

ORIGINAL ARTICLE

Frequency of surgical site infections in prolene suture and staples in midline laparotomy wound closure.

Mateen Shanawar¹, Bashir Ahmad², Osman Riaz³, Junaid Misbah⁴, Amer Abbas Warraich⁵

ABSTRACT... **Objective:** To compare the frequency of surgical site infection (SSI) between Prolene sutures and skin staples for closure of midline laparotomy wounds. **Study Design:** Randomized Controlled Trial. **Setting:** Department of Surgery, Allied-II Hospital, Faisalabad. **Period:** 29-10-2025 to 29-01-2026. **Methods:** Ninety patients between the ages of 18 and 60 who were having emergency midline laparotomies were recruited and divided into two equal groups at random. Staples were used to close the skin in Group A, and Prolene sutures were used in Group B. Individuals with a history of laparotomy scarring, chronic steroid use, or immunocompromised status were not included. To ensure consistency, all procedures were carried out by consultant surgeons. In accordance with CDC criteria, patients were monitored for the development of SSI for fourteen days following surgery. SPSS 25 was used to analyze the data; the chi-square test was used, and $p \leq 0.05$ was deemed significant. **Results:** Mean age was 40.79 ± 8.48 years with male predominance (65.6%). Baseline characteristics, including age, gender, BMI, ASA class, and indication for surgery, were comparable between groups ($p > 0.05$). SSI occurred in 14 patients (31.1%) in the staples group compared with 25 patients (55.6%) in the Prolene group ($p = 0.019$). Stratified analysis showed significantly higher SSI with Prolene among males ($p = 0.047$), patients aged 46–60 years ($p = 0.048$), overweight patients ($p = 0.049$), and diabetics ($p = 0.015$). Mean duration of surgery was similar in both groups ($p = 0.335$). **Conclusion:** Skin closure with staples is associated with significantly lower frequency of surgical site infection compared to Prolene sutures after midline laparotomy. Staples may be considered a safer and more effective method for wound closure, particularly in high-risk patients.

Key words: Midline Laparotomy, Prolene Sutures, Surgical Site Infection, Staples, Wound Closure.

Article Citation: Shanawar M, Ahmad B, Riaz O, Misbah J, Warraich AA. Frequency of surgical site infections in prolene suture and staples in midline laparotomy wound closure. Professional Med J 2026; 33(08):1545-1551. <https://doi.org/10.29309/TPMJ/2026.33.08.10466>

INTRODUCTION

An incision made through the anterior abdominal wall to reach the abdominal cavity is referred to as a laparotomy. The benefits of midline incisions during laparotomy are their speed and ease of access to the abdominal cavity.^{1,2} In order to quickly and safely access the abdominal cavity for both elective and emergency abdominal treatments, midline laparotomies are a common surgical procedure. Patients having midline laparotomies are particularly vulnerable to surgical site infections (SSIs) and other post-operative problems (SSIs).^{3,4}

Infections of the tissues, organs, or areas that surgeons expose when performing an invasive surgery are known as surgical site infections (SSIs). About 2% of surgical procedures result in severe surgical site infections (SSIs), which make up about 20% of illnesses linked to healthcare.⁵ In an effort

to lower the incidence of surgical site infections, a variety of wound closure methods have been investigated. Among the different techniques, two main ones—skin staples and skin sutures—have become more popular.⁶

Because suture threads are easily accessible, simple to use, and effective, as well as because suture material offers the mechanical support required to maintain the closure, they are the most often used method of wound closure.⁷ Sutures have a number of disadvantages, including cutting through parenchyma and early and delayed resorption, but their main benefits are their strength, flexibility, and lack of toxicity. Staples are simple to place and are composed of stainless steel. According to certain research, staples may lower infection rates because of their fast closure and inertness.^{7,8}

1. MBBS, PGR, Allied-II Hospital, Faisalabad.

2. MBBS, FCPS, Assistant Professor, Allied-II Hospital, Faisalabad.

3. MBBS, FCPS, Assistant Professor, Allied-II Hospital, Faisalabad.

4. MBBS, FCPS, Senior Registrar, Allied-II Hospital, Faisalabad.

5. MBBS, FCPS, Senior Registrar, Allied-II Hospital, Faisalabad.

Correspondence Address:

