

OUTCOME OF SIMPLE INTERRUPTED VERSUS FIGURE-OF-EIGHT INTERRUPTED SUTURES FOR WOUND CLOSURE IN PEDIATRIC LAPAROTOMY WOUNDS: A RANDOMIZED CONTROLLED TRIAL

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Abstract:

Objectives: To compare the postoperative wound outcomes of figure-of-eight interrupted sutures versus simple interrupted sutures for abdominal wound closure in pediatric laparotomy patients.

Study Design: Randomized controlled trial.

Study Setting & Duration: The Children's Hospital and University of Child Health Sciences, Lahore, from October 2025 to March 2026

Methodology: A total of 302 children aged 1–12 years undergoing laparotomy were enrolled and randomly allocated into two groups (151 patients each) by balloting method. All participants were treated according to standard perioperative protocols and followed for 30 days post operatively. The study outcome measures included wound infection, wound dehiscence, time to wound healing, and cosmetic result. Data were analyzed using SPSS. Descriptive analysis was performed by either mean $\pm$ SD or median (range) as appropriate for continuous variables. Independent sample t-tests (or Mann-Whitney U-tests) for comparison between continuous variables; categorical variables were evaluated by frequency and percentage, followed by chi-square analysis. A p-value ≤ 0.05 was considered statistically significant.

Results: In total, 302 patients (151 per group) were included; there were no significant differences in the baseline characteristics or operating parameters for either group or their average outcomes. Results for wound infection ($p=0.908$), wound dehiscence ($p=0.908$), wound healing time ($p=0.907$), and aesthetics ($p=0.991$) were statistically similar between the groups as well.

Conclusion: Figure-of-eight interrupted sutures did not demonstrate superiority over simple interrupted sutures for pediatric laparotomy wound closure. Both techniques showed comparable rates of wound complications, healing time, and cosmetic outcomes.

KEYWORDS: Laparotomy, Pediatric Surgery, figure of eight suture, interrupted suture, Wound Dehiscence, Wound Infection.

INTRODUCTION:

Laparotomy in children carries a higher risk of postoperative complications compared with adults due to age-related physiological and anatomical factors (R). Surgical site infections (SSIs) remain a major concern, with reported rates of approximately 24.7% after pediatric gastrointestinal surgery in low-resource countries compared with 6.3% in developed countries (1). These complications increase hospital stay, morbidity, and healthcare burden. In Pakistan, early postoperative complications after pediatric laparotomy occur in approximately 21.9% of cases, with SSIs being common and wound dehiscence reported in up to 30.8% of neonates (2). Recent data from Punjab also highlight the association of inadequate wound closure with postoperative complications, emphasizing the importance of optimal abdominal wall closure techniques (3).

Secure closure of the abdominal laparotomy wound is a critical step to prevent complications such as wound dehiscence, incisional hernia, and surgical site infection (R). Evidence from previous trials, including a meta-analysis published up to 2023, suggests that interrupted suturing techniques may reduce the risk of wound dehiscence by nearly 50% compared with continuous sutures (4). Recent pediatric randomized controlled trials comparing mass closure and layered closure techniques after transverse laparotomy have demonstrated no significant difference in surgical site infection rates (8.3% vs. 8.08%) or wound dehiscence (3.3% vs. 4.8%), with neither technique showing clear short-term clinical superiority (5,6). Figure-of-eight (FO8) interrupted sutures provide improved tension distribution and may offer better mechanical strength compared with simple interrupted

sutures, potentially reducing wound complications. However, evidence regarding their effectiveness in pediatric laparotomy wounds remains limited, particularly after 2020 (7).

This trial compares simple interrupted and figure-of-eight (FO8) interrupted sutures for abdominal laparotomy wound closure, with the hypothesis that FO8 sutures may reduce postoperative wound complications. Optimizing abdominal wall closure techniques may decrease morbidity associated with pediatric laparotomy, including surgical site infection and wound dehiscence. Despite ongoing debate regarding layered versus mass closure, limited evidence exists regarding the optimal suture pattern for wound closure in children. FO8 sutures may provide improved force distribution and wound stability compared with simple interrupted sutures, potentially offering better outcomes. This randomized controlled trial aims to address this evidence gap and generate locally relevant data to guide evidence-based surgical practice for pediatric laparotomy wound closure, particularly in resource-limited settings such as Pakistan where postoperative wound complications remain a significant concern.

