Original Article

OPEN ACCESS

Prevalence of Wound Infection with New Internal Tension Sutures Technique for Midline Laparotomy Closure

Agha Afaque Hussain[1], Sarang Tagar[2], Mujeeb-ur-Rehman[3], Mehwish Zafar[4], Anita Kumari [5] Shehzad Asfandyar[6],

[1]Senior Registrar, [2]Assistant Professor General Surgery, Suleman Roshan Medical College Tando Adam
[3]Assistant Professor of Surgery (BMC) for boys Jamshoro
[4]Assistant Professor of Pathology Department, Suleman Roshan Medical College, Tando Adam
[5,6]Assistant Professor of Surgery Isra University Hospital Hyderabad

Author`s Contribution

[1,2]Substantial contributions to the conception or design of the work; or the acquisition, Drafting the work or revising it critically for important intellectual content
[3-6]Active participation in active methodology, analysis, or interpretation of data for the work,

Funding Source: None
Conflict of Interest: None

Received: June 17, 2024
Accepted: Nov 29, 2024

Address of Correspondent
Dr Agha Afaque Hussain
Senior Registrar General Surgery,
Suleman Roshan Medical College
Tando Adam
Agha_afaque@yahoo.com

ABSTRACT

Objective: To determine the incidence of wound infections in patients undergoing laparotomy closure using the internal tension sutures technique.

Methodology: This descriptive case series study was conducted at surgery department, JPMC, Karachi. Patients aged 18-50 years, undergoing laparotomy due to any one of perforated viscus, intestinal obstruction, stab wound to abdomen and other intra- abdominal malignancies of either gender were included. Patients underwent laparotomy under general anesthesia, with midline incisions, abdominal irrigation, and drain placement. Closure followed Jenkins' rule using continuous mass closure with Vicryl 1/0 and internal tension sutures. Skin was closed with staples or Prolene 2/0, and postoperative care included antibiotics, nutrition, and analgesics. Patients were followed weekly in OPD, and wound infections were assessed on the 15th postoperative day. Data was recorded by especially designed proforma.

Results: A total of 141 patients undergoing laparotomy were included in this study. Mean age, duration of surgery and weight in our study was 41.90±8.82 years, 105.11±12.25 minutes and 71.9±9.87 years. 69 (48.9%) were male and 72 (51.1%) were female. Out of 141 patients, 07 (5%) and 134 (95%) had and did not have 141 infection. Furthermore the stratification revealed no significant relationship of wound infection with age of the patients, gender, and the BMI, (p->0.05).

Conclusion: Study revealed that internal tension sutures technique reduce the incidence of wound dehiscence in abdominal surgery patients, it may cause postoperative pain and wound infection as evident from the results of our study and therefore should be cautiously applied in patients with a high risk.

Keywords: Laparotomy, internal tension sutures technique and wound infection.

Cite this article as: Hussain AA, Tagar S, Mujeeb-ur-Rehman, Zafar M, Kumari A Asfandyar S. Prevalence of Wound Infection with New Internal Tension Sutures Technique for Midline Laparotomy Closure. Ann Pak Inst Med Sci. 2025; 21(1):60-64. doi. 10.48036/apims.v21i1.1330.

Introduction

Laparotomy, a surgical procedure involving an incision into the abdominal cavity to manage serious abdominal conditions and save lives,[1] is one of the most frequently performed procedures in surgical departments. Midline incisions are the preferred choice for laparotomy due to their ease of access, faster execution, minimal bleeding, and the absence of muscle disruption, allowing for efficient mass closure.[2] However, postoperative wound complications remain a major concern for general surgeons, including surgical site infection (SSI), wound dehiscence, persistent discharge, and incisional hernia as a long-term complication. Among these, SSIs are particularly significant in emergency surgeries, ranking as the second most common nosocomial infection and accounting for approximately 17% of all healthcare-associated infections in hospitalized patients.[2] It leads to multiple serious complications, resulting in increased healthcare costs due to prolonged hospital stays and additional surgical interventions.[3] The prevalence of

wound infections following midline laparotomy closure remains a significant concern in surgical practice, necessitating advancements in suture techniques to optimize healing and reduce complications. The optimal technique for abdominal wall closure following emergency midline laparotomy remains a subject of debate, primarily due to the lack of conclusive evidence supporting a universally superior approach.[4] Although the novel internal tension suture technique has emerged as a potential alternative to conventional methods, to provide enhanced wound stability while minimizing infection rates.[5] Several aspects of closure, including barbed delayed absorbable sutures, interrupted vs continuous polydioxanone sutures, and antibiotic-coated suture material to decrease surgical site infection, have been previously studied.[6,7] Although barbed sutures enhance wound closure speed and reduce dehiscence, surgical site infections still occur in as many as 40% of patients. [6] In a similar study comparing interrupted and continuous sutures the rate of wound dehiscence was found to be higher in continuous suture closure (60% continuous and 44% interrupted), thereby favoring interrupted suture technique in decreasing postoperative complications.[7]

