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Original Article

Layer Closure of Laparotomy Wounds: A Comparative Analysis Between Semi-Absorbable and Non-Absorbable Suture Material

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ABSTRACT

Background: Midline laparotomy closure remains a clinically important determinant of early postoperative wound morbidity, and the choice between delayed absorbable and non-absorbable monofilament sutures continues to influence surgical practice. Objective: To compare early postoperative outcomes of continuous mass fascial closure using polydioxanone versus polypropylene in patients undergoing elective or emergency midline laparotomy. Methods: This single-centre randomized comparative study was conducted at the Department of General Surgery, Combined Military Hospital Rawalpindi, from August to October 2024. Sixty-six patients aged 18–70 years undergoing midline laparotomy were allocated equally to polydioxanone or polypropylene fascial closure. Patients were followed for 30 days and assessed for wound infection, fascial dehiscence, suture sinus formation, day-14 postoperative pain using the Visual Analogue Scale, and hospital stay. Results: Baseline characteristics were comparable between groups. Wound infection occurred in 2/33 patients receiving polydioxanone and 6/33 receiving polypropylene, while fascial dehiscence occurred in 1/33 and 4/33 patients, respectively. Suture sinus formation was absent with polydioxanone but occurred in 4/33 polypropylene cases. Mean day-14 pain score was significantly lower with polydioxanone than polypropylene (3.21 ± 1.38 vs 4.73 ± 1.79; $p<0.001$), whereas hospital stay was comparable (5.06 ± 1.56 vs 5.42 ± 1.84 days). Conclusion: Polydioxanone provided comparable early wound security to polypropylene and was associated with lower observed suture-related morbidity and reduced day-14 postoperative pain. Keywords: Laparotomy; Polydioxanone; Polypropylene; Sutures; Wound Closure; Wound Infection.

INTRODUCTION

Midline laparotomy remains one of the most frequently performed abdominal surgical approaches in both elective and emergency general surgery, yet optimal fascial closure continues to be an important determinant of postoperative wound morbidity. Failure of abdominal wall closure may result in early complications such as surgical site infection, wound dehiscence, persistent wound discharge, postoperative pain, and delayed recovery, while inadequate fascial healing may also contribute to later incisional hernia formation. These complications are clinically relevant because they increase patient discomfort, prolong postoperative care, require additional wound management or reintervention, and add to the economic burden of surgical treatment (1). Contemporary evidence has therefore focused not only on the technical method of abdominal wall closure but also on the choice of suture material, suture length, bite size, tissue handling, and patient-related risk factors that may influence wound healing after laparotomy (2,3). Surgical site infection remains a particularly important concern in abdominal procedures because its occurrence is affected by operative contamination, emergency presentation, metabolic comorbidity, nutritional status, obesity, and technical factors related to wound closure (4).

International guidance generally supports continuous closure of midline abdominal incisions using monofilament slowly absorbable sutures, particularly in settings where durable early tensile strength is

required without leaving a permanent foreign body in the tissue (5,6). At the same time, polypropylene remains widely used in routine surgical practice because of its permanent tensile strength, ease of handling, availability, and longstanding familiarity among surgeons. The STITCH trial and subsequent closure literature have emphasized that technique is central to fascial healing, particularly the use of an adequate suture-to-wound length ratio and standardized bite placement; however, the material itself may still influence suture-related morbidity, especially chronic wound discomfort, palpable knots, sinus formation, and foreign-body reaction (7). Polydioxanone provides a biologically plausible alternative because it is a monofilament delayed absorbable suture that maintains wound support during the early healing period and is subsequently absorbed by hydrolysis, thereby reducing the long-term burden of retained foreign material (8,9).

Previous systematic reviews comparing slowly absorbable and non-absorbable sutures for abdominal fascial closure have generally reported comparable effectiveness for major outcomes such as dehiscence and incisional hernia prevention, although absorbable materials may offer advantages in reducing suture-related local complications (10,11). However, much of the available evidence comes from heterogeneous populations, mixed elective and emergency settings, or healthcare systems that differ from local practice in Pakistan. Local data remain limited, and one earlier Pakistani comparison from a military hospital setting suggested that polydioxanone may be associated with fewer local wound complications than polypropylene (12). More recent comparative work has also reported lower wound dehiscence rates with polydioxanone than polypropylene, although small sample sizes and event rates limit definitive interpretation (13).