Dr. Mateen Shanawar
Allied-II Hospital, Faisalabad.
mateenshanawar1@gmail.com

Article received on:

30/01/2026

Accepted for publication:

29/03/2026



However, some research suggests that staples may be linked to higher rates of infection and hospital stays.⁹

Naseer et al. evaluated the SSI in abdominal procedures using staples versus Prolene sutures. Following surgery, patients in group B had their skin closed using Prolene sutures, whereas patients in group A had their skin closed using staples. There were notable differences in SSI rates between groups A and B. 19 patients (30.6%) in group A and 37 patients (59.7%) in group B experienced SSI ($P=0.001$). Group A's mean skin closure time was significantly shorter than group B's ($p=0.000$).¹⁰

Although there are several options available to surgeons for sealing the abdominal fascia, there is currently no agreement on the ideal suture material or closure technique. Thus, the purpose of this study was to compare the effects of skin staples and skin sutures on surgical site infection rates following midline laparotomy. It is anticipated that the results of this study will be crucial in improving surgical results and post-operative recuperation.

METHODS

This randomized controlled trial was carried out in the Surgery Department of Allied-II Hospital in Faisalabad from 29-10-2025 to 29-01-2026 after taking approval from ethical committee (No.48. ERC/FMU/2024-25/121). The WHO sample size calculator with an 80% research power and a 95% confidence level was used to determine the sample size. The computed sample size was 90 patients, with 45 patients in each group, taking into account the expected rates of surgical site infection (SSI) of 30.6% in the staples group (P1) and 59.7% in the Prolene sutures group (P2). A successive sampling method without probability was employed.

The study comprised patients of any gender who were undergoing an emergency midline laparotomy, were in ASA class I-III, and were between the ages of 18 and 60. Individuals with immunocompromised conditions, such as HIV infection, immunosuppressive medications, long-term steroid therapy, peritoneal dialysis, chronic obstructive airway disease, autoimmune or collagen disorders, and a history of laparotomy scarring,

were not included.

The Institutional Ethical Review Committee and CPSP gave their consent before the study was started. Prior to registration, all participants gave their informed consent after being informed about the study's goals and given a confidentiality guarantee. Following a thorough history and clinical examination, patients who met the inclusion criteria were selected from the surgical ward. The lottery approach was used to divide the participants into two groups at random. Staples were used to close the skin in Group A, and Prolene sutures were used in Group B. All surgeries were carried out by a consultant surgeon who had at least three years of post-fellowship experience to guarantee consistency in surgical technique. Patients were monitored for a month following surgery in order to identify any wound problems. According to the operational definition, surgical site infection was evaluated using the Centers for Disease Control (CDC) standards. A pre-made proforma was used to record all pertinent data.

SPSS version 25.0 was used for data entry and analysis. Mean $\pm$ standard deviation was used to express quantitative factors such as age, height, weight, BMI, and length of surgery. Gender, laparotomy indication, comorbidities (diabetes mellitus, hypertension), ASA class, and SSI were among the qualitative factors that were displayed as percentages and frequencies. The frequency of SSI was compared between the two groups using the Chi-square test. Stratification was used to control effect modifiers like age, gender, BMI, ASA class, comorbidities, and length of operation. The impact of these factors on SSI was then evaluated using a post-stratification Chi-square test. A statistically significant p-value was defined as ≤ 0.05 .

RESULTS

The study included 90 patients receiving emergency midline laparotomies, who were divided into two equal groups of 45 at random. Staples were used to close the skin in Group A, and Prolene sutures were used in Group B. After a fourteen-day follow-up, each participant's development of surgical site infection (SSI) was examined. The bulk of the patients (65.6%) were male, with an overall mean

age of 40.79 ± 8.48 years. There were no statistically significant differences between the two groups' baseline clinical and demographic parameters.

Both groups had comparable distributions of gender, age groups, body mass index, ASA status, comorbidities, and laparotomy indications. The Prolene group's mean age was 40.56 ± 8.29 years, while the Staples group's was 41.02 ± 8.74 years ($p=0.796$). In both groups, male preponderance was noted (64.4% vs. 66.7%, $p=0.824$). Patients who were overweight made up 55.6% of Group A and 60.0% of Group B ($p=0.670$). Similarly, there was no significant intergroup difference for diabetes, hypertension, ASA class, or surgical indications (all

$p>0.05$), confirming successful randomization and study population homogeneity.