Implementing antimicrobial treatments for surgical wound management are effective, with antibiotic-coated sutures having shown a lower rate of infection than traditional suture techniques.[8] Studies have also examined the effectiveness of negative pressure wound therapy in laparotomy closures and have found significantly decreased surgical site infections and wound dehiscence rates.[9] The advantages of subcutaneous suturing have also been reported in the literature with lower incidence rates of superficial surgical site infection, hematoma, seroma and total wound dehiscence without significant difference in the duration of the hospital stay.[10] Despite these advancements, showed the need of further research to assess the long-term efficacy and cost-effectiveness of internal tension suture techniques in preventing wound infections and improving patient outcomes specifically at local level. However this study was aimed to evaluate the prevalence of wound infections associated with internal tension suture techniques for midline laparotomy closure, comparing their effectiveness to existing methods and identifying strategies to enhance surgical safety and recovery.

Methodology

A descriptive case series study was conducted in the Department of Surgery at Jinnah Postgraduate Medical Center (JPMC), Karachi, from January 2019 to June 2019. The sample size was calculated using the WHO sample size formula, based on an expected wound infection rate of 4.71%[6] and a margin of error of 3.5%, with a 95% confidence level, resulting in a sample of 141 patients. A non-probability consecutive sampling technique was used.

The study included patients of both genders, aged 18 to 50 years, who underwent laparotomy for conditions such as perforated viscus (perforated duodenum, enteric perforation, and ruptured appendix), intestinal obstruction, and abdominal stab wounds, as well as other intra-abdominal pathologies. Patients with a history of previous laparotomies, incisional hernias, cirrhosis with ascites, diabetes, or hypertension were excluded.

After obtaining a detailed medical history and performing a clinical examination, informed consent was taken from each patient or their guardian. The study objectives and data confidentiality were explained to all participants.

Laparotomies were performed under general anesthesia following standard protocols, using either upper or lower midline incisions. The abdominal cavity was irrigated with six liters of saline, and a subhepatic or pelvic drain was placed as needed. Preoperative antibiotics were administered at induction.

For wound closure, continuous sutures were placed using Vicryl 1/0, following Jenkins' rule (suture length four times the incision length) with a mass closure technique, incorporating the peritoneum and rectus sheath. Sutures were placed 1 cm from the wound edge at 1 cm intervals. Every five continuous sutures were reinforced with an internal tension suture in a simple interrupted manner, approximately 1.5 cm from the wound margins, including all layers of the anterior abdominal wall except the skin and subcutaneous tissues. These tension sutures were tied sequentially after crossing the continuous sutures. Skin closure was performed using staples or Prolene 2/0 sutures, followed by the application of an antiseptic dressing.

Postoperatively, all patients received appropriate antibiotics, nutrition, fluids, and analgesics. Patients were followed up weekly in the outpatient department (OPD), and on the 15th postoperative day, wound infection was assessed based on predefined criteria. Patients who missed their follow-ups were contacted via phone and reminded of their appointments.

All wound infection data was recorded using a structured proforma designed by the researcher. Data analysis was performed using SPSS version 26.

doi. 10.48036/apims.v21i1.1330

Results

A total of 141 patients who underwent laparotomy at the Department of Surgery, Jinnah Postgraduate Medical Center, Karachi, were studies; their overall mean age was 41.90 ± 8.82 years, with mean surgery duration of 105.11 ± 12.25 minutes and a mean patient weight of 71.9 ± 9.87 kg. Table I

Table I: Baseline and clinical characteristics of the patients. (n=141)

Variable		Statistics
Age		41.90±8.82 years
Duration of procedure		105.11±12.25 minutes
Weight		71.9±9.87 kg
Gender	Male	69(48.94%)
	Female	72(51.06%)
BMI	≤25mg/m^2	75(53.19%)
	>25mg/m^2	66(46.81%)

Out of 141 patients, 7 (4.96%) developed a wound infection, while 134 (95.04%) did not, as illustrated in Figure 1.