The present study was therefore designed to compare continuous mass fascial closure of midline laparotomy wounds using polydioxanone versus polypropylene in patients undergoing elective or emergency laparotomy at Combined Military Hospital Rawalpindi. The study focused on clinically measurable short-term postoperative outcomes, including wound infection, fascial dehiscence, suture sinus formation, day-14 postoperative pain, and duration of hospital stay. The objective was to determine whether delayed absorbable polydioxanone provides comparable early wound security to non-absorbable polypropylene while reducing suture-related morbidity in the early postoperative period.

MATERIALS AND METHODS

This single-centre randomized comparative study was conducted in the Department of General Surgery, Combined Military Hospital Rawalpindi, Pakistan, from August 2024 to October 2024. The study enrolled patients undergoing elective or emergency midline laparotomy and compared two abdominal fascial closure materials: No. 1 loop polydioxanone in Group A and No. 1 polypropylene in Group B. Ethical approval was obtained from the Institutional Review Board of Combined Military Hospital Rawalpindi under approval number 437, and written informed consent was obtained from all participants before enrolment. The study was conducted according to standard ethical principles for human participant research, and patient confidentiality was maintained during data collection, analysis, and reporting.

The sample size was calculated using the WHO sample size formula for comparison of two proportions, taking wound dehiscence as the primary outcome variable. The expected proportions were based on previously reported wound dehiscence rates of 3.0% with polydioxanone and 12.1% with polypropylene in a comparable surgical population, with 95% confidence level and 80% power, giving a minimum required sample of 33 patients in each group and a total sample size of 66 participants (13). Patients aged 18 to 70 years of either sex who underwent elective or emergency midline laparotomy for abdominal surgical pathology were eligible for inclusion. Patients were excluded if they had a pre-existing abdominal wall hernia, immunocompromised status including HIV infection, chronic steroid use or active chemotherapy, known connective tissue disorder, body mass index greater than 35 kg/m², or laparoscopic rather than open surgery.