Compared to 25 patients (55.6%) in the Prolene sutures group, 14 patients (31.1%) in the staples group experienced surgical site infections. This difference showed a greater prevalence of SSI with Prolene closure and was statistically significant ($p=0.019$). Group A's mean surgical time was 129.6 ± 28.2 minutes, whereas Group B's was 125.3 ± 134.0 minutes. There was no statistically significant difference between the two groups ($p=0.335$). These results imply that the kind of skin closure affected the incidence of SSI rather than the length of the procedure.

TABLE-I

Baseline characteristics of patients by group

Characteristic	Group A (Staples)	Group B (Prolene Sutures)	Total	P-Value*
Gender				
Male	29 (64.4%)	30 (66.7%)	59 (65.6%)	0.824
Female	16 (35.6%)	15 (33.3%)	31 (34.4%)	
Age (years)				
Mean Age	41.02±8.74	40.56± 8.29	40.79±8.48	0.796
18–30	6 (13.3%)	6 (13.3%)	12 (13.3%)	0.974
31–45	23 (51.1%)	24 (53.3%)	47 (52.2%)	
46–60	16 (35.6%)	15 (33.3%)	31 (34.4%)	
BMI Group				
Normal weight	20 (44.4%)	18 (40.0%)	38 (42.2%)	0.670
Overweight	25 (55.6%)	27 (60.0%)	52 (57.8%)	
ASA Status				
ASA I	13 (28.9%)	11 (24.4%)	24 (26.7%)	0.500
ASA II	22 (48.9%)	19 (42.2%)	41 (45.6%)	
ASA III	10 (22.2%)	15 (33.3%)	25 (27.8%)	
Diabetes				
Yes	19 (42.2%)	20 (44.4%)	39 (43.3%)	0.832
No	26 (57.8%)	25 (55.6%)	51 (56.7%)	
Hypertension				0.399
Yes	20 (44.4%)	24 (53.3%)	44 (48.9%)	0.959
No	25 (55.6%)	21 (46.7%)	46 (51.1%)	
Indication for Laparotomy				
Perforated viscus	12 (26.7%)	11 (24.4%)	23 (25.6%)	0.959
Intestinal obstruction	13 (28.9%)	12 (26.7%)	25 (27.8%)	
Peritonitis	12 (26.7%)	12 (26.7%)	24 (26.7%)	
Abdominal trauma	8 (17.8%)	10 (22.2%)	18 (20.0%)	

TABLE-II

Surgical site infection and surgery duration by closure method

		Group A	Group B	Total	P-Value*
SSI	Yes	14 (31.1%)	25 (55.6%)	39 (43.3%)	0.019
	No	31 (68.9%)	20 (44.4%)	51 (56.7%)	
Duration of Surgery		129.6 ± 28.2	125.3–134.0	-	0.335

TABLE-III

Association of surgical site infection with closure method stratified by patient and surgical factors