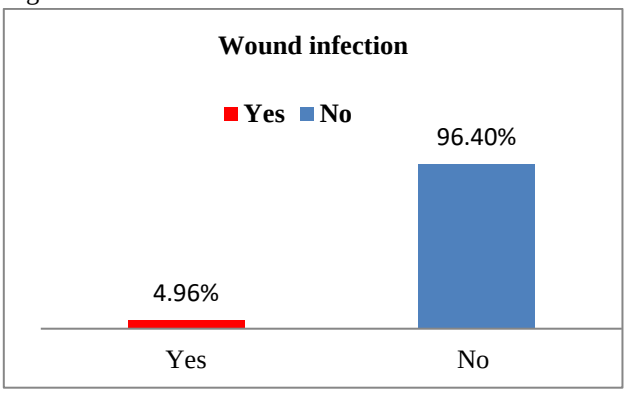

Figure 1. Frequency of wound infection. (n=141)

Wound infection occurred in 36.6% of patients, with higher rates in older patients (71.4%), females (57.1%), and smokers (71.4%), though none were statistically significant (p > 0.05). Perforated viscus (71.4%) had the highest infection rate among laparotomy indications, but this association was also not significant (p = 0.174). Surgical duration, socioeconomic status, and BMI also did not show a significant impact on infection rates (p > 0.05). Table II

However, smoking status (OR = 1.89) and low socioeconomic status (OR = 1.64) showed a potential increase in infection risk, though not statistically significant. Prolonged laparotomy duration (>120 minutes) was associated with higher infection rates (OR = 1.72).

Table II: Prevalence of wound infection based on effect modifiers. (n=141)

Variables	Wound Infection		Total	p-value
Age groups				
18-35 years	02(28.6%)	49(36.6%)	51(36.2%)	0.504
36-50 years	05(71.4%)	85 63.4%)	90(63.8%)	
Gender				
Male	03 (42.9%)	66 (49.3%)	69 (48.9%)	0.525
Female	04 (57.1%)	68 (50.7%)	72 (51.1%)	
Duration of laparotomy				
< 120 minutes	5 (71.4%)	57 (42.5%)	62 (44%)	0.133
> 120 minutes	02 (28.6%)	77 (57.5%)	79 (56%)	
Indications of laparotomies				
Perforated viscus	05 (71.4%)	37 (27.6%)	42 (29.8%)	0.174
Intestinal obstruction	02 (28.6%)	74 (55.2%)	76 (53.9%)	
Stab wound	00 (00%)	12 (9%)	12 (8.5%)	
Pancreatitis	00 (00%)	08 (6%)	08 (5.7%)	
Malignancies	00 (00%)	03 (2.2%)	03 (2.1%)	
Smoking status				
Yes	05 (71.4%)	56 (41.8%)	61 (43.3%)	0.125
No	02 (28.6%)	78 (58.2%)	80 (56.7%)	
Poor SES				
Yes	05 (71.4%)	86 (64.2%)	91 (64.5%)	0.525
No	02 (28.6%)	48 (35.8%)	50 (35.5%)	
BMI				
≤ 25 kg/m^2	05 (71.4%)	70 (52.2%)	75 (53.2%)	0.273
> 25 kg/m^2	02 (28.6%)	64 (47.8%)	66 (46.8%)	

Discussion

The midline laparotomy incision is the most commonly used abdominal incision in both emergency and elective surgeries. Proper closure of this incision is crucial for minimizing postoperative complications such as pain, infection, and incisional hernia. This study, which assessed the frequency of wound infections following midline laparotomy closure using internal tension sutures, found a relatively low infection rate of 5%. Notably, this rate is lower than those reported in studies evaluating conventional closure techniques.[11,12] A randomized controlled trial conducted by Khorgami et al[13] in high-risk patients found a 4% wound dehiscence rate in the TSC group, compared to 13.3% in the single-layer closure group. Additionally, our findings were aligned

with a systematic review by Israelsson et al[14] which emphasized that suture techniques optimizing tensile strength and tissue approximation are crucial for reducing SSIs and improving wound healing. The internal tension sutures used in this study likely contributed to better wound integrity, reducing mechanical stress and lowering the risk of infection and dehiscence.

Furthermore, the role of innovative suture techniques in enhancing surgical outcomes has been reinforced by Zhang et al[15] who reported that the step-type suture group exhibited a significantly narrower average incision scar width compared to the normal suture group, which suggests that advanced tension-relieving suture techniques not only minimize wound complications but also improve cosmetic outcomes by reducing scar width. Consistently Khan R et al[16] reported that the wound dehiscence was assessed on the 10th postoperative day, showing 6% in TSC group and 12.7% in SLC group, with a statistically significant difference (χ^2, $p = 0.047$). Given these findings, the internal tension suture approach presents a viable alternative to conventional closure methods by offering better wound stability, lower infection rates, and improved aesthetic results. The significant reduction in infection rates may be attributed to the internal tension suture technique, which enhances wound stability and minimizes tissue strain, thereby reducing the likelihood of wound breakdown and subsequent infection. However the some differences across the studies may be influenced by variations in patient demographics, surgical techniques, and perioperative care protocols.