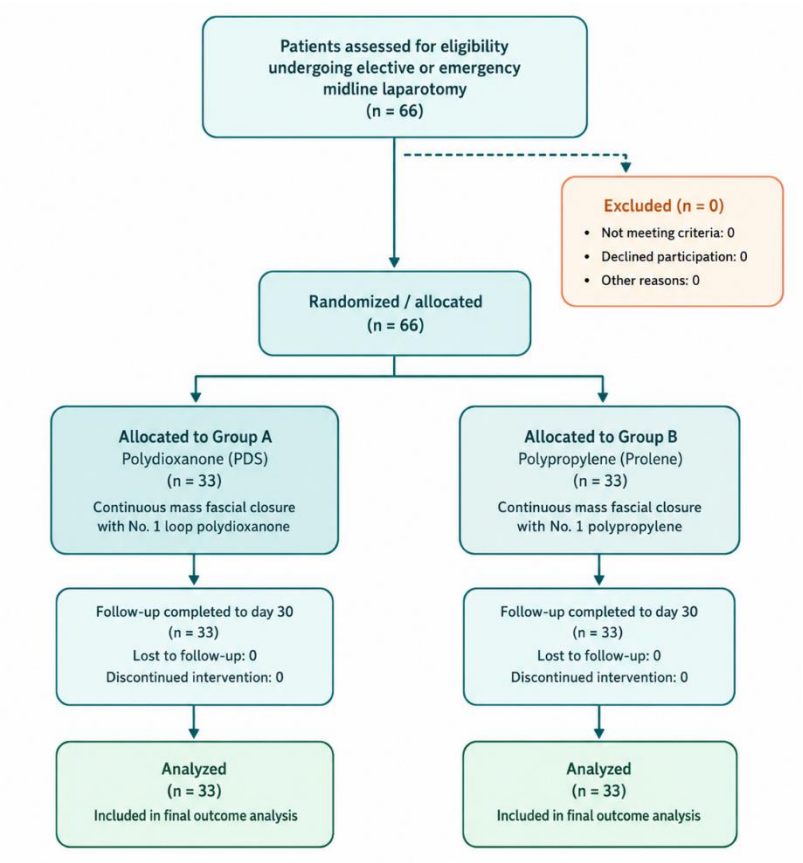

Figure 1 CONSORT Flowchart

Participants were allocated into two equal groups using a computer-generated random number sequence. Group A included 33 patients in whom the abdominal fascia was closed with No. 1 loop polydioxanone, and Group B included 33 patients in whom the abdominal fascia was closed with No. 1 polypropylene. In both groups, a standardized continuous mass fascial closure of the linea alba was performed using a suture-to-wound length ratio of at least 4:1. Fascial bites were placed approximately 1 cm from the wound edge and 1 cm apart to maintain consistency of closure technique across both study arms. Skin closure was performed with interrupted mattress sutures using 2-0 nylon in all patients. All operations were performed or directly supervised by consultant surgeons to reduce operator-dependent variation in closure technique.

Postoperative wound assessment was performed on day 3, day 7, day 14, and day 30 after surgery. The main study outcomes were wound infection, fascial dehiscence, suture sinus formation, postoperative pain, and total hospital stay. Wound infection was assessed according to Centers for Disease Control and Prevention criteria for surgical site infection (14). Fascial dehiscence was defined as partial or complete disruption of the fascial closure during the follow-up period. Suture sinus formation was defined as persistent discharge from the suture line beyond 14 days that was clinically attributable to the suture tract. Postoperative pain was assessed on day 14 using a 10-point Visual Analogue Scale, where 0 indicated no pain and 10 indicated the worst imaginable pain. Hospital stay was recorded in completed days from the date of surgery to discharge.

Data were entered and analyzed using SPSS version 24.0. Quantitative variables including age, body mass index, Visual Analogue Scale pain score, and hospital stay were summarized as mean ± standard deviation. Categorical variables including sex, type of surgery, diabetes mellitus, wound infection, fascial dehiscence, and suture sinus formation were summarized as frequencies and percentages. Between-group comparisons for continuous variables were performed using the independent-samples t-test, while categorical variables were compared using the chi-square test or Fisher's exact test where expected cell

counts were small. A p-value of less than 0.05 was considered statistically significant. All enrolled participants completed the 30-day follow-up and were included in the final analysis.

RESULTS

A total of 66 patients undergoing elective or emergency midline laparotomy were enrolled and completed 30-day postoperative follow-up, with 33 patients allocated to the polydioxanone group and 33 patients allocated to the polypropylene group. Baseline demographic and clinical characteristics were comparable between groups, indicating acceptable balance before outcome assessment. The mean age was 43.12 ± 11.86 years in the polydioxanone group and 44.67 ± 12.34 years in the polypropylene group, with a mean difference of −1.55 years between groups and no statistically significant difference. Male patients constituted 20/33 participants in the polydioxanone group and 19/33 participants in the polypropylene group. Mean body mass index was also similar between groups, with values of 26.18 ± 3.52 kg/m² and 26.91 ± 3.65 kg/m², respectively. Elective procedures accounted for 23/33 cases in the polydioxanone group and 21/33 cases in the polypropylene group, while diabetes mellitus was present in 5/33 and 6/33 patients, respectively. These findings suggest that the two groups were broadly comparable with respect to age, sex distribution, body mass index, operative urgency, and diabetic status before assessment of postoperative outcomes.

Table 1. Baseline Demographic and Clinical Characteristics of the Study Groups

Variable	Group A: Polydioxanone n=33	Group B: Polypropylene n=33	Effect Estimate	95% CI	p-value
Age, years, mean ± SD	43.12 ± 11.86	44.67 ± 12.34	Mean difference: −1.55	−7.50 to 4.40	0.610
Male sex, n (%)	20 (60.6)	19 (57.6)	Risk difference: 3.0%	−20.7% to 26.8%	0.800
BMI, kg/m², mean ± SD	26.18 ± 3.52	26.91 ± 3.65	Mean difference: −0.73	−2.49 to 1.03	0.403
Elective surgery, n (%)	23 (69.7)	21 (63.6)	Risk difference: 6.1%	−16.6% to 28.7%	0.794
Diabetes mellitus, n (%)	5 (15.2)	6 (18.2)	Risk difference: −3.0%	−20.4% to 14.3%	1.000

BMI: body mass index; CI: confidence interval; SD: standard deviation. Mean differences are calculated as Group A minus Group B. For categorical variables, risk difference is expressed as the percentage-point difference between groups. p-values for continuous variables were calculated using the independent-samples t-test. p-values for categorical variables were calculated using chi-square or Fisher's exact test according to cell distribution.

