Open Access

Original Article

Comparison of Midline Closure Results after Laparotomy sing Prolene Versus Polydioxanone Suture

Muhammad Tayyab Malik, Muhammad Qasim Butt, Muhammad Yousaf Shah*, Usman Ghani, Khurram Sarfraz Bajwa, Aqib Malik*****

Department of General Surgery, Combined Military Hospital/National University of Medical Sciences (NUMS), Rawalpindi Pakistan,
*Department of General & Laparoscopic Surgery, Combined Military Hospital Pano Aqil/National University of Medical Sciences (NUMS) Pakistan,
**Department of General & Laparoscopic Surgery, Combined Military Hospital Kohat/National University of Medical Sciences (NUMS) Pakistan,
***Department of Family Medicine, EME College, Rawalpindi Pakistan

ABSTRACT

Objective: To determine the outcome of midline closure among patients undergoing laparotomy using Prolene versus Polydiaxanone Suture (PDS).
Study Design: Quasi-experimental study.
Place and Duration of Study: Combined Military Hospital, Rawalpindi Pakistan, from Jun to Dec 2021.
Methodology: All patients over the age of 18 who had an elective abdominal laparotomy were enrolled in the study. The patients were randomly assigned using randomization tables to one of two groups, i.e., midlines closed with Prolene (Group-A) and with PDS suture (Group-B). At a one-month follow-up, these patients were evaluated for complications related to abdominal incision (e.g., surgical site infection, persistent wound discomfort, and wound dehiscence).
Results: Of 140 patients, surgical site infection was observed in 30(21.4%), abdominal wound discomfort in 33(23.6%), and wound dehiscence in 2(1.4%) patients. Surgical site infection was found significantly higher in Prolene group as compared to PDS group, i.e., 20(28.6%) and 10(14.3%) respectively (*p*-value 0.039). Abdominal wound discomfort was also found significantly higher in Group-A as compared to Group-B, i.e., 22(31.4%) and 11(15.7%) respectively (*p*-value 0.029).
Conclusion: The outcome of midline closure using Polydiaxanone Suture (PDS) was found better compared to Prolene among patients having elective laparotomy.

Keywords: Laparotomy, Midline Closure, Polydiaxanone Suture, Prolene.

How to Cite This Article: *Malik MT, Butt MQ, Shah MY, Ghani U, Bajwa KS, Malik A. Comparison of Midline Closure Results after Laparotomy sing Prolene Versus Polydioxanone Suture. Pak Armed Forces Med J 2025; 75(6): 1055-1059. DOI: https://doi.org/10.51253/pafmj.v75i6.8646*

INTRODUCTION

Exploratory laparotomy is still one of the most widely used surgical procedures.[1,2] As a result, the thorough and safe closure of a laparotomy incision is critical to reducing postoperative morbidity.[2,3] This, in turn, may result in an earlier discharge from the hospital, an earlier return to activities, and the possibility to save the overall cost of the treatment.

In abdominal surgery, a midline incision is routinely employed. Because most structures do not cross the midline, it allows for relatively rapid and wide access to the abdominal cavity while causing minimum injury to muscles, nerves, and blood supply.[1,4,5]

Techniques for closing the midline abdominal incision have evolved over time as we have gained a greater understanding of the physiology and engineering of abdominal wall closure, as well as advancements in surgical suture materials. The perfect wound closure offers strength as well as a barrier against infection. Closure should be rapid, efficient, conducted without tension/ischemia, pleasant for the patient, technically simpler for the surgeon, and aesthetically pleasing to attain that aim. As a result, wound closure principles should be followed.[6]

To enable an appropriate closure of the fascia and consequently the abdominal wall, a wide range of suture materials and needles have been created.[4,6] Because of these characteristics, abdominal incision closure is still a hotly debated topic.

Complications resulting from abdominal fascial closure are highly prevalent, particularly in resource-constrained nations such as Pakistan.[7,8] As a result, it was critical to comprehend the procedures and challenges involved with fascial closure. The purpose of this study was to compare the results of midline closure with Prolene versus Polydiaxanone Suture (PDS) suture in patients having laparotomy at a military tertiary care facility in Rawalpindi, Pakistan.