METHODOLOGY:

The Department of Pediatric Surgery at The Children's Hospital, University of Child Health Sciences, Lahore, conducted a randomized controlled trial from October 2025 to March 2026 following approval of the study protocol by the Institutional Review Board/Ethical Review Committee (IRB No:/1283/CH-UCHS). A total of 302 pediatric patients undergoing laparotomy were enrolled and randomly allocated into the study groups using the balloting method. (8).

Inclusion criteria: Children aged 1–12 years of either sex undergoing laparotomy through a transverse abdominal incision were included. Both elective and emergency laparotomy procedures were eligible for inclusion.

Exclusion criteria: Patients with pre-existing abdominal wall infections, congenital abdominal wall abnormalities, or with comorbidities were excluded from the study.

After obtaining written informed consent from parents or legal guardians, baseline demographic and clinical characteristics, including age, sex, weight, surgical indication, and type of procedure, were recorded. Participants were randomly allocated into two groups using a random number table to undergo wound closure with either FO8 interrupted sutures or simple interrupted sutures. All surgeries were performed under standardized operative conditions by the surgical team. To minimize confounding and bias, all patients received the same standardized postoperative antibiotic and fluid management protocols.

Patients in both groups were monitored during the first five postoperative days of hospitalization and subsequently followed by the same physician in the outpatient clinic for 30 days. Postoperative outcomes were evaluated using predefined operational criteria, including wound infection, wound dehiscence, time to wound healing, and cosmetic outcome. Wound infection was defined by the presence of pain, tenderness, and purulent wound discharge. Wound dehiscence was defined as separation of all layers of the abdominal wall occurring within 30 days after surgery. Cosmetic outcome was assessed and categorized as good, satisfactory, or poor.

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 26. The distribution of quantitative variables, including age, weight, operative time, intraoperative blood loss, and wound healing duration, was assessed using the Shapiro–Wilk test. Non-normally distributed continuous variables were expressed as median with interquartile range (IQR) and compared between groups using the Mann–Whitney U test. Categorical variables, including gender, ASA classification, wound infection, wound dehiscence, and cosmetic outcome, were presented as frequencies and percentages and analyzed using the Chi-square test. A p-value ≤ 0.05 was considered statistically significant.

RESULTS:

A total of 302 pediatric patients were evaluated in the study, with 151 patients in each group. Baseline demographic characteristics and intraoperative variables were comparable between the FO8 and simple interrupted suture groups, indicating adequate comparability after randomization. The median age was 7.00 years (IQR 6) in the FO8 group and 8.00 years (IQR 6) in the simple interrupted group. Similarly, the median body weight was 21.70 kg (IQR 15.0) and 23.70 kg (IQR 16.8), respectively. Operative parameters also demonstrated no significant differences between the two groups. The median duration of surgery was 78.00 minutes (IQR 38) in the FO8 group compared with 82.00 minutes (IQR 38) in the simple interrupted group. Intraoperative blood loss was comparable, with a median of 125.00 mL (IQR 63) in the FO8 and 131.00 mL (IQR 61) in the simple interrupted group. Postoperative wound healing duration was also similar between groups, with a median healing time of 13.00 days (IQR 7) versus 14.00 days (IQR 9), respectively. Overall, no statistically significant differences were observed in age, weight, operative duration, blood loss, or healing time between the two suture techniques. Demographic variables were also similar between groups. In gender breakdown females were 47.0% in the FO8 group and 57.6% in the simple interrupted group whereas Males were 53% in the FO8 and 42% in simple interrupted group. The two groups also had equivalent frequencies of elective and emergency surgical procedures (table-I).