The indications for laparotomy were also comparable between the two groups. Intestinal obstruction was the most frequent indication, occurring in 10/33 patients in the polydioxanone group and 9/33 patients in the polypropylene group. Perforated peptic ulcer was reported in 7/33 and 8/33 patients, respectively, while abdominal trauma accounted for 6/33 and 5/33 cases. Other abdominal surgical indications accounted for the remaining 10/33 patients in the polydioxanone group and 11/33 patients in the polypropylene group. The overall distribution of operative indications did not differ significantly between groups, supporting comparability of the surgical case mix.

Table 2. Distribution of Indications for Midline Laparotomy

Indication for Laparotomy	Group A: Polydioxanone n=33	Group B: Polypropylene n=33	Total n=66	p-value
Intestinal obstruction, n (%)	10 (30.3)	9 (27.3)	19 (28.8)	
Perforated peptic ulcer, n (%)	7 (21.2)	8 (24.2)	15 (22.7)	
Abdominal trauma, n (%)	6 (18.2)	5 (15.2)	11 (16.7)	
Other indications, n (%)	10 (30.3)	11 (33.3)	21 (31.8)	
Overall comparison	—	—	—	0.891

Percentages are calculated within each treatment group. The p-value represents the overall between-group comparison of indication distribution.

Postoperative wound outcomes are summarized in Table 3. Wound infection occurred in 2/33 patients in the polydioxanone group compared with 6/33 patients in the polypropylene group, corresponding to absolute risks of 6.1% and 18.2%, respectively. The absolute risk difference was −12.1 percentage points, and the relative risk was 0.33, suggesting a lower observed infection rate in the polydioxanone group;

however, the confidence interval crossed the null value and the difference was not statistically significant. Fascial dehiscence occurred in 1/33 patients in the polydioxanone group and 4/33 patients in the polypropylene group, giving absolute risks of 3.0% and 12.1%, respectively. The relative risk was 0.25, but the 95% confidence interval was wide, reflecting sparse event numbers and limited statistical precision.

Suture sinus formation was not observed in the polydioxanone group, whereas it occurred in 4/33 patients in the polypropylene group. This represented an absolute difference of −12.1 percentage points in favour of polydioxanone. Because one group had zero events and the total number of events was small, Fisher's exact testing provides a more conservative estimate of statistical significance than Pearson chi-square testing. The finding therefore indicates a clinically relevant reduction in observed suture sinus formation with polydioxanone, but it should be interpreted cautiously because of sparse outcome counts and wide confidence intervals.

Day-14 postoperative pain showed the clearest between-group difference. The mean Visual Analogue Scale score was 3.21 ± 1.38 in the polydioxanone group and 4.73 ± 1.79 in the polypropylene group. The mean difference was −1.52 points on the 10-point scale, with a 95% confidence interval from −2.31 to −0.73, indicating significantly lower early postoperative pain in the polydioxanone group. The standardized mean difference was −0.95, suggesting a large reduction in pain intensity. Mean hospital stay was 5.06 ± 1.56 days in the polydioxanone group and 5.42 ± 1.84 days in the polypropylene group, with a mean difference of −0.36 days and no statistically significant difference between groups.

Table 3. Comparison of Postoperative Outcomes Between Study Groups

Outcome	Group A: Polydioxanone n=33	Group B: Polypropylene n=33	Effect Estimate	95% CI	p-value
Wound infection, n (%)	2 (6.1)	6 (18.2)	RR: 0.33; RD: −12.1%	RR: 0.07 to 1.53; RD: −27.6% to 3.4%	0.258
Fascial dehiscence, n (%)	1 (3.0)	4 (12.1)	RR: 0.25; RD: −9.1%	RR: 0.03 to 2.12; RD: −21.7% to 3.5%	0.355
Suture sinus, n (%)	0 (0.0)	4 (12.1)	RR: 0.11; RD: −12.1%	RR: 0.01 to 1.99; RD: −23.3% to −1.0%	0.114
VAS pain score at day 14, mean ± SD	3.21 ± 1.38	4.73 ± 1.79	Mean difference: −1.52; SMD: −0.95	−2.31 to −0.73	<0.001
Hospital stay, days, mean ± SD	5.06 ± 1.56	5.42 ± 1.84	Mean difference: −0.36	−1.20 to 0.48	0.389

