Volume 4, Issue 1, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

COMPARISON OF SKIN STAPLERS AND POLYPROPYLENE SKIN SUTURES IN WOUND CLOSURE FOLLOWING MIDLINE ELECTIVE LAPAROTOMY

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DOI: https://doi.org/10.5281/zenodo.18921420

Keywords
Surgical site infection, skin staplers, polypropylene sutures, laparotomy, wound closure.

Article History
Received: 05 July 2025
Accepted: 16 December 2025
Published: 01 January 2026

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Abstract

Background:
Surgical site infections (SSI) are frequent post-operative complications that result in raising morbidity, length of stay, and expenses of healthcare. Skin closure technique can determine the wound healing outcome. This paper contrasted the performance of stainless-steel skin staplers and polypropylene sutures as concerns postoperative wound infection after performing a midline elective laparotomy.

Materials and Methods:
This is a randomized controlled trial, which will be held in the Department of Surgery, Hayatabad Medical Complex, Peshawar, between 1 st November 2024 and 30 th April 2025. One hundred and sixty-six patients aged between 18 and 60 years who were undergoing elective midline laparotomy were randomly assigned to two groups; Group A (polypropylene subcuticular sutures, n=58) and Group B (skin staplers, n=58). Wound infection was assessed by following the patients 30 days after surgery. The SPSS version 23 was used to analyze data. Chi-square and independent t-tests were implemented and p 0.05 was taken as significant.

Results:
Infection of the wound was found in 27.6 percent of the patients in the stapler group and 12.1 percent in the suture group (p=0.033). The stapler group showed a high level of infection (p=0.048) and patients with BMI 25 kg/m 2 (p=0.042). The mean time of skin closure using staplers (6.5 differences 1.3 minutes) was significantly less than the time of skin closure using sutures (14.2 differences 2.1 minutes; p<0.001).

Conclusion:
Polypropylene sutures were found to have low rates of postoperative wound infection when compared to skin staplers in elective midline laparotomy despite needing more time to close.

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INTRODUCTION

Surgical site infections (SSIs) are still considered to be one of the most prevalent problems that occur post-operative procedures and are also characterized by a high level of morbidity, extended hospitalization period, and high health expenditure. The rates of SSI are also dependent on the level of wound contamination, patient related factors, and the method of surgery. With clean surgical cases, the rate of infection tends to be low (1 to 2 percent) yet this low percentage has an accumulative effect to the cumulative number of postoperative complications as a whole [1]. Notably, the occurrence rate of a significant percentage of SSIs can be avoided by following evidence-based perioperative practices [2].

The development of SSIs is affected by many factors that are optimisation of the operating room setting, antibiotic prophylaxis, surgical technique, and postoperative wound care. One of them is the technique of skin closure, which is an adjustable technical aspect that can potentially affect wound healing and infection rates. It is necessary to properly approximate the skin edges with minimum tissue trauma to ensure the maximum healing and decrease the microbial colonization [2].

Polypropylene sutures are non-absorbable, monofilament and relatively inert and are used in skin closure. They have a low bacterial adherence due to their smooth texture and low tissue response as opposed to braided sutures like silk that have a high propensity to host microorganisms [3]. Subcuticular polypropylene closure has been commonly undertaken due to its positive cosmetic outcome and reasonable complication rates.

Another way of wound closure is through the use of metallic skin staples which are normally stainless steel in nature. Staples are readily implaced and save skin closure time to an extent of up to 80 percent of interrupted or subcuticular suture methods [4]. In theory, the shortened operations and minimum tissue contact is likely to lead to a smaller risk of infection. Also, the stainless steel can be inert, and this has the potential to inhibit local inflammatory response.

Comparison between sutures and staples has demonstrated mixed findings in different specialties of surgery. A meta-analysis study by Mackeen et al. reported a positive wound morbidity outcome with the use of staplers over the use of sutures in patients under cesarean section surgery [1]. Other randomized studies and meta-analyses have also demonstrated similar or better results using staples in some operative units [5,6].