Variable	Category	Group A (Staples)	Group B (Prolene)	Total	P-Value
Gender	Male	9/29 (31.0%)	17/30 (56.7%)	26/59 (44.1%)	0.047*
	Female	5/16 (31.3%)	8/15 (53.3%)	13/31 (41.9%)	0.213
Age (years)	18–30	2/6 (33.3%)	4/6 (66.7%)	6/12 (50.0%)	0.248
	31–45	8/23 (34.8%)	12/24 (50.0%)	20/47 (42.6%)	0.292
	46–60	4/16 (25.0%)	9/15 (60.0%)	13/31 (41.9%)	0.048*
BMI	Normal weight	6/20 (30.0%)	9/18 (50.0%)	15/38 (39.5%)	0.208
	Overweight	8/25 (32.0%)	16/27 (59.3%)	24/52 (46.2%)	0.049*
ASA Status	I	4/13 (30.8%)	6/11 (54.5%)	10/24 (41.7%)	0.239
	II	6/22 (27.3%)	9/19 (47.4%)	15/41 (36.6%)	0.183
	III	4/10 (40.0%)	10/15 (66.7%)	14/25 (56.0%)	0.188
Diabetes	Yes	5/19 (26.3%)	13/20 (65.0%)	18/39 (46.2%)	0.015*
	No	9/26 (34.6%)	12/25 (48.0%)	21/51 (41.2%)	0.332
Hypertension	Yes	7/20 (35.0%)	14/24 (58.3%)	21/44 (47.7%)	0.123
	No	7/25 (28.0%)	11/21 (52.4%)	18/46 (39.1%)	0.091
Indication	Perforated viscus	4/12 (33.3%)	7/11 (63.6%)	11/23 (47.8%)	0.146
	Intestinal obstruction	4/13 (30.8%)	6/12 (50.0%)	10/25 (40.0%)	0.327
	Peritonitis	4/12 (33.3%)	7/12 (58.3%)	11/24 (45.8%)	0.219
	Abdominal trauma	2/8 (25.0%)	5/10 (50.0%)	7/18 (38.9%)	0.280

Staples continued to outperform Prolene on stratification in the majority of subgroups. SSI occurred in 31.0% of male patients with staples and 56.7% with Prolene ($p=0.047$). The Prolene group had a considerably higher infection rate in the 46–60 age range (60.0% vs. 25.0%, $p=0.048$). Additionally, overweight patients benefited more from staples, with SSI in 32.0% of cases compared to 59.3% in the Prolene group ($p=0.049$). Prolene infection was much greater in diabetic patients (65.0%) than staple infection (26.3%) ($p=0.015$). Similar patterns were seen with ASA class, hypertension, and various surgical causes, although they were not statistically significant ($p>0.05$).

DISCUSSION

This randomized controlled study showed that

patients whose midline laparotomy wounds were closed with Prolene sutures had a significantly higher frequency of surgical site infection (SSI) (55.6%) than those whose wounds were closed with staples (31.1%) ($p=0.019$). This difference was more noticeable in male patients (56.7% vs. 31.0%, $p=0.047$), in the overweight subgroup (59.3% vs. 32.0%, $p=0.049$), in patients between the ages of 46 and 60 (60.0% vs. 25.0%, $p=0.048$), and in patients with diabetes (65.0% vs. 26.3%, $p=0.015$). These results imply that, particularly in high-risk subpopulations, skin closure technique significantly influences the risk of SSI after emergency midline laparotomy.

The current trial's findings are consistent with those of Naseer et al., who found that when staples and

Prolene sutures were compared for SSI rates, the Prolene group had higher infection rates (59.7%) compared to staples (30.6%) ($P=0.001$), supporting the trend seen in our population.¹⁰ The evidence that staples may be helpful in lowering SSI in specific emergency abdominal settings is strengthened by this consistency.

Despite conflicting findings, a number of studies have looked at the impact of wound closure technique on postoperative infections in different surgical contexts. Subcuticular sutures and staples were compared for open abdominal surgery in a multicenter randomized controlled trial conducted by Tokyo Metropolitan institutions. The results showed no discernible difference in the rates of superficial SSI between the two groups.¹⁰ Even though this larger trial used subcuticular sutures instead of interrupted Prolene and included both elective and emergency procedures, the similar infection outcomes highlight how differences in suture technique and surgical indication may impact comparative efficacy.

Stapling was linked to a higher risk of SSI than suturing in studies with low risk of bias, according to a systematic review and meta-analysis of wound closure techniques in hip and knee arthroplasty (RR: 2.56; 95% CI: 1.20–5.44).¹¹ Although this analysis focuses on orthopedic procedures, it highlights the differential infection risk associated with the closure method, which is similar to our findings in general surgery. On the other hand, a more comprehensive meta-analysis of abdominal surgeries found that, generally, there was no discernible difference in SSI between sutures and staples.¹² Different surgical contexts, patient demographics, and definitions of the SSI endpoint are probably the reasons for the variation in results among evidence syntheses.