In the present study, the overall mean age of the patients was recorded as 41.90 ± 8.82 years, with a notable predominance of female patients. The mean duration of surgery was observed to be 105.11 ± 12.25 minutes, while the mean patient weight was 71.9 ± 9.87 kg, with overweight individuals accounting for 46.81% of the total sample. Comparatively, Khan R et al[16]reported the mean age in their study as 50.15 ± 14.75 years in group A and 50.39 ± 14.54 years in group B, showing a slightly higher mean age than our study population. However, their findings regarding gender distribution contrast with our results, as they identified a higher proportion of male patients (71.6%) compared to females (28.4%), which diverges from our observed female predominance. Similarly, AFRIDI SK et al[17] reported a male predominance, with 76.7% of patients being male and only 23.3% being female. Additionally, their study documented a mean age of 39.09 ± 12.24 years, which is slightly lower than our findings, and a mean BMI of 28.17 ± 8.42 kg/m². The differences in BMI and age distribution highlight the potential influence of demographic and lifestyle factors, which may impact surgical considerations and outcomes. Overall, some variations in demographic characteristics across the studies underscore the importance of contextualizing findings within specific populations, as factors such as geographic location, healthcare access, and underlying health conditions may contribute to observed differences in patient profiles.

The findings of this study highlighted several key factors influencing wound infection rates following laparotomy, though statistical significance was not consistently achieved. Wound infections were more frequent in older patients and females. However, smoking status (OR = 1.89) and low socioeconomic status (OR = 1.64) indicated a potential increase in infection risk, though not statistically significant. Additionally, prolonged laparotomy duration (>120 minutes) was associated with higher infection rates (OR = 1.72). Comparatively Joshi M et al[18] reported that the occurrence of surgical site infections following laparotomies is estimated at 25%. Contributing risk factors include emergency procedures, contaminated surgical wounds, male gender, advanced age, smoking, diabetes mellitus; obesity, low hemoglobin levels, and prolonged operative duration exceeding two hours.[18] Additionally other studies also demonstrated that the wound infections are more prevalent in prolonged duration of the surgeries, smoking and older individuals compared to younger patients due to weakened immune function and a less favorable disease outcome. In contrast, younger patients demonstrated better recovery and healing potential.[19-21] This study has some limitations, such as a small sample size and the absence of a comparison group. The low infection rate suggests that internal tension sutures may be a better option for closing large wounds, but further large scale studies are recommended to validate the findings. Future studies should focus on improving surgical techniques, strengthening infection control, and reducing risk factors like smoking. A team-based approach involving surgeons, anesthetists, and infection specialists can lead to better recovery, fewer complications, and improved patient outcomes.

Conclusion

This study underscores the importance of evaluating multiple patient- and surgery-related factors in assessing

wound infection risk. While no statistically significant associations were identified, trends observed in smoking, low socioeconomic status, and prolonged surgical duration align with existing literature on SSI risk factors. The low infection rate achieved with internal tension sutures highlights their potential effectiveness in midline laparotomy closure. Future large-scale studies are required to validate these findings and optimize surgical techniques to further minimize SSIs. Continued research into risk reduction strategies, including preoperative patient optimization and intraoperative infection control measures, will be critical in improving surgical outcomes.