On the other hand, other researchers have found a higher rate of infection and longer hospitalization in case of skin staples, especially during emergency cesarean deliveries, with no significant differences in pain or other wound morbidity [7]. In orthopedic surgery, meta-analyses have indicated that staples could be the same as to sutures in certain results and in others it could be related to greater pain/discomfort or risk of infection [8].

Varghese et al. specifically in abdominal surgery have reported that wound infection rate was significantly higher in patients who experienced midline abdominal closure with staples (30%) as compared to those who experienced conventional sutures (11.7%), with the controversy on the best technique of closing persisting. With these opposing results, further research on elective midline laparotomy wounds specifically on the local population is still needed, through well-designed randomized controlled trials.

A midline elective laparotomy is a general surgery that is regularly practiced. It is necessary to identify the most effective and safest way of skin closure in this environment to reduce postoperative wound infection and increase patient outcomes.

OBJECTIVE:

To compare the use of stainless-steel skin staplers and polypropylene sutures in wound closure with regard to postoperative wound infection after midline elective laparotomy.

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ISSN: (e) 3007-1607 (p) 3007-1593

METHODOLOGY

Study Design and Setting

This was a randomized controlled trial done in the Department of Surgery, Hayatabad Medical Complex, Peshawar. The research was conducted between 1 st November 2024 and 30 th April 2025 (a period of 6 months) upon being approved by the institutional ethical and research committee.

Sample Size and Method of Sampling.

The formula used to calculate sample size was n = (Z 1.96 + Z 2) 2 {P1(1 —P1) + P2(1 -P2)/(P1 -P2) 2 at 5% level of significance and P2 at 80% power was taken. The anticipated rate of wound infection was 30 percent and 10 percent in the stapler and suture group respectively. One hundred and sixty patients were recruited, and there are 58 patients in the groups. The enrolment of the patients was done using non-probability consecutive sampling.

Inclusion and Exclusion Criteria.

The study included all patients between the ages of 18 and 60 years undergoing elective midline abdominal surgery regardless of gender and ethnicity. The study did not include patients with chronic illnesses like COPD, stroke, renal failure, liver disease, hematological diseases, neoplastic diseases, malnutrition, a history of radiotherapy/chemotherapy, concomitant infections, immunocompromised condition, anemia (Hb <10 g/dL), obesity (BMI >30 kg/m 2), and those who were contaminated intraoperatively.

Randomization and Intervention.

Patients that met the inclusion criteria and signed an informed consent were then randomized to two equal groups after a blocked randomization technique. The senior specialist surgeons carried out all surgical procedures. Group A In Group A, skin closure was done using subcuticular polypropylene (Prolene 2/0) sutures. Wound closure in Group B was done using stainless steel skin staples. Removal of the first postoperative dressing was done at 48 hours.

Data Collection Procedure

Follow up of patients was done after 30 days of the operation. Infection indicators such as redness, swelling and purulent discharge were also checked on wounds as laboratory culture where required. Demographic information such as age, sex, and the body mass index was noted on a pre designed proforma. All the findings were recorded accordingly.

Statistical Analysis

The IBM SPSS version 23 was used to analyze the data. Quantitative variables, including age and BMI were determined using mean and standard deviation. Qualitative variables such as wound infection and gender were calculated using frequencies and percentages. The comparison of the two groups was on wound infection rates. The stratification was done based on age, sex, and BMI. Chi-square test post-stratification Chi-square test was used and the p-value of 0.05 was regarded as statistically significant at the confidence interval of 95%.

RESULTS

The study had a total of 116 patients whereby 58 of them were in the stapler group and another 58 were in the suture group. The 30-day postoperative follow-up of all patients was conducted, and they were all analyzed.