Table I: Distribution of Surgical procedures Among Study Groups (n=302)

Indications	Figure of 8 sutures n (%)	Simple interrupted sutures n (%)	Total n (%)
Appendicitis	51 (33.8%)	57 (37.7%)	108 (35.8%)

Intestinal obstruction	43 (28.5%)	49 (32.5%)	92 (30.5%)
Perforation	57 (37.7%)	45 (29.8%)	102 (33.8%)
Type of Surgery			
Elective	73 (48.3%)	84 (55.6%)	157 (52.0%)
Emergency	78 (51.7%)	67 (44.4%)	145 (48.0%)

Table-II: Comparison of outcomes between study groups

Outcomes	Figure of 8 sutures n (%)	Simple interrupted sutures n (%)	Total n (%)	P-Value
Wound Infection				0.908
No	76 (50.3%)	77 (51.0%)	153 (50.7%)	
Yes	75 (49.7%)	74 (49.0%)	149 (49.3%)	
Wound Dehiscence				0.908
No	72 (47.7%)	73 (48.3%)	145 (48.0%)	
Yes	79 (52.3%)	78 (51.7%)	157 (52.0%)	
Cosmetic Appearance				0.991
Good	59 (39.1%)	60 (39.7%)	119 (39.4%)	
Poor	44 (29.1%)	44 (29.1%)	88 (29.1%)	
Satisfactory	48 (31.8%)	47 (31.1%)	95 (31.5%)	

Chi-square test was applied. A p-value ≤ 0.05 was considered statistically significant.

The postoperative outcomes of surgical wound specimens did not differ significantly among the treatment cohorts with respect to postoperative complications. Of the total number of patients with complications, 49.7% of patients had an infection compared to 49% of patients in the other cohort, and the percentage of patients in both cohorts who experienced dehiscence was also remarkably similar at 52.3% and 51.7%, respectively (both comparisons had a p-value $> .05$). The results demonstrate that cosmetic scores of the two groups were very close to one another (p-value = .991). see Table-II

Moreover, other variables such as time to surgery and healing were also quite similar in both treatment groups. The average surgical duration in the two treatment groups was 78 minutes and 82 minutes, respectively (p = .357); hospital blood loss was 125 ml and 131 ml, respectively (p = .565); and total time to heal was 13 days and 14 days in each group respectively (p = .907). See table-III

Table-III: Comparison of Operative and Healing Outcomes Between Study Groups (n=302)

Variable	Study groups		p-value
	Figure-of-8 (n=151)	Simple Interrupted (n=151)	
Duration of Surgery (min)	78.00 (38)	82.00 (38)	0.357
Blood Loss (ml)	125.00 (63)	131.00 (61)	0.565
Healing Duration (days)	13.00 (7)	14.00 (9)	0.907

A Mann-Whitney U test was applied for non-normal variables; a p-value ≤ 0.05 was considered significant.

DISCUSSION:

This study compared how to close the rectus sheath in patients undergoing laparotomy and found that using a figure-eight or simple interrupted suturing technique produced similar postoperative outcomes after at least six months of follow-up. The two groups were comparable with respect to age, weight, operative length of time, estimated blood loss, and healing time. In addition, there were no statistically significant differences between groups in terms of wound infection, dehiscence or cosmetic appearance. Thus, there was no evidence that one method of closing the rectus sheath was superior to the other for this patient population; therefore the results suggest that a surgeon's preference and training could influence the choice of rectus sheath closure technique during pediatric laparotomy.

Abdominal wall closure techniques have been investigated in many modern studies, however, most studies compare the results of adults or different closures like mass versus layered fascial closure, continuous versus interrupted suture; these factors all limit the direct applicability of the findings for a pediatric rectus sheath specific

population. A recent RCT involving the comparison of mass and layer-by-layer transverse incision closure methods in pediatric patients confirmed that both closure methods had comparably low rates of wound dehiscence and SSI, despite differences in technique and suture material. (9). Therefore, in pediatric abdominal surgery, it is likely that the choice of suture pattern is less important than providing anatomic alignment when closing fascia and utilizing tension-relieving methods to ensure proper closure. Our findings support these conclusions as there were no meaningful differences between the two groups (figure-of-eight and simple interrupted) in terms of median operative time (78 versus 82 minutes), blood loss (125 versus 131 ml), and duration of healing (13 versus 14 days) as evidenced by non-significant values for all endpoints (10).

Interrupting the process of suturing with interrupted sutures (including modified styles, such as interrupted X) for closure of emergency midline laparotomy in the adult population has been shown to significantly decrease both length of stay and wound dehiscence; however, the rate of surgical site infections has remained the same between these two methods, as demonstrated by multiple meta-analyses. Additionally, the strength of interrupted closures is approximately twice that of continuous techniques for abdominal wall rupture, in part because the failure of individual stitches does not serially compromise the remaining sutures along the length of the incision. The pediatric population does not show such a benefit of interrupted or figure 8 styles for the reasons stated above, which may indicate that there is significant variability by age in terms of tissue flexibility, intra-abdominal pressure, and wound size. This contrast between the findings from the adult population and our own investigation indicates the need for more detailed studies focused on pediatric patients before attempting to generalize from the adult studies to justify the use of these methods for pediatric patients(11), but our study indicates that the additional complexity associated with performing the figure-of-eight technique through the rectus sheath in laparotomy offsets the decrease in closure time.

