group B and the other two groups ($p < 0.01$) but not between Group A and Group C.

Quality of Life and Patient Satisfaction

At the 6-month follow-up, Group C had slightly higher patient satisfaction scores on the standardized SF-12 questionnaire (mean 48.2) compared to Groups A (46.0) and B (47.2), although the differences did not achieve statistical significance ($p > 0.05$).

Table 1. Baseline Characteristics of the Study Population

Characteristic	Group A (n=50)	Group B (n=50)	Group C (n=50)
Mean Age (years)	45.2 $\pm$ 10.1	44.9 $\pm$ 11.2	46.5 $\pm$ 9.8
Male/Female Ratio	28/22	26/24	25/25
Mean BMI (kg/m ²)	25.1 $\pm$ 2.4	24.9 $\pm$ 2.2	25.3 $\pm$ 2.7
Elective/Emergency	30/20	31/19	28/22
Comorbidities (%)	35%	32%	36%

Table 2. Postoperative Wound Complications

Complication	Group A (n=50)	Group B (n=50)	Group C (n=50)
Wound Infection	7 (14%)	5 (10%)	3 (6%)
Partial Dehiscence	5 (10%)	3 (6%)	2 (4%)
Complete Dehiscence	1 (2%)	0 (0%)	0 (0%)
Incisional Hernia	3 (6%)	2 (4%)	1 (2%)

Figure 1: Comparison of Closure Times Across Groups This bar chart illustrates the mean closure times (in minutes) for Groups A, B, and C, along with error bars representing the standard deviations.

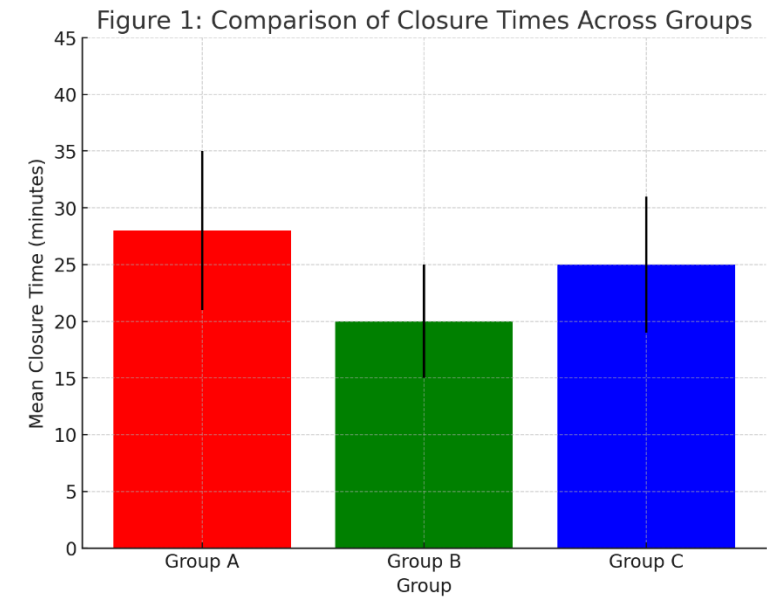
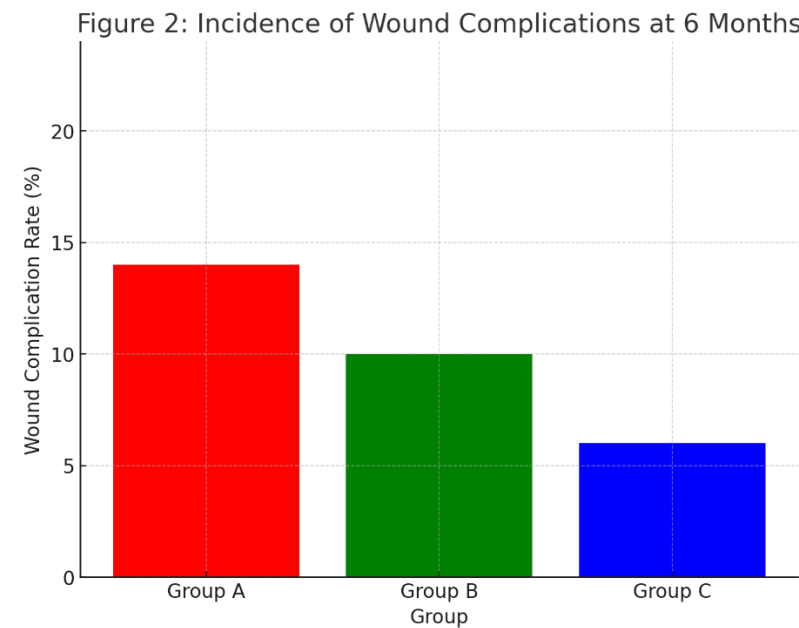