There was a similarity in the baseline demographic and clinical characteristics of both groups. The average age in the stapler group was 41.2 years old at a standard deviation of 9.1 years and in the suture group it was 39.8 years old at a standard deviation of 8.7 years. This difference between them was not significant (p = 0.412). On the same note, the mean BMI in stapler group was 26.1 ± 2.3 kg/m 2 and mean BMI in the suture group was 25.7 ± 2.5 kg/m 2 (p = 0.338). There were also similarities in the situation of gender distribution (p = 0.701). Table 1 contains detailed baseline characteristics.

The stapler group was found to have postoperative wound infection in 16 (27.6%) whereas the suture group had an infection in 7 (12.1%) patients. This difference was significant (r = 2.542, p = 0.033), as the patients of which

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ISSN: (e) 3007-1607 (p) 3007-1593

the wound was closed by using staplers had a higher infection rate. Table 2 indicates this comparison.

Stratification analysis was done to manipulate the possible confounding factors. In gender stratification, male patients were much more infected by stapler group (30.6%) than by suture group (11.8%) ($p = 0.048$). The difference, however, was not statistically different between female patients ($p = 0.377$). The summary of these findings is presented in Table 3.

BMI stratified results indicated that wound infection was more prevalent among patients with BMI 25kg/m 2 and higher stapler group (30.0%) than suture group (15.8%) ($p = 0.042$). However, the difference was not statistically significant in patients with BMI <25 kg/m^2 ($p = 0.088$). Table 4 provides the details.

Besides the rates of infection, the operative efficiency was also evaluated with the view to mean skin closure time in the two groups. There was a significant difference between stapler (6.5 + 1.3 minutes) and suture (14.2 + 2.1 minutes) with significant difference ($p < 0.001$). This analogy is demonstrated in Figure 1.

Table 1: Baseline Demographic and Clinical Characteristics of Patients (n = 116)

Variable	Stapler Group (n=58)	Suture Group (n=58)	Test Applied	p-value
Mean Age (years)	41.2 ± 9.1	39.8 ± 8.7	Independent t-test	0.412
Age 18–40 years	24 (41.4%)	27 (46.6%)	Chi-square	0.566
Age 41–60 years	34 (58.6%)	31 (53.4%)		
Mean BMI (kg/m²)	26.1 ± 2.3	25.7 ± 2.5	Independent t-test	0.338
BMI <25 kg/m²	18 (31.0%)	20 (34.5%)	Chi-square	0.682
BMI ≥25 kg/m²	40 (69.0%)	38 (65.5%)		
Male	36 (62.1%)	34 (58.6%)	Chi-square	0.701
Female	22 (37.9%)	24 (41.4%)		

Table 2: Comparison of Postoperative Wound Infection Between Groups

Outcome	Stapler Group (n=58)	Suture Group (n=58)	Chi-square	p-value
Wound Infection (Yes)	16 (27.6%)	7 (12.1%)	4.52	0.033
Wound Infection (No)	42 (72.4%)	51 (87.9%)		
Total	58 (100%)	58 (100%)		

Table 3: Stratification of Wound Infection with Respect to Gender

Gender	Stapler Group – Infection	Suture Group – Infection	Chi-square	p-value
Male (n=70)	11/36 (30.6%)	4/34 (11.8%)	3.89	0.048
Female (n=46)	5/22 (22.7%)	3/24 (12.5%)	0.78	0.377

Table 4: Stratification of Wound Infection with Respect to BMI

BMI Category	Stapler Group – Infection	Suture Group – Infection	Chi-square	p-value
BMI <25 kg/m²	4/18 (22.2%)	1/20 (5.0%)	2.91	0.088
BMI ≥25 kg/m²	12/40 (30.0%)	6/38 (15.8%)	4.11	0.042