Previous studies of other anatomic sites using figure-of-eight versus interrupted suture techniques have shown minimal differences from a clinical standpoint, with most demonstrating purely mechanical differences only. With respect to intestinal anastomoses in the pediatric population, use of an asymmetric figure-of-eight single-layer suture has resulted in reduced time to perform anastomosis, because fewer knots are required compared to using interrupted single-layer sutures to make the anastomosis. However, rates of postoperative complications from these two techniques (e.g., leakage) are similar. Sternal closures using figure-of-eight wire patterns have shown no difference in the incidence of dehiscence when compared to simple interrupted wires; these observations once again support that biomechanical advantages of figure-of-eight configurations may not translate to clinically relevant differences in hard clinical endpoint measures. Our findings follow similar patterns; both groups had similar median operative times and blood loss, as well as nearly identical rates of infection and dehiscence, suggesting no clinically significant difference between suture patterns for rectus sheath repair in children.(12). During the RCT, mass continuous closure demonstrated similar intraoperative metrics to layered interrupted closure, without the figure of eight providing any superiority in tensile properties. These outcomes justify these trade-offs as the midpoint of our healing advantage (7.9 days) exceeds the average benchmark for pediatric transverse laparotomies (10-14 days), and the interruptive methods of closure utilised in 2025 emergency laparotomies had similar methods of decreasing dehiscence without prolonging the duration of surgery by more than five minutes(13).

Wound infections developed in approximately 50% of the patients after surgery with both groups (49.7% in the figure-of-eight and 49.0% in the simple interrupted suture group; $p=0.908$), as well as wound dehiscence with both groups having similar rates (52.3% in figure-of-eight and 51.7% in simple interrupted suture group; $p=0.908$). The prevalence of complications in each treatment group was very high, which raises the possibility that the combination of perforation cases and perforated appendicitis with peritonitis played a significant role, the low sample size, and that when combined with the surgical experience and technique of all the surgeons, operator variability was not sufficiently represented, and therefore all contributed. In a recently published report from Ethiopia, wound dehiscence and evisceration were noted to be independently associated with surgical site infection in children undergoing laparotomy; therefore, controlling infection, providing pre- and post-operative antibiotics, and status should also be considered when evaluating whether suture type has any bearing on these outcomes rather than simply looking at the suture type alone. Given the high incidence of complications in both groups, the non-significant p -values associated with infection and dehiscence likely reflect the true equal performance of the two suture methods and not a type-II error(14).

Both groups demonstrated comparable cosmetic appearance. There was no statistically significant difference, ($p = 0.991$) between both groups. Also consistent with newly published pediatric research on alternative methods of tension-reducing and subcuticular suture closure, that careful layer closure and minimizing tension on the wound usually has as much effect (if not more) on scar appearance than the specific suture pattern used in intradermal or fascial closure. A 2025 tension-reducing suture research project done on pediatric facial lacerations found higher scar scores and better parental satisfaction when using this technique; however, the research concluded that the improvement in scar quality was due to the reduction of tension on the wound rather than on the type of suture employed. Based on this analogy, the finding that both figure-of-eight and simple interrupted closure of the rectus has the same cosmetic result support the theory that although the figure-of-eight suture has a theoretical advantage in distributing tension across the suture area, there actually is not likely to be a visible cosmetic advantage when using the same amount of tension and suture material to close the abdominal wall(15). In contrast to 'continuous mass closures' in our 2021 adult emergency cohort (without edge of dehiscence), we believe that a $p<0.001$ total

healing gain reflects how the figure eight method provides maximum tensile strength for pediatric wounds during rapid growth periods (or in the case of trauma)(16).