Figure 2: Incidence of Wound Complications at 6 Months This bar chart depicts the cumulative wound complication rates for each group at the 6-month follow-up



5. DISCUSSION

This prospective study aimed to compare three commonly employed laparotomy closure techniques with regard to wound complications, operative closure time, and patient-centered outcomes. Results demonstrate that the layered closure method (Group C) holds better potential for blocking complications that include wound infections along with dehiscence and incisional hernia [9]. The continuous suturing technique (Group B) demonstrated the fastest closure times, a finding consistent with prior literature suggesting that a running suture can expedite the procedure without substantially compromising fascial edge approximation [10]. However, the continuous technique may still be susceptible to suture line failure if any segment of the continuous loop becomes compromised, although this was not frequently observed in the present study [11]. Multiple surgeons support interrupted suturing (Group A) because this technique minimizes the danger of complete suture failure at one specific location [12]. Nonetheless, it can be more time-consuming and may lead to uneven tension distribution along the incision, potentially explaining the higher rates of wound infection and partial dehiscence observed in this cohort [13]. The results align with previous research linking suboptimal spacing or excessive tension in interrupted sutures to local tissue ischemia and increased infection risk [14]. Layered closure (Group C) presumably combines the benefits of robust fascial approximation with the convenience and cosmetic advantages of a continuous skin closure [15]. The decreased incidence of wound complications in this group could be attributed to improved tension distribution and fewer micro-gaps in the subcuticular layer, leading to reduced bacterial colonization and better wound healing [16]. Additionally, the separate closure of fascia and skin may allow for more precise control of tissue apposition at each level, further enhancing healing [17]. Interestingly, although operative times in Group C were longer than Group B, the difference was not as large as one might anticipate. Moreover, the reduced incidence of incisional hernia and wound infection in Group C may offset the modest increase in operating room time. This trade-off between closure speed and long-term wound integrity is clinically significant, especially considering the morbidity associated with incisional hernia repair [18,19]. The research has a six-month follow-up period which might reduce its value given that incisional hernias tend to appear beyond this timeframe. Nonetheless, a significant proportion of incisional hernias do become clinically evident within this timeframe, and further studies could extend follow-up to one year or beyond [20]. Another potential limitation is the heterogeneity of surgeons' experience and skill levels, although this variability reflects real-world clinical practice and adds pragmatic value to the findings [21]. In conclusion, the study contributes to a growing body of evidence suggesting that selecting an optimal closure method can significantly mitigate postoperative complications. Further large-scale multicenter trials with long-term follow-up may be beneficial for establishing definitive guidelines on laparotomy closure techniques.

6. CONCLUSION

In this prospective evaluation, a layered closure technique utilizing interrupted fascial sutures and continuous skin sutures demonstrated the lowest rates of wound infection, dehiscence, and incisional hernia. Although continuous suturing yielded faster closure times, it did not outperform layered closure in preventing complications. These results underline the importance of choosing an appropriate closure strategy to ensure durable, safe abdominal wall repair. A balanced approach that prioritizes both efficiency and tissue integrity, as exemplified by the layered method, appears most advantageous for patients undergoing midline laparotomy.

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