The difference in the infection rates is biologically plausible. Staples are easier to close and have less tissue touching, and may expose the endogenous flora and environmental pathogens less. Prolene sutures, where several needle insertions have to be made and contact time with the skin and subcutaneous tissue is extended, on the contrary, can increase the risk of contamination during an emergency with a high concentration of bacteria.¹²

According to the CDC, SSI is an infection that begins within 30 days after the procedure and depends on the technique used to perform surgeries, the material used to close the wound, and the presence of patient.

An observational prospective study in Pakistan of staples and sutures in elective abdominal procedures reported decreased SSI rates with staples and considerable savings in closure time.¹³ Even though such an elective surgery scenario is different than emergency laparotomy and could have less dirty operative areas, the results confirm the possibility of the helpfulness of staple repair in reducing the risk of infection under specified circumstances.¹⁴

These encouraging findings notwithstanding, not everything supports staples. A randomized trial of absorbable versus non-absorbable sutures in the abdominal wound closure found that there was a significant reduction in SSI with absorbable sutures, versus non-absorbable polypropylene, possibly as a result of material properties as well as worsening infection risk.¹⁵ This highlights that the interaction between the type of material (absorbable and non-absorbable) and closure technique (staples and sutures) should be taken into account when interpreting the outcome of SSI.

All other observational research in distinct populations [i.e., renal transplant recipients] demonstrated an increased trend in SSI with staples versus sutures, but non-significantly, potentially because of small sample sizes and the presence of immunosuppression confounding wound healing.¹³ This underscores that comorbidity profiles of patients are vital factors that affect SSI risk more than closure mode.

The quality and the findings of the available evidence on the use of staples and sutures in the context of abdominal surgery are heterogeneous. An evidence review on a high level observed that low to moderate evidence data do not always demonstrate a stable difference in SSI rates between staples and sutures following laparotomy.¹⁶ The same review, however, found that there were worse results when using staples in wound dehiscence, and that context-specific advantages were found between sutures

and staples when adjusted to clinical situations.¹⁷

The current research is based on emergency midline laparotomy, which is usually contaminated in comparison with the elective cases, and the utilization of Prolene (a popular non-absorbable monofilament) makes its application in high-risk clinical practice even stronger. Stratified findings with strong difference between results in overweight subgroups and diabetic subgroups underline the significance of the personal approach to surgical planning. Diabetes and elevated BMI have been found to independently affect defective tissue perfusion and retarded healing, and thus augment the effect of closure technique on the SSI. Though there are some scant data about this interaction, our results are consistent with the general literature of surgery infection that suggests strict closure procedures in patients at high risk of metabolic factors.

In this study, its single-center design and comparatively limited follow-up, up to two weeks, limit the study to late SSIs or more extensive wound complications. Also, the technique used by the surgeon and the quality of postoperative care might play a role in wound closure and have become standardized to the greatest extent possible, but still create variability. This paper illustrates that staple closure in the context of emergency midline laparotomy is characterized by much lower SSI incidence than Prolene suture closure, especially in males, overweight patients, older adults, and people with diabetes. Although there is evidence of a mixed nature in other surgical settings, our results would count in favor of staples being considered as a potential choice of intervention in minimizing SSI among selected high-risk groups. Future multicenter randomized studies as a comparative study to particular suture materials and techniques of closure are justified to update the guidelines on optimal wound closure in laparotomy.

CONCLUSION

The closure of the skin using staples was linked to a significantly lower rate of surgical site infection in patients who underwent an emergency laparotomy of the midline as opposed to Prolene sutures. The disparity was more significant in patients at risk,

such as older patients and patients with overweight and diabetes. There was no significant difference in the duration of operations in the two techniques. There is a better way of wound closure to prevent postoperative SSI, and this is called Staples. These findings should be reaffirmed with bigger multicentre randomized trials.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SOURCE OF FUNDING

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Copyright© 29 Mar, 2026.