METHODOLOGY

This Quasi-experimental study was carried out at Combined Military Hospital, Rawalpindi Pakistan, from June to December 2021. Prior to conducting the

Correspondence: Dr Muhammad Tayyab Malik, Department of General Surgery, Combined Military Hospital, Rawalpindi Pakistan
Received: 29 Apr 2022; revision received: 11 Sep 2023; accepted: 13 Oct 2023

study, all ethical considerations were addressed, and approval from the Institutional Ethical Review Board was obtained.

Inclusion Criteria: Patients of either gender over the age of 18 who had an elective abdominal laparotomy were enrolled.

Exclusion Criteria: Patients who had previous abdominal incisions, were operated by Pfannenstiel incision, had advanced inoperable malignancies or patients who were lost to follow up were excluded.

Epi Info calculator was used for the estimation of sample size, taking percentage of surgical site infection in PDS group as 23.2%, and infection in Prolene group as 45.5%.[9] The total estimated sample size came out to be 140, i.e., 70 in each group.

Patients were recruited from the surgical, liver transplant/vascular surgery/thoracic surgery, and gynecology wards. Written informed consent was taken from each patient. Laparotomy was described as abdominal visceral exposure surgery performed through an abdominal incision. The patients were randomly assigned using randomization tables to one of two groups, i.e., A or B. Patients in study Group-A had their midlines closed with Prolene, whereas patients in Group-B had their midlines closed with PDS suture, which can be seen in Figure.

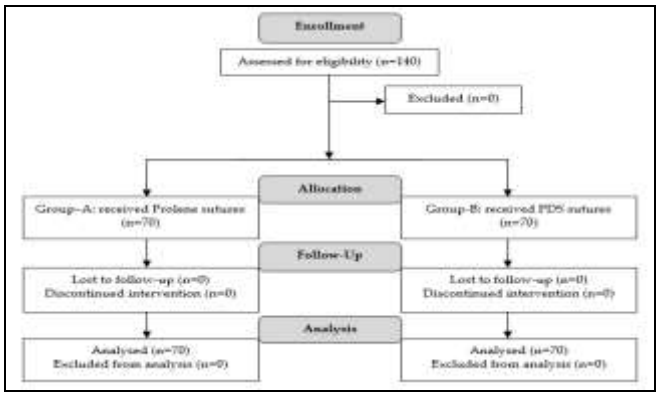

Figure: Patient Flow Diagram (n=140)

Age, gender, diagnosis, type of case, BMI, and operating method were among the data collected for the study.

Relevant clinical, radiological, and laboratory examinations were carried out to establish fitness for surgery. Single-dose cephalosporin, gentamicin, and metronidazole were administered as pre-operative antibiotic prophylaxis at the time of anesthesia induction. All patients were given general anesthesia and had an exploratory laparotomy through a midline incision. The surgeries were carried out by a skilled surgeon. The type of surgery performed, and the suture material utilized were all recorded in operation notes. Patients were maintained nil per oral until bowl sounds returned, at which point nasogastric tubes were withdrawn based on the volume of nasogastric tube drainage. At a one-month follow-up, these patients were evaluated for complications related to abdominal incision (e.g., surgical site infection, persistent wound discomfort, and wound dehiscence). Purulent discharge from the surgical site, or serous discharge if it exhibits any growth on culture, was defined as a surgical site infection up to one month following surgery. Wound discomfort was defined as pain that caused any level of activity restriction for more than one month. Wound dehiscence, on the other hand, was defined as the partial or total dehiscence of an abdominal wound, accompanied by the protrusion of intra-abdominal contents.

Data was analysed using Statistical Package for Social Sciences (SPSS) version 24. For quantitative variables, mean and standard deviation were used, while for qualitative variables, frequencies and percentages were computed. The mean difference in age, weight, height, BMI, and duration of surgery was compared across groups using independent sample t-test, whereas association of qualitative variables like gender and operative procedure with groups, as well as association of surgical site infection, persistent abdominal pain, and wound dehiscence with independent variables were compared using Chi-square test. A p-value of <0.05 was considered significant.

RESULTS

Of 140 patients, the mean age was 55.14±8.80 years. There were 59(42.1%) patients under 55 years and 81(57.9%) over 55 years of age. Majority of the patients were males, i.e., 109(77.9%). General surgery was the most common surgical procedure performed in 62(44.3%) patients, followed by liver transplant/vascular surgery/thoracic surgery in 55(39.3%) and gynecological surgery in 23(16.4%) patients. Age was found significantly higher among patients who were in Prolene group (Group-A) than that of those who were in PDS group (Group-B), i.e., 58.35±5.64 years and 51.92±10.15 years respectively (p<0.001). However, duration of surgery was significantly higher in Group-B as compared to Group-A, i.e., 4.14±0.67 and 3.62±0.68, p-value <0.001.