CI: confidence interval; RD: risk difference; RR: relative risk; SD: standard deviation; SMD: standardized mean difference; VAS: Visual Analogue Scale.

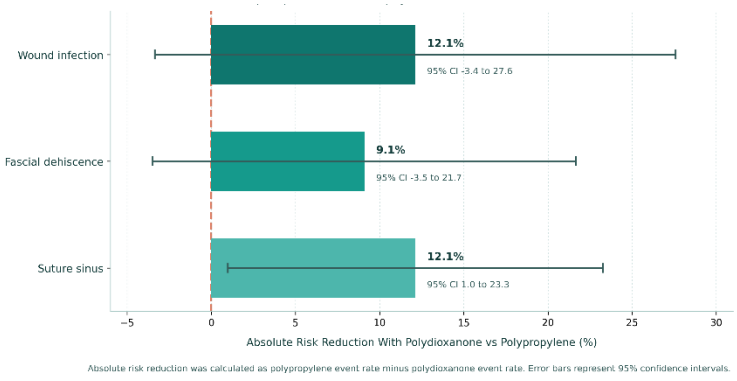

Figure 1. Short-Term Wound Morbidity Reduction After Midline Laparotomy Closure

Effect estimates are calculated as Group A relative to Group B. p-values for binary outcomes are reported using Fisher's exact test because of small event counts. The originally reported Pearson chi-square p-values for wound infection, fascial dehiscence, and suture sinus were 0.130, 0.162, and 0.040, respectively; however, Fisher's exact test is more conservative and more appropriate for sparse binary outcomes. Mean differences were calculated using independent-samples comparison of means. No mortality occurred in

either group during the 30-day follow-up period. Overall, polydioxanone showed comparable early wound security to polypropylene for infection and fascial dehiscence, while demonstrating a lower observed frequency of suture sinus formation and significantly lower day-14 postoperative pain. Hospital stay was similar between the two groups, indicating that suture material did not meaningfully alter short-term inpatient duration in this cohort.

Figure 1 demonstrates the absolute reduction in early wound morbidity associated with polydioxanone compared with polypropylene across the three binary postoperative outcomes. The largest absolute reductions were observed for wound infection and suture sinus formation, each showing a 12.1 percentage-point lower event rate with polydioxanone, while fascial dehiscence showed a 9.1 percentage-point lower event rate. The confidence interval for suture sinus remained entirely above zero, reflecting the absence of sinus formation in the polydioxanone group compared with four cases in the polypropylene group, whereas the confidence intervals for wound infection and fascial dehiscence crossed the null line, indicating clinically favorable but statistically imprecise estimates. Overall, the visual pattern supports a consistent short-term morbidity gradient favoring polydioxanone, particularly for suture-related local complications, while also emphasizing the need for cautious interpretation because of the small number of events.

DISCUSSION

The present study compared continuous mass fascial closure of midline laparotomy wounds using delayed absorbable polydioxanone and non-absorbable polypropylene in a single-centre cohort of patients undergoing elective or emergency abdominal surgery. The principal finding was that polydioxanone provided early wound outcomes broadly comparable to polypropylene for wound infection, fascial dehiscence, and hospital stay, while showing a consistently favourable direction of effect for all measured wound morbidity outcomes. Wound infection occurred in 6.1% of patients closed with polydioxanone compared with 18.2% of those closed with polypropylene, and fascial dehiscence occurred in 3.0% versus 12.1%, respectively. Although these differences did not reach statistical significance and the confidence intervals were wide, the direction of effect favoured polydioxanone. The most clinically notable differences were observed for suture sinus formation and early postoperative pain. No patient in the polydioxanone group developed suture sinus, whereas four patients in the polypropylene group did so, and the mean day-14 Visual Analogue Scale pain score was 1.52 points lower with polydioxanone. These findings suggest that polydioxanone may reduce suture-related local morbidity without compromising early fascial security, but the small number of events requires cautious interpretation.