REFERENCES

1. Sengar HOS, Charokar K, Nema P. **Closure methods for midline laparotomy incisions following abdominal surgery: A comparative study from Central India.** Journal of Evidence-Based Medicine and Healthcare. 2021; 8(24):2089-93.
2. Hussain AA, Tagar S, Rehman MU, Zafar M, Kumari A, Asfandiyar S. **Prevalence of wound infection with new internal tension sutures technique for midline laparotomy closure.** Annals of PIMS-Shaheed Zulfiqar Ali Bhutto Medical University. 2025; 21(1):60-4.
3. Gandhi CS, Mote DG, Shivani Z, Sama KK. **Short term outcome of midline laparotomies in view abdominal fascia closer.** International Surgery Journal. 2022; 9(1):107-10.
4. Kumar R, Hastir A, Goyal S, Walia RS. **Sutures versus staplers for skin closure of midline incision in laparotomy patients and their outcome.** Pain. 2017; 5:125.
5. Aghara C, Rajyaguru A, Bhatt J. **Prospective comparative study of modified Smead Jones versus conventional continuous method of fascial closure in emergency midline laparotomy.** Int Surg J. 2020; 7(11):3713-7.
6. Cochetti G, Abraha I, Randolph J, Montedori A, Boni A, Arezzo A, et al. **Surgical wound closure by staples or sutures?: Systematic review.** Medicine. 2020; 99(25):e20573.
7. Ravi S, Purushothaman V, Chase S, Nayak S. **Skin staples: An alternative for polypropylene sutures for mesh fixation in Lichtenstein's tension-free repair of inguinal hernia.** Journal of Current Research in Scientific Medicine. 2023; 9(2):167-72.
8. Ford C, Hill B. **A guide to removing surgical staples.** British Journal of Nursing. 2024; 33(8):372-80.
9. Akram K, Akhtar UB, Janjua OS, Zahra R, Ahmed T, Jabbar M. **Comparison of skin staples versus prolene sutures for closure of neck dissection incisions in terms of aesthetics and wound healing.** Pakistan Journal of Medical & Health Sciences. 2022; 16(10):921-.

10. Naseer S, Khan TH, Gul A, Mumtaz N, editors. **Comparison of the skin closures using staples versus prolene sutures in patients undergoing clean elective abdominal surgeries.** Medical Forum Monthly. 2024; 35(1):76-79.
11. Van de Kuit A, Krishnan R, Mallee W, Goedhart L, Lambert B, Doornberg J, et al. **Surgical site infection after wound closure with staples versus sutures in elective knee and hip arthroplasty: A systematic review and meta-analysis.** Arthroplasty. 2022; 4(1):12.
12. Feng J, Jiang X, Zhi Z. **Subcuticular sutures versus staples for skin closure in patients undergoing abdominal surgery: A meta-analysis of randomized controlled trials.** Plos one. 2021; 16(5):e0251022.
13. Ullah I, Manan F, Moosa M, Rehman KU, Manan Sr F. **Surgical site infections after wound closure with staples versus sutures in post-renal transplant recipients: A prospective observational study.** Cureus. 2025; 17(9):e92197.
14. Scott MJ, Aggarwal G, Aitken RJ, Anderson ID, Balfour A, Foss NB, et al. **Consensus guidelines for perioperative care for emergency laparotomy. Enhanced Recovery After Surgery (ERAS®) Society recommendations part 2—emergency laparotomy: Intra-and postoperative care.** World Journal Of surgery. 2023; 47(8):1850-80.
15. Sajid MS, McFall MR, Whitehouse PA, Sains PS. **Systematic review of absorbable vs non-absorbable sutures used for the closure of surgical incisions.** World Journal of Gastrointestinal Surgery. 2014; 6(12):241.
16. Hemming K, Pinkney T, Futaba K, Pennant M, Morton DG, Lilford RJ. **A systematic review of systematic reviews and panoramic meta-analysis: Staples versus sutures for surgical procedures.** PloS One. 2013; 8(10):e75132.
17. Martin EK, Beckmann MM, Barnsbee LN, Halton KA, Merollini K, Graves N. **Best practice perioperative strategies and surgical techniques for preventing caesarean section surgical site infections: a systematic review of reviews and meta-analyses.** BJOG: An International Journal of Obstetrics & Gynaecology. 2018; 125(8):956-64.

AUTHORSHIP AND CONTRIBUTION DECLARATION

1	Mateen Shanawar: Concept, design, data collection, writing.
2	Bashir Ahmad: Proof reading.
3	Osman Riaz: Data analysis.
4	Junaid Misbah: Literature search.
5	Amer Abbas Warraich: Literature search, statistical support.