Furthermore, a significant difference of gender (p=0.025) and operative procedure (p<0.001) was observed in between both groups (Table-I).

Table-I: Demographic Characteristics of Participants (n=140)

Variables	Total	Study Groups		
		Group-A (n=70)	Group-B (n=70)	
	Mean±SD	Mean±SD	Mean±SD	*p*-value
Age (years)	55.14±8.80	58.35±5.64	51.92±10.15	<0.001
Weight (kg)	60.07±5.11	60.01±5.11	60.14±5.14	0.869
Height (m)	1.54±0.06	1.53±0.05	1.54±0.06	0.910
BMI (kg/m2)	27.21±4.99	27.09±5.02	27.34±5.01	0.771
Duration of surgery (hours)	3.89±0.72	3.62±0.68	4.14±0.67	<0.001
	Total	n(%)	n(%)	*p*-value
Gender				
Males	109	49(45.0)	60(55.0)	0.025
Females	31	21(67.7)	10(32.3)	
Operative Procedure				
General Surgery	62	23(37.1)	39(62.9)	<0.001
Liver transplant/Vascular surgery/Thoracic surgery	55	40(72.7)	15(27.3)	
Gynecology	23	7(30.4)	16(69.6)	

Thirty (21.4%) patients reported surgical site infection, 33(23.6%) with abdominal wound discomfort, whereas only 2(1.4%) experienced wound dehiscence.

Surgical site infection was found significantly higher in Prolene group as compared to PDS group, i.e., 20(28.6%) and 10(14.3%) respectively (p=0.039). Abdominal wound discomfort was also found significantly higher in Prolene group as compared to PDS group, i.e., 22(31.4%) and 11(15.7%) respectively (p=0.029), which can be seen in Table-II.

Table-II: Comparison of Post-Operative Complications of Participants (n=140)

	Surgical Site Infection			Abdominal Wound Discomfort		
	Yes (n=30)	No (n=110)	*p*-value	Yes (n=42)	No (n=98)	*p*-value
Group						
A	20(28.6)	50(71.4)	0.039	22(31.4)	48(68.6)	0.029
B	10(14.3)	60(85.7)		11(15.7)	59(84.3)	
Age (years)						
≤55	13(22.0)	46(78.0)	0.882	10(16.9)	49(83.1)	0.115
>55	17(21.0)	64(79.0)		23(28.4)	58(71.6)	
Gender						
Males	20(18.3)	89(81.7)	0.096	27(24.8)	82(75.2)	0.531
Females	10(32.3)	21(67.7)		6(19.4)	25(80.6)	
BMI (kg/m2)						
≤25	16(25.4)	47(74.6)	0.301	17(27.0)	46(73.0)	0.389
>25	14(18.2)	63(81.8)		16(20.8)	61(79.2)	
Operative Procedure						
General Surgery	10(16.1)	52(83.9)	0.341	10(16.1)	52(83.9)	0.133
Liver transplant/Vascular surgery/Thoracic surgery	15(27.3)	40(72.7)		17(30.9)	38(69.1)	
Gynecology	5(21.7)	18(78.3)		6(26.1)	17(73.9)	
Duration of surgery (minutes)						
≤4	25(22.5)	86(77.5)	0.537	28(25.2)	83(74.8)	0.367
>4	5(17.2)	24(82.8)		5(17.2)	24(82.8)	

BMI: Body Mass Index, SSI: Surgical Site Infection

The findings of the culture report showed that out of 30 patients with surgical site infection, majority presented with Escherichia coli, i.e., 9(6.4%), followed by Escherichia coli with Klebsiella Pneumoniae 5(3.6%), Methicillin Resistant Staphylococcus Aureus 4(2.9%), enterococcus species 3(2.1%), Klebsiella Pneumoniae 2(1.4%), Escherichia Coli with Enterococcus species 2(1.4%), Staphylococcus Aureus 2(1.4%), Klebsiella Pneumoniae with Pseudomonas Aeruginosa 2(1.4%), while one 1 patient presented with Klebsiella Pneumoniae with Enterococcus species. The detailed results are shown in detail in Table-III.