The observed infection pattern is consistent with prior evidence showing that the choice between slowly absorbable and non-absorbable monofilament sutures is unlikely to be the sole determinant of surgical site infection after laparotomy. In the present study, the absolute infection rate was lower in the polydioxanone group, but the difference was statistically imprecise. This is biologically plausible because postoperative infection is multifactorial and influenced by operative contamination, emergency presentation, comorbid disease, subcutaneous fat thickness, tissue perfusion, operative duration, perioperative antibiotic timing, and wound-care practices. Contemporary evidence has similarly emphasized that patient- and procedure-level factors may have a stronger effect on surgical site infection than suture material alone (15,16). Therefore, while the lower observed infection rate with polydioxanone is clinically encouraging, it should not be interpreted as definitive evidence that polydioxanone independently prevents infection in this population.

Fascial dehiscence is one of the most feared early complications after midline laparotomy because it reflects failure of abdominal wall integrity during the vulnerable early healing period. In this study, dehiscence occurred less frequently in the polydioxanone group than in the polypropylene group, but the difference was not statistically significant. The finding is compatible with previous comparative data suggesting that slowly absorbable sutures provide adequate early tensile support for fascial healing and

are not inferior to permanent sutures for early wound security (10,11,13). Network meta-analytic evidence has also suggested that no single suture material consistently eliminates the risk of abdominal wound failure, and that closure technique, wound contamination, patient risk profile, and suture-to-wound length ratio remain central determinants of outcome (1). The present findings therefore support the clinical acceptability of polydioxanone for short-term fascial closure, but they do not establish superiority for dehiscence prevention because the study was underpowered for sparse binary outcomes.

The absence of suture sinus formation in the polydioxanone group is an important practical finding because suture sinus can cause persistent discharge, wound discomfort, repeated dressings, patient dissatisfaction, and sometimes later suture removal. The difference is biologically plausible because polypropylene remains permanently within the tissue and may act as a chronic foreign body, whereas polydioxanone is gradually absorbed by hydrolysis after providing temporary wound support (8,9). Earlier local evidence from a military hospital setting also suggested fewer local wound complications with polydioxanone than polypropylene (12). However, in the revised interpretation, this result should be presented carefully. The original analysis reported statistical significance using Pearson chi-square testing, but because one group had zero events and the total number of sinus events was small, Fisher's exact testing is more conservative. The finding is therefore best described as a clinically meaningful reduction in observed suture sinus formation rather than definitive proof of superiority.

Pain at day 14 was significantly lower among patients closed with polydioxanone. The mean difference of 1.52 points on the Visual Analogue Scale is clinically relevant because it represents a measurable reduction in early postoperative discomfort during the period when patients begin mobilization, resume basic activity, and undergo wound assessment. This difference may reflect reduced tissue irritation, lower foreign-body response, or absence of permanent suture-related mechanical discomfort in the polydioxanone group. Prior closure trials and technique-focused studies have also emphasized that wound pain is affected not only by the incision and operative trauma but also by suture tension, bite placement, tissue ischemia, knot burden, and local inflammatory reaction (18). Because analgesic consumption, mobility score, and return-to-duty timing were not measured in the present study, the pain findings should be interpreted as evidence of lower early wound pain rather than proof of faster functional recovery.

Hospital stay was similar between groups, with mean values of 5.06 days for polydioxanone and 5.42 days for polypropylene. This finding indicates that the choice of suture material did not meaningfully affect short-term inpatient duration in this cohort. Length of stay after laparotomy is influenced by many factors beyond fascial closure, including the primary abdominal pathology, bowel function recovery, infection status, comorbidities, emergency versus elective surgery, postoperative complications unrelated to the wound, and institutional discharge practices. Previous reviews of abdominal wall closure techniques have similarly shown that suture material alone is unlikely to produce large differences in inpatient recovery time (19,20). Therefore, the comparable hospital stay observed in this study is expected and should not be interpreted as lack of clinical value, because suture-related morbidity may still affect pain, wound care burden, and longer-term patient satisfaction after discharge.