Volume 4, Issue 1, 2026

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

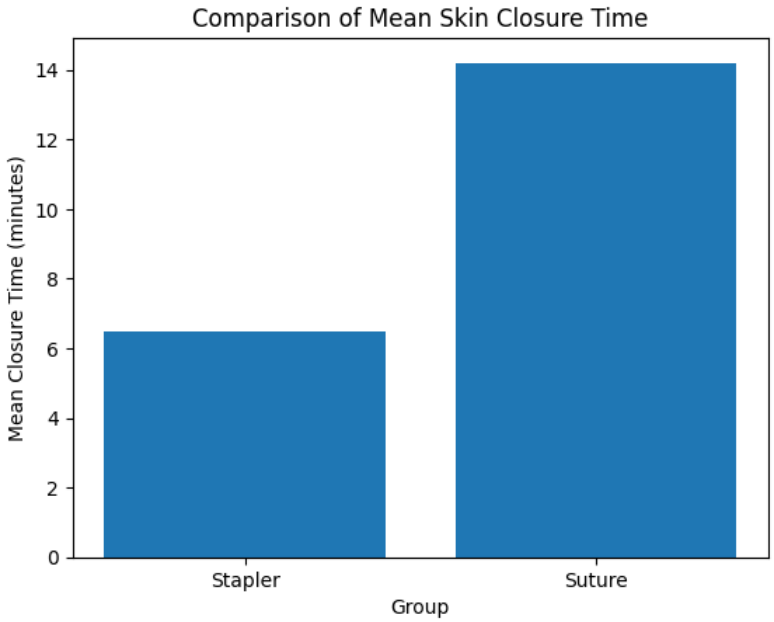


Figure 1: Comparison of Mean Skin Closure Time Between Stapler and Suture Groups

DISCUSSION

It was a randomized controlled trial to determine the efficacy and postoperative wound infection rates of skin staplers versus polypropylene sutures as midline elective laparotomy closures. The results showed that a much greater proportion of postoperative wound infection was found in the stapler group (27.6%) than the suture group (12.1%) even though staples were beneficial in terms of shortening the time of skin closure. These results point to a possible trade-off between the efficiency of the procedures and the safety of the patient.

We find that our findings agree with the previous researches that indicated rising rates of infection with the use of staplers in abdominal surgeries. Statistically significant results in a comparative analysis regarding the use of midline wound closures show that staplers were linked with a higher incidence of wound infection than polypropylene sutures [9]. Other clinical trials had reported in the same vein that although the staplers decreased the time of operation, it did not always translate to better wound outcomes [10,11]. These observations confirm the fact that speed is a good thing, but wound healing outcomes cannot be ignored during elective surgeries.

As a matter of fact, other meta-analyses have indicated that staples might provide similar or even better results in wound morbidity, especially during obstetric surgery involving caesarean section [12]. Nevertheless, the generalizability of these results to midline abdominal surgery is not so high, and results may be different in other tissues and surgery conditions. Our article is focused on elective laparotomies and contributes to the data that the use of suture in such an environment might be more consistent in terms of preventing postoperative infection.

A stratified analysis of our study demonstrated a significantly higher infection rate among the males who were in the stapler group than the ones in the suture group. Although gender is not a typical risk factor of SSIs, it can indirectly represent variations in skin structure, fat distribution, or postoperative compliance of care, but no particular evaluation of these factors was conducted in the present research. The statistically significant findings in male patients indicate that more research is required in demographic subgroups during the assessment of closure methods [13].

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ISSN: (e) 3007-1607 (p) 3007-1593

Another factor that contributed to the rate of infection was BMI. The patients with BMI 25 kg/m 2 and more were more likely to be infected, particularly those who had staplers. This is in line with the previous literature that have found that obesity is a contributing factor to SSIs, because of high levels of subcutaneous fat and blood vessels that limit the healing process and allow bacteria to grow [14,15]. A relationship between the closure technique and BMI must be taken into account when designing postoperative care and wound closure techniques.