Table-III: Bacterial Culture Report of Patients with Surgical Site Infection (n=30)

	Total n(%)	Group-A n(%)	Group-B n(%)
Escherichia Coli	9(6.4)	7(77.8)	2(22.2)
Escherichia Coli + Klebsiella Pneumoniae	5(3.6)	2(40.0)	3(60.0)
Methicillin-resistant Staphylococcus aureus	4(2.9)	2(50.0)	2(50.0)
Enterococcus Species	3(2.1)	2(66.7)	1(33.3)
Klebsiella Pneumoniae	2(1.4)	2(100)	0(0)
Escherichia Coli + Enterococcus Species	2(1.4)	2(100)	0(0)
Staphylococcus Aureus	2(1.4)	2(100)	0(0)
Klebsiella Pneumoniae + Pseudomonas Aeruginosa	2(1.4)	0(0)	2(100)
Klebsiella Pneumoniae + Enterococcus Species	1(0.7)	1(100)	0(0)

DISCUSSION

Surgeons have been continuously striving to overcome postoperative complications associated with midline closure tin patients undergoing laparotomy using newer techniques and newer suture materials.[10-15]

According to the current study, surgical site infection was the most common complication observed in 21.4% patients, abdominal wound discomfort in 23.6%, and wound dehiscence in 1.4% patients. Somewhat similar findings were reported in previous studies conducted by Pai *et al.*, and Talpur *et al.*[9,16] However, Pandey *et al.*, in their study reported a higher wound dehiscence, which they attributed to patient-related factors or health care setting associated factors.[17] Patient related clinical factors include poor general condition of the patient at presentation, prior mismanagement by the health care providers, presence of complications such as septicemia and fluid, electrolyte derangements. A lack of knowledge, negligence of health, and poverty could also be the reason for higher rate of wound dehiscence.

Sajid *et al.*, in their systematic review, also reported that PDS and Prolene are equally effective for the closure of abdominal fascia following laparotomy. However, the author suggested further studies to evaluate the cost-effectiveness and assessment of health related quality of life.[18]

The findings of the current study revealed that all post-operative complications such as surgical site infection and abdominal wound discomfort were found significantly higher in Prolene group as compared to PDS group. Contrary to the current study findings, Pai *et al.*, reported no statistically significant difference among patients in whom Prolene or PDS for performed.[9] The author stated that even in late post-operative complications, no significant difference was observed, suggesting either of the two suture materials could be used in elective midline laparotomies.

As per the current study findings, culture report showed amongst patients with surgical site infection, majority of the patients presented had Escherichia Coli followed by Escherichia Coli along with Enterococcus species, and Escherichia Coli along with Klebsiella Pneumoniae. This matched findings of a previous study as in which Escherichia Coli was the most common organism reported in the culture report.[9]

LIMITATION OF STUDY

The current study has certain limitations. First, the advanced statistical analysis such as binary logistic regression could not be performed as majority of the variables found statistically non-significant. Secondly, though operative procedure performed was reported in the current study, however, particular indication for the surgery was not noted. Thirdly, the follow-up time period of the study was less, due to which other post-operative complications such as incisional hernia could not be observed.

CONCLUSION

The outcome of midline closure using Polydiaxanone Suture (PDS) was found better compared to Prolene among patients having elective laparotomy.

Conflict of Interest: None.

Funding Source: None.

Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

MTM & MQB: Data acquisition, data analysis, critical review, approval of the final version to be published.