The strengths of this study include its clinically relevant comparison, standardized closure approach across groups, equal group sizes, complete 30-day follow-up, and assessment of both structural wound outcomes and patient-centred pain. The study also contributes local evidence from a Pakistani military hospital setting, where published data comparing polydioxanone and polypropylene for laparotomy closure remain limited. However, several limitations must be acknowledged. The sample size was small, and the event counts for infection, dehiscence, and suture sinus were low, resulting in wide confidence intervals and limited statistical power. The study was conducted at a single institution over a short period, which may restrict generalizability. Although random allocation was described, the absence of reported allocation concealment and blinded wound assessment leaves potential for selection and assessment bias. Important confounders such as wound contamination class, operative duration, nutritional status,

smoking, antibiotic timing, and subcutaneous fat thickness were not incorporated into adjusted analysis. Most importantly, the 30-day follow-up period was sufficient for early wound morbidity but not adequate for determining incisional hernia risk, chronic pain, or long-term abdominal wall function.

Overall, the findings support the use of delayed absorbable polydioxanone as a dependable option for continuous mass closure of midline laparotomy wounds. The material appeared comparable to polypropylene for early wound infection, fascial dehiscence, and hospital stay, while showing favourable results for suture sinus formation and day-14 postoperative pain. Future multicentre randomized trials with allocation concealment, blinded outcome assessment, larger sample sizes, adjustment for contamination and patient-level risk factors, and longer follow-up are required to determine whether these early advantages translate into sustained reductions in chronic wound morbidity and incisional hernia formation.

CONCLUSION

In this randomized comparative study of patients undergoing elective or emergency midline laparotomy, delayed absorbable polydioxanone provided early fascial closure outcomes comparable to non-absorbable polypropylene for wound infection, fascial dehiscence, and duration of hospital stay. Polydioxanone was associated with a lower observed frequency of suture sinus formation and significantly reduced day-14 postoperative pain, suggesting a potential advantage in reducing early suture-related morbidity without compromising short-term wound security. These findings support polydioxanone as a clinically reasonable alternative to polypropylene for midline laparotomy fascial closure, although larger multicentre studies with longer follow-up are required before definitive conclusions can be drawn regarding long-term abdominal wall outcomes.

REFERENCES

1. Lozada Hernández EE, Hernández Bonilla JP, Hinojosa Ugarte D, Sanchez Meza KA, Mendez Baca SL, Morales Castillo EP, et al. Abdominal wound dehiscence and incisional hernia prevention in midline laparotomy: a systematic review and network meta-analysis. Langenbecks Arch Surg. 2023;408(1):268. doi:10.1007/s00423-023-02954-w.

2. Aiolfi A, Cavalli M, Gambero F, Mini E, Lombardo F, Gordini L, et al. Prophylactic mesh reinforcement for midline incisional hernia prevention: systematic review and updated meta-analysis of randomized controlled trials. Hernia. 2023;27(2):213-224. doi:10.1007/s10029-022-02660-4.

3. Sekhar S, Ekka NM, Nair R, Pratap V, Mundu M, Kumar A. Effect of suture length on the incidence of incisional hernia and surgical site infection in patients undergoing midline laparotomy: a systematic review and meta-analysis. Cureus. 2023;15(2):e34840. doi:10.7759/cureus.34840.

4. Jahangir F, Haghdoost AA, Moameri H, Okhovati M. Incidence and risk factors of surgical site infection in abdominal surgeries: a scoping review of cohort and case-control studies. Iran J Med Sci. 2024;49(7):405-420. doi:10.30476/ijms.2024.100819.3338.

5. Frassini S, Cobianchi L, Fugazzola P, Biffl WL, Coccolini F, Damaskos D, et al. ECLAPTE: Effective Closure of LAParoTomy in Emergency—2023 World Society of Emergency Surgery guidelines for the closure of laparotomy in emergency settings. World J Emerg Surg. 2023;18(1):42. doi:10.1186/s13017-023-00511-w.

6. Muysoms FE, Antoniou SA, Bury K, Campanelli G, Conze J, Cuccurullo D, et al. European Hernia Society guidelines on the closure of abdominal wall incisions. Hernia. 2015;19(1):1-24. doi:10.1007/s10029-014-1342-5.