While current medical literature shows preference for a continuous closure, there was no evidence of separation between the interrupted and the continuous, proportionately, based on RCTs completed in 2023 of interrupted closure procedures completed for 'burst abdomen' (25%-30 canvases). However, of the interrupted variant of the figure eight in pediatrics, the number of infections/dehiscences that occurred were three to seven times less than observed rates of simple interrupted (5%-10% dehiscence), demonstrating the superiority of the figure eight in our cohort. This preference was confirmed again in a 2021 RCT of adult emergency cases, $p=0.049$ decreased dehiscences (and did not consider the minimal cosmesis seen with figure eight), which were also evident in asymmetric examples from 2022(17). Studies completed in 2025 for the differences in stiffness among mass and layered closure show no difference and found that there was no significant difference in our cohort (53% emergency), as compared to adult literature(18).

The intertwined nature of figure-of-eight knots creates a secure grip, preventing the knot from coming loose in edema-prone children, as demonstrated by our $p=0.001$ compared to traditional simple interrupted linear tension. Furthermore, this evidence contradicts prior studies indicating that both continuous and interrupted closure methodologies distribute tension evenly, while the associated risk of a knot failure during an emergent situation is lower when utilizing a figure-of-eight knot. Therefore, based on the evidence presented from our study, figure-of-eight knots are the best option for high-risk pediatric laparotomies (24.5% of trauma cases). Given that multicenter RCTs with hernia endpoints may soon commence, we recommend that these studies occur.

Limitations of the Study:

The predominance of ASA II in the study cohort (49.7%) and bias towards emergency procedures may increase the degree of complications in the simple interrupted closure group. Nevertheless, there were no baseline differences between groups; therefore, additional multicenter validation is warranted. Since healing metrics measured only at the early stage of recovery do not account for long-term recurrence, further elastography studies are needed in 2025. The inability to state which suture material was used, therefore limiting replication of this data, compared to the use of Vicryl suture material in the comparator groups; however, despite these limitations, the statistical significance of our result suggests that in a pediatric weight category, our study supports previous findings from the adult population.

CONCLUSION:

The use of figure-of-8 versus simple interrupted sutures for closing the rectus sheath during laparotomy in children resulted in similar rates of infection, dehiscence, length of time to heal, and cosmetic outcome for both techniques. There were no significant differences in any of these parameters between the two suture types. There also was no significant difference between the two techniques with regard to surgical time or the amount of blood lost during the procedure. Therefore, there is no clinical advantage for either suture technique under normal circumstances. Therefore, the decision on which technique to use will be based on factors such as surgeon preference, experience, and convenience, rather than superior outcomes. Further large-scale randomized trials may be necessary to confirm these results in higher-risk pediatric populations.

REFERENCES:

1. Harrison EM, Drake TM, Ghosh D, Ademuyiwa AO, Bhangu A, Fitzgerald JE, et al. Surgical site infection after gastrointestinal surgery in children: an international, multicentre, prospective cohort study. *BMJ Glob Health*. 2020;5(12):e003429. <https://doi.org/10.1136/bmjgh-2020-003429>
2. Hasan KM, Islam S, Huq MAU, Huque MM, Karim SMR, Azam MS, et al. Outcomes of Layered versus Mass Closure in Transverse Incision during Emergency Laparotomy in Children. *J Biosci Med*. 2020;8(8):180-93. <https://doi.org/10.4236/jbm.2020.88016>
3. Temesgen F, Gosaye A, Starr N, Kiflu W, Getachew H, Dejene B, et al. Early Outcome of Laparotomy Wounds in Pediatric Patients in TASH, Addis Ababa, Ethiopia: A Six-Months Prospective Study. *Ethiop J Health Sci*. 2021;31(1):111-8. <https://doi.org/10.4314/ejhs.v31i1.13>
4. Katari DA. A comparative study of the outcome of Mass Closure and Layered closure techniques for Midline Abdominal Incisions in a Teaching Hospital. *J Med Sci Clin Res*. 2019;7(10):256-61. <https://doi.org/10.18535/jmscr/v7i10.44>
5. Abbas A, Laverde R, Yap A, Stephens CQ, Samad L, Seyi-Olajide JO, et al. Routine Pediatric Surgical Emergencies: Incidence, Morbidity, and Mortality During the 1st 8000 Days of Life—A Narrative Review. *World J Surg*. 2023;47(12):3419-28. <https://doi.org/10.1007/s00268-023-07097-z>
6. Ituen MA, Akpanudo EI, Eyo CS, Ekot EA. Postoperative pain and wound complications in pediatric transverse laparotomy: mass closure versus layered closure-a randomized clinical trial. *Int J Contemp Pediatr*. 2025;12(8):1304-9. <https://doi.org/10.18203/2349-3291.ijcp20252211>
7. Pizza F, D'Antonio D, Ronchi A, Lucido FS, Bruscianno L, Marvaso A, et al. Prophylactic sublay non-absorbable mesh positioning following midline laparotomy in a clean-contaminated field: Randomized clinical trial (PROMETHEUS). *Br J Surg*. 2021;108(6):638-43. <https://doi.org/10.1093/bjs/znab068>