References

1. Daba AB, Beshah DT, Tekletsadik EA. Magnitude of in-hospital mortality and its associated factors among patients undergone laparotomy at tertiary public hospitals, West Oromia, Ethiopia, 2022. BMC Surg. 2024;24(1):193. https://doi.org/10.1186/s12893-024-02477-1
2. Hassan Y, Arajmand ST, Wani A, Gilkar IA, Ahmad Shah SM. Small bite closure in midline laparotomy: a practice to reduce surgical site infection, wound dehiscence, and incisional hernia. Ibnosina J Med Biomed Sci. 2021;13:204-8. https://doi.org/10.4103/ijmbs.ijmbs_65_21
3. Costabella F, Patel KB, Adepoju AV, Singh P, Mahmoud HA, Zafar A. Healthcare cost and outcomes associated with surgical site infection and patient outcomes in low- and middle-income countries. Cureus. 2023;15(7):e42493. https://doi.org/10.7759/cureus.42493
4. Wolf S, de Gracia LA, Sommer F, Schrempf MC, Anthuber M, Vlasenko D. Continuous and interrupted abdominal-wall closure after primary emergency midline laparotomy (CONIAC trial): study protocol for a randomized controlled single-center trial. BMJ Open. 2022;12(11):e059709. https://doi.org/10.1136/bmjopen-2021-059709
5. Preemptive deep tension suturing in prevention of burst abdomen. J Popul Ther Clin Pharmacol. 2022;29(3):552-558
6. Tolat A, Arya SV, Chejara RK, Kalwaniya DS, Singh A, Rohith VN, et al. Evaluation of wound closure outcomes using barbed delayed absorbable polydioxanone sutures after emergency laparotomy: an observational study. Cureus. 2025;17(1):e77257. https://doi.org/10.7759/cureus.77257
7. Chauhan P, Gupta J, Bhardwaj I, Purohit A, Vishwanath AE, Pahal D. A study to compare abdominal wall closure with interrupted vs. continuous sutures using polydioxanone in patients undergoing emergency exploratory laparotomy. Int Surg J. 2024;11(10):1234-9. https://doi.org/10.18203/2349-2902.isj20243236
8. Singh C, Pratap P, Singh R, Pandey VK. Comparison of the incidence of surgical site infection in abdominal wound closure: antibiotic-coated polyglactin 910 suture versus polyglactin suture with local infiltration of antibiotic along the incision line. Cureus. 2024;16(8):e66654. https://doi.org/10.7759/cureus.66654
9. Tsukazaki Y, Enomoto H, Takeuchi N, Ushigome T, Suwa K, Okamoto T, et al. Incisional negative pressure wound therapy for wounds in patients with lower intestinal perforations. J Anus Rectum Colon. 2024;8(3):123-30. https://doi.org/10.23922/jarc.2023-059
10. Madathil JP, Kumar RP, Haridas TV, Job JC, Chandran P, Siby J. A prospective study of sutured versus non-sutured subcutaneous fat tissue in laparotomy wound closure. Cureus. 2024;16(6):e62034.
11. Muysoms FE, Antoniou SA, Bury K, et al. European Hernia Society guidelines on the closure of abdominal wall incisions. Hernia. 2020;24(1):1-24. https://doi.org/10.1007/s10029-014-1342-5
12. Deerenberg EB, Harlaar JJ, Steyerberg EW, et al. Small bites versus large bites for closure of abdominal midline incisions (STITCH): a double-blind, multicentre, randomised controlled trial. Lancet. 2022;389(10076):1254-60. https://doi.org/10.1016/S0140-6736(15)60459-7
13. Khorgami Z, Shoar S, Laghaie B, Aminian A, Araghi NH, Soroush A. Prophylactic retention sutures in midline laparotomy in high-risk patients for wound dehiscence: a randomized controlled trial. J Surg Res. 2013;180:238-43. https://doi.org/10.1016/j.jss.2012.05.012
14. Israelsson LA. The suture length-to-wound length ratio and healing of midline laparotomy incisions. Hernia. 2021;25(2):365-72.
15. Zhang Y, Lei Z, Lin B, Lin Z, Dong Y, Ren P, et al. Split-level folding, step-type tension-relieving suture technique, and the evaluation on scar minimization. J Cosmet Dermatol. 2024;23(6):2199-208. https://doi.org/10.1111/jocd.16236
16. Khan R, Qadar M, Maqsood SU, Kashif MA, Hussain MZ, Afzal M. Tension sutures in closure of midline laparotomy: avoidance of wound dehiscence. Pak Armed Forces Med J. 2017;67(Suppl 1):S74-7.
17. Afridi SK, Yousaf M, Gul Sharif AM, Khan MS, Waheed D. Internal tension sutures in wound healing in patients undergoing laparotomy. Emerg Med J. 2021;30:20. https://doi.org/10.53350/pjmhs211582381
18. Joshi M, Srinath S, Jayanth BN. Retrospective and prospective study of surgical site infection, associated risk factors and profile of causative micro-organisms in laparotomy wounds. Compr Publ. 2020;4(2):245-9. https://doi.org/10.33545/surgery.2020.v4.i2d.426
19. Habib M, Ashraf A, Arshad N. Frequency of wound infection after laparotomy in different age groups. Theor Appl Sci. 2018;11:324-6. https://doi.org/10.15863/TAS.2018.11.67.55
20. Fan Chiang YH, Lee YW, Lam F, Liao CC, Chang CC, Lin CS. Smoking increases the risk of postoperative wound complications: a propensity score-matched cohort study. Int Wound J. 2023;20(2):391-402. https://doi.org/10.1111/iwj.13887