The other notable finding in our research was that staplers are time-saving. The average time to close the skin at the stapler group was 6.5 minutes and staples at the suture group was 14.2 minutes, which is consistent with the previous studies where staples decrease the time of the skin closure by 50-80 percent [16]. Currently time-saving can be an important asset in high volume surgical environments, but such a benefit is unlikely to be worth paying with the cost of an increased risk of infection in the elective surgical practice where the quality of closure and wound results are of primary importance.

Although this study did not measure their cosmetic outcomes and patient satisfaction, past studies have reported that subcuticular suture could have superior cosmetic outcomes particularly where the surgeries are clean [17]. Also, one cannot neglect the essence of technique, experience of the surgeon, and postoperative wound treatment. These factors may also vary thus indicating that the best closure is not single factorial but multifactorial.

The price-effectiveness of staplers as compared to sutures is also a factor, particularly when resources are constrained in healthcare facilities. Even though staplers can help save time used in performing an operation and other costs of labor, higher rates of postoperative infection can lead to longer stay in the hospital, resulting in increased interventions, which ends up negating the original advantage [18–20]. Accordingly, time and ease of use are not the only factors of clinical decision making but the long-term consequences of patient recovery and the use of available healthcare are also important.

Limitations

The research was carried out at one surgical unit, which does not provide much scope of generalization. The variability of operators and the lack of efficient control over standardization of techniques was a problem though randomization was applied. There was no evaluation of cosmetic results and patient satisfaction, which could have given more indications on the benefits or limitations of each technique. Also, only 30 days follow-up was carried out; long-term wound complications and incisional hernia development were not measured. It is advisable to conduct future multi-centric trials that have larger sample size and wider parameters of evaluation.

CONCLUSION

Polypropylene subcuticular sutures were found to be significantly less associated with postoperative wound infection rates than skin staplers in midline elective laparotomy but staplers had a definite edge in the reduction of skin closure time. Although staplers enhanced the efficiency of the operators, it did not compensate the higher risk of surgical site infection that was realized in our study. Thus, polypropylene sutures can be regarded as a less harmful and more effective technique of skin closure in elective midline laparotomies, especially in individuals with a larger BMI or who have other risk factors of wound infection.

REFERENCES:

Rahman DS, Alom DS, Salahuddin DG. A Comparison between Skin Stapler and Polypropylene Sutures in Closing Laparotomy Wounds: A Study of 100 Cases. SAS J Surg. 2022 Aug;8:562-7.

Anyanwu SN, Okoye AO, Obiesie EA, Eze BU, Ihekwoaba EC, Nwofor AM. Comparative study of use of reusable skin staples and vertical mattress sutures in the closure of midline laparotomy wounds. Journal of West African College of Surgeons. 2024 Jan 1;14(1):41-7.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Naseer S, Khan TH, Gul A, Mumtaz N. Comparison of the Skin Closures Using Staples Versus Prolene Sutures in Patients Undergoing Clean Elective Abdominal Surgeries. InMedical Forum Monthly 2024 Jan 30 (Vol. 35, No. 1).

Correnti C, Blankenship K, Ufkes N, Strasswimmer J. Sutures, Adhesives, Staples, and Other Closure Technologies. InEvidence-Based Procedural Dermatology 2019 May 17 (pp. 175-212). Cham: Springer International Publishing.

Rao YA, Padmasri R, Divya TK, Moharana AK, Deepak TS. A single-blind randomised controlled trial comparing clinical equivalence of Trulon® and Ethilon® polyamide sutures for the skin closure following laparotomy incisions. International Journal of Surgery Open. 2022 Sep 1;46:100534.

Chowdhury S, El-Hussuna A, Gallo G, Keatley J, Kelly ME, Minaya-Bravo A, Ovington L, Pata F, Pellino G, Pinkney T, Sanchez Guillen L. An international assessment of surgeon practices in abdominal wound closure and surgical site infection prevention by the European Society for Coloproctology. Colorectal Disease. 2023 May;25(5):1014-25.

Sharma A, Rajalingam V, Nageswaran H, Best L. A meta-analysis on continuous versus interrupted skin closure following appendicectomy. British Journal of Surgery. 2021 Aug 1;108(8):898-907.