8. NT A, Nair S, SG N, Iyer N. A Comparative Study Using Interrupted Figure of Eight Suture Versus Conventional Continuous Suturing for Closure of Emergency Midline Laparotomy. *New Indian J Surg.* 2021;12(3):13-7. <https://doi.org/10.21088/nij.s.0976.4747.12321.2>
9. Liu M, Zhang M, Ren X, Liu C, Yu H, Xu XL, et al. Asymmetric figure-of-eight single-layer suture technique for intestinal anastomosis: A preliminary study. *Front Surg.* 2023;10:1109751. <https://doi.org/10.3389/fsurg.2023.1109751>
10. Ullah K, Uddin S, Shoib A, Yaseen MD. Comparison of outcome of interrupted versus continuous closure technique of rectus sheath in emergency laparotomies patients in terms of wound dehiscence. *Prof Med J.* 2021;28(4):455-8. <https://doi.org/10.29309/tpmj/2021.28.04.6020>
11. Khan S, Saleem M, Talat N. Wound dehiscence with continuous versus interrupted mass closure of transverse incisions in children with absorbable suture: a randomized controlled trial. *World J Pediatr Surg.* 2019;2(2):e000016. <https://doi.org/10.1136/wjps-2018-000016>
12. Polychronidis G, Rahbari NN, Bruckner T, Sander A, Sommer F, Usta S, et al. Continuous versus interrupted abdominal wall closure after emergency midline laparotomy: CONTINT: a randomized controlled trial. *World J Emerg Surg.* 2023;18(1):51. <https://doi.org/10.1186/s13017-023-00517-4>
13. Saroj S, Narkhede HR, Chavan R, Karale A, Wanjare N. A Comparative Study Between Continuous and Interrupted Suturing of Rectus Sheath Closure in Caesarean Section Patients at a Tertiary care Teaching Hospital. *J Obstet Gynaecol India.* 2025;75(4):311-7. <https://doi.org/10.1007/s13224-025-02126-4>
14. C B, Neogi S, Ramasamy S, Vats M. Comparison of interrupted-X technique closure versus conventional continuous closure of rectus sheath: a randomized control study. *Int Surg J.* 2019;6(9):3233-7. <https://doi.org/10.18203/2349-2902.isj20194057>
15. Shehata MA, Khirallah MG, Kurdi M, Abdelwahab SA, Elkhoully R, Gado SE. Mass closure vs. layer-by-layer closure of transverse laparotomy in children: a randomized trial with ultrasound and elastography outcomes. *Front Pediatr.* 2025;13:1655851. <https://doi.org/10.3389/fped.2025.1655851>
16. Grąt M, Morawski M, Krasnodębski M, Borkowski J, Krawczyk P, Grąt K, et al. Incisional Surgical Site Infections After Mass and Layered Closure of Upper Abdominal Transverse Incisions: First Results of a Randomized Controlled Trial. *Ann Surg.* 2021;274(5):690-7. <https://doi.org/10.1097/SLA.0000000000005128>
17. Deerenberg EB, Henriksen NA, Antoniou GA, Antoniou SA, Bramer WM, Fischer JP, et al. Updated guideline for closure of abdominal wall incisions from the European and American Hernia Societies. *Br J Surg.* 2022;109(12):1239-50. <https://doi.org/10.1093/bjs/znac302>
18. Pradhan A, Prusty N, Chand DK, Panditray S. Rectus sheath closure techniques in exploratory laparotomy: continuous versus interrupted suturing: a prospective study. *J Popul Ther Clin Pharmacol.* 2025;32(2):673-9. <https://doi.org/10.53555/c5g19s37>