MYS & UG: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

KSB & AM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Chase NF, Carballo CJ, Faulkner JD, Bilezikian JA, Hope WW. Laparotomy Closure: A Review of Available Education Training Models. Surg Technol Int 2020; 37: 121-125. https://doi.org/10.52198/21.sti.38.hr1430
2. 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. https://doi.org/10.1002/14651858.CD005661.pub2
3. Vyas PH, Pandya JB, Narola SD. A Comparative Study On Outcome Of Midline Laparotomy Wound Closure. Indian J Appl Basic Med Sci 2019; 21(1): 186-196. https://doi.org/10.18203/2320-6012.ijrms20161765
4. Fortelny RH. Abdominal Wall Closure in Elective Midline Laparotomy: The Current Recommendations. Front Surg 2018; 5(1): 34. https://doi.org/10.3389/fsurg.2018.00034
5. 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. https://doi.org/10.1007/s00268-017-4393-9
6. Heger P, Pianka F, Diener MK, Mihaljevic AL. Current standards of abdominal wall closure techniques: Conventional suture techniques. Chirurg 2016; 87(9): 737-743. https://doi.org/10.1007/s00104-016-0231-0
7. Murtaza B, Ali N, Sharif MA, Malik IB, Mahmood A. Modified midline abdominal wound closure technique in complicated/high risk laparotomies. J Coll Physicians Surg Pak 2010; 20(1): 37-41.
8. Waqar SH, Malik ZI, Razzaq A, Abdullah MT, Shaima A, Zahid MA. Frequency and risk factors for wound dehiscence/burst abdomen in midline laparotomies. J Ayub Med Coll Abbottabad 2005; 17(4): 70-73.
9. Pai D, Shenoy R, Chethan K. Comparison of non-absorbable (polypropylene) versus delayed absorbable (polydioxanone) suture material for abdominal wound closure after laparotomy. Int Sur J 2018; 5(5): 1690-1696. https://doi.org/10.18203/2349-2902.isj20181404
10. Shahid MA, Mahmoud FA, Elmallah AS. Evaluation of a new technique for abdominal wall closure in midline laparotomies. Int Surg J 2018; 24; 5(8): 2701-2707. https://doi.org/10.18203/2349-2902.isj20183188
11. Albahadili M, Kadhem MJ, Majeed AW. Polydioxanone Sutures Instead of Polypropylene Sutures for Abdominal Closure to Prevent Wound Sinuses. Indian J Forensic Med Toxicol 2021; 15(2): 2927. https://doi.org/10.37506/ijfmt.v15i2.14817
12. Gandhi CS, Mote DG, Shivani Z, Sama KK. Short term outcome of midline laparotomies in view abdominalfascia closer. Int Surg J 2021; 9(1): 107-110. https://doi.org/10.18203/2349-2902.isj20215140
13. Naz S, Memon SA, Jamali MA, Ahmed MR, Almani T. Polydioxanone Versus Polypropylene Closure For Midline Abdominal Incisions. J Ayub Med Coll Abbottabad 2017; 29(4): 591-594.
14. Justinger C, Slotta JE, Ningel S, Gräber S, Kollmar O, Schilling MK. Surgical-site infection after abdominal wall closure with triclosan-impregnated polydioxanone sutures: results of a randomized clinical pathway facilitated trial (NCT00998907). Surgery 2013; 154(3): 589-595. https://doi.org/10.1016/j.surg.2013.04.011

15. Gurjar V, Halvadia BM, Bharaney RP, Ajwani V, Shah SM, Rai S. Study of two techniques for midline laparotomy fascial wound closure. Indian J Surg 2014; 76(2): 91-94. https://doi.org/10.1007/s12262-012-0612-7
16. Talpur AA, Awan MS, Surhio AR. Closure of elective abdominal incisions with monofilament, non-absorbable suture material versus polyfilament absorbable suture material. J Ayub Med Coll Abbottabad 2011; 23(2): 51-54.
17. Pandey S, Singh M, Singh K, Sandhu S. A Prospective Randomized Study Comparing Non-absorbable Polypropylene (Prolene®) and Delayed Absorbable Polyglactin 910 (Vicryl®) Suture Material in Mass Closure of Vertical Laparotomy Wounds. Indian J Surg 2013; 75(4): 306-310. https://doi.org/10.1007/s12262-012-0492-x
18. 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. https://doi.org/10.1016/j.ijsu.2011.09.006
19. Chalya PL, Massinde AN, Kihunrwa A, Mabula JB. Abdominal fascia closure following elective midline laparotomy: a surgical experience at a tertiary care hospital in Tanzania. BMC Res Notes 2015; 8(1): 281. https://doi.org/10.1186/s13104-015-1243-4
20. El-Charif MH, Hassan Z, Hoballah J, Khalife M, Sbaity E. Protocol for a randomized controlled trial comparing wound Complications in elective midline laparotomies after Fascia Closure using two different Techniques of Running sutures: COFACTOR trial. Trials 2020; 21(1): 608. https://doi.org/10.1186/s13063-020-04507-8

.....