RAJ A. Comparative study on the outcome of primary skin closure versus delayed primary skin closure in case of emergency laparotomies. International journal of health sciences. 2022 Jan 1.

YII E. SMALL BITE VERSUS LARGE BITE STITCHING TECHNIQUE FOR LAPAROTOMY WOUND CLOSURE: A SYSTEMATIC REVIEW AND META-ANALYSIS. ANZ J. Surg. 2022;92(S1):62-88.

Martinez-Lopez J, Brown JA, Werre SR. Incisional complications after skin closure with n-butyl cyanoacrylate or stainless-steel skin staples in horses undergoing colic surgery. Veterinary Surgery. 2021 Jan;50(1):186-95.

Winston KR, Ketch LL. Surgery of Skin: General. InPlastic Neurosurgery: Opening and Closing Neurosurgical Doors in Adults and Children 2023 Sep 24 (pp. 77-114). Cham: Springer International Publishing.

Joshi D, Varandani N, Vaidya M. Study of different methods of midline laparotomy incision closure and their outcomes. MVP J Med Sci. 2022;8:249-52.

Shankar AP, Mathew S, Tippana VN, BR K, Naik S, Pandita RK, An NK, Bhat BK, Moharana AK, Ts D, Kumar NA. A Prospective Randomized Controlled Trial Comparing Clinical Equivalence of PD Synth and PDS Polydioxanone Sutures. Cureus. 2023 Dec 10;15(12).

Heger P, Feißt M, Krisam J, Klose C, Dörr-Harim C, Tenckhoff S, Büchler MW, Diener MK, Mihaljevic AL. Hernia reduction following laparotomy using small stitch abdominal wall closure with and without mesh augmentation (the HULC trial): study protocol for a randomized controlled trial. Trials. 2019 Dec 16;20(1):738.

Raff L, Reid T. Small Bowel Resection and Anastomosis. InIllustrative Handbook of General Surgery 2024 Sep 25 (pp. 273-283). Cham: Springer Nature Switzerland.

Choi CH, Kim NK, Kim K, Lee YJ, Lee KH, Lee JM, Lee KB, Suh DH, Kim S, Kim MK, Seong SJ. Effects of subcutaneous drain on wound dehiscence and infection in gynecological midline laparotomy: Secondary analysis of a Korean Gynecologic Oncology Group study (KGOG 4001). European Journal of Surgical Oncology. 2024 Sep 1;50(9):108484.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Kohler A, Lavanchy JL, Lenoir U, Kurmann A, Candinas D, Beldi G. Effectiveness of prophylactic intraperitoneal mesh implantation for prevention of incisional hernia in patients undergoing open abdominal surgery: a randomized clinical trial. JAMA surgery. 2019 Feb;154(2):109-15.

Aguirre-Allende I, Alkorta-Zuloaga M, Iglesias-Gaspar MT, Urreta-Ballobre I, García-Domínguez A, Arteaga-Martin X, Beguiristain-Gómez A, Medrano-Gómez MÁ, Ruiz-Montesinos I, Riverola-Aso AP, Jiménez-Agüero R. Subcuticular suture and incisional surgical-site infection in elective hepatobiliary and pancreatic surgery: an open-label, pragmatic randomized clinical trial (CLOSKIN trial). BMC surgery. 2023 Jan 13;23(1):9.

Zolin SJ, Rosen MJ. Failure of abdominal wall closure: prevention and management. Surgical Clinics. 2021 Oct 1;101(5):875-88.

Bravo-Salva A, Argudo-Aguirre N, González-Castillo AM, Membrilla-Fernandez E, Sancho-Insenser JJ, Grande-Posa L, Pera-Román M, Pereira-Rodríguez JA. Long-term follow-up of prophylactic mesh reinforcement after emergency laparotomy. A retrospective controlled study. BMC surgery. 2021 May 18;21(1):243.