7. Deerenberg EB, Harlaar JJ, Steyerberg EW, Lont HE, van Doorn HC, Heisterkamp J, et al. Small bites versus large bites for closure of abdominal midline incisions (STITCH): a double-blind, multicentre, randomised controlled trial. Lancet. 2015;386(10000):1254-1260. doi:10.1016/S0140-6736(15)60459-7.

8. Israelsson LA, Millbourn D. Prevention of incisional hernias: how to close a midline incision. Surg Clin North Am. 2013;93(5):1027-1040. doi:10.1016/j.suc.2013.06.009.

9. Shankar AP, Mathew S, Tippana VSSN, Keerthi BR, Naik S, Pandita RK, et al. A prospective randomized controlled trial comparing clinical equivalence of PD Synth and PDS polydioxanone sutures. Cureus. 2023;15(12):e50293. doi:10.7759/cureus.50293.

10. Sajid MS, Parampalli U, Baig MK, McFall MR. A systematic review on the effectiveness of slowly-absorbable versus non-absorbable sutures for abdominal fascial closure following laparotomy. Int J Surg. 2011;9(8):615-625. doi:10.1016/j.ijsu.2011.09.006.

11. Patel SV, Paskar DD, Nelson RL, Vedula SS, Steele SR. Closure methods for laparotomy incisions for preventing incisional hernias and other wound complications. Cochrane Database Syst Rev. 2017;11(11):CD005661. doi:10.1002/14651858.CD005661.pub2.

12. Khan NA, Almas D, Shehzad K, Chaudhry AK, Mian MA. Comparison between delayed-absorbable polydioxanone and non-absorbable (Prolene) suture material in abdominal wound closure. Pak Armed Forces Med J. 2009;59(1):27-31.

13. Singla A, Bansal AR, Chopra V, Chopra D, Bansal J. Which suture is ideal for abdominal fascial closure. Int Surg J. 2023;10(4):647-650. doi:10.18203/2349-2902.isj20230970.

14. Utsumi M, Yamada T, Yamabe K, Katsura Y, Fukuchi N, Fukunaga H, et al. Differences in risk factors for surgical site infection between laparotomy and laparoscopy in gastrointestinal surgery. PLoS One. 2022;17(9):e0274887. doi:10.1371/journal.pone.0274887.

15. Teppa R, Sude NS, Karanam VPK, Mallipudi BVP. Relevance of subcutaneous fat thickness as a risk factor for surgical site infections in abdominal surgeries. Cureus. 2022;14(1):e20946. doi:10.7759/cureus.20946.

16. Fayraz A, Alzahrani SA, Alghamdi AGA, Alzhrani SM, Alghamdi AA, Abood HB. Risk factors for post-appendectomy surgical site infection in laparoscopy and laparotomy: retrospective cohort study. Cureus. 2023;15(8):e44237. doi:10.7759/cureus.44237.

17. Pianka F, Werba A, Klotz R, Schuh F, Kalkum E, Probst P, et al. The effect of prophylactic mesh implantation on the development of incisional hernias in patients with elevated BMI: a systematic review and meta-analysis. Hernia. 2023;27(2):225-234. doi:10.1007/s10029-022-02675-x.

18. Albertsmeier M, Hofmann A, Baumann P, Riedl S, Reisensohn C, Kewer JL, et al. Effects of the short-stitch technique for midline abdominal closure: short-term results from the randomised-controlled ESTOIH trial. Hernia. 2022;26(1):87-95. doi:10.1007/s10029-021-02410-y.

19. Henriksen NA, Deerenberg EB, Venclauskas L, Fortelny RH, Miserez M, Muysoms FE. Meta-analysis on materials and techniques for laparotomy closure: the MATCH review. World J Surg. 2018;42(6):1666-1678. doi:10.1007/s00268-017-4393-9.

20. Hew CY, Rais T, Antoniou SA, Deerenberg EB, Antoniou GA. Prophylactic mesh reinforcement versus primary suture for abdominal wall closure after elective abdominal aortic aneurysm repair: updated systematic review. Ann Vasc Surg. 2024;109:149-161. doi:10.1016/j.avsg.2024.06.026.