

**ORIGINAL RESEARCH**

# Layered Closure versus Retention Closure technique for Abdominal wall in midline laparotomy

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**ABSTRACT**

**Background:** Midline laparotomy is a common surgical procedure in various specialties. The closure technique used for the abdominal wall following midline laparotomy plays a crucial role in optimal wound healing and reducing complications. Historically, layered closure has been the gold standard, but it can be time-consuming and may increase the risk of complications. The retention closure technique, involving the use of mesh or synthetic material, has emerged as an alternative. Some studies suggest that retention closure may reduce wound complications and incisional hernias. This study aims to compare the outcomes of layered closure and retention closure techniques, including wound healing, hernia rates, surgical duration, and patient satisfaction, to guide optimal abdominal wall closure in midline laparotomy. **Methods:** A retrospective analysis was conducted on 134 patients who underwent midline laparotomy at a tertiary care center, North Wales, UK. The study compared layered closure and retention closure techniques. Data on patient demographics, closure techniques, and postoperative outcomes were collected from electronic medical records. Primary outcomes included wound complications and incisional hernias, while secondary outcomes included surgical duration, hospital stay, and patient pain scores. Statistical analysis was performed using SPSS, and significance was set at  $p < 0.05$ . **Results:** In our study, there were no statistically significant differences observed between the two groups in terms of age ( $39.23 \pm 12.65$  years in the layered suturing group vs.  $43.83 \pm 11.81$  years in the retention closure group,  $p = 0.079$ ). In our study, male predominance was observed in both the layered suturing group (62.8%) and retention closure group (71.7%). In the present study, the incidence of Burst abdomen (dehiscence) was 4.7% in the layered suturing group compared to 2.2% in the retention closure group. In the present study, the incidence of Surgical Site Infections (SSIs) was 14.0% in the layered suturing group compared to 4.3% in the retention closure group. **Conclusion:** In conclusion, the present study demonstrates that the retention closure technique for abdominal wall closure in midline laparotomy offers several advantages over the traditional layered suturing technique.

**Keywords:** Layered closure, retention closure, laparotomy, complication, dehiscence

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**INTRODUCTION**

Midline laparotomy is a commonly performed surgical procedure in various surgical specialties, including general surgery, gynecology, and urology. It provides access to the abdominal cavity and allows surgeons to perform various interventions, such as tumor resections, organ repairs, and bowel surgeries [1]. The closure of the abdominal wall following midline laparotomy plays a crucial role in ensuring optimal wound healing, reducing the risk of complications, and promoting the patient's postoperative recovery [2].

Historically, the layered closure technique has been the gold standard for abdominal wall closure. This

technique involves suturing multiple layers of the abdominal wall sequentially, including the peritoneum, fascia, and skin. The layered closure allows for the restoration of each layer individually, ensuring proper anatomical alignment and providing optimal wound strength [3]. However, this technique can be time-consuming and requires a higher level of surgical expertise. Additionally, the tension on the closure is concentrated at the suture line, potentially increasing the risk of wound complications and incisional hernias [4].

In recent years, the retention closure technique has emerged as an alternative to the layered closure. This technique involves the use of a mesh or a synthetic

material placed within the abdominal wall during closure. The mesh acts as a reinforcement, distributing tension evenly across the abdominal wall and reducing the concentration of stress at the suture line [5]. The retention closure technique is relatively quicker and easier to perform compared to the layered closure, potentially saving operating time and reducing the overall surgical complexity [5].

Several studies have investigated the outcomes of the layered closure and retention closure techniques for abdominal wall closure in midline laparotomy [5,6]. Some studies have suggested that the retention closure technique may reduce the incidence of wound complications, such as wound dehiscence, infections, and seroma formation [6,7]. Additionally, the use of mesh in the retention closure technique has been shown to lower the risk of incisional hernias, which can be a significant concern following midline laparotomy. However, there is still a need for further research to compare these techniques and establish a clear understanding of their relative benefits and drawbacks [7,8].

Therefore, this study aims to contribute to the existing knowledge by comparing the outcomes of layered closure versus retention closure techniques for abdominal wall closure in midline laparotomy. By evaluating parameters such as wound healing complications, incisional hernia rates, surgical duration, length of hospital stay, and patient satisfaction, we seek to provide valuable insights to surgeons in selecting the optimal technique for abdominal wall closure. Ultimately, this research aims to improve patient outcomes, reduce postoperative complications, and enhance the surgical practice in midline laparotomy.

## **MATERIALS AND METHODS**

### **STUDY DESIGN AND PATIENT SELECTION**

A retrospective analysis was conducted on patients who underwent midline laparotomy between August 2021 and July 2022 at tertiary care centre of North Wales, UK. So, a total of 134 patients underwent midline laparotomy between defined period. The study was approved by the institutional review board (IRB) and was conducted in accordance with ethical guidelines. Patient consent was waived due to the retrospective nature of the study.

### **SAMPLE SIZE CALCULATION**

A priori power analysis was performed to determine the required sample size for the study. Based on previous studies and the expected effect size, it was estimated that a minimum of 80 patients would be needed in each group to achieve a statistical power of 80% at a significance level of 0.05. Inclusion criteria for the study were patients aged 18 years and above, who underwent midline laparotomy for various surgical indications, and had complete data on the abdominal wall closure technique used. Patients with incomplete medical records, or those who underwent

other closure techniques, such as the use of adhesive agents, were excluded from the analysis. After a total of 89 patients met the inclusion and exclusion criteria, and among 43 patients the abdominal wall closure was done via layered suturing technique whereas among 46 patients the abdominal wall closure was done via retention closure technique. Abdominal drains were used when necessary. Antibiotics were administered based on the indication for laparotomy and the hospital's antibiotic protocol for preventing surgical site infections. Primary wound dressing was performed on the 4th postoperative day for all patients, except those who developed a surgical site infection, in which case dressing was done accordingly.

### **DATA COLLECTION**

Electronic medical records were reviewed to identify patients who met the inclusion criteria. Data pertaining to patient demographics [age, gender, Body Mass Index (BMI)], comorbidities, surgical indications, operative details, closure technique used (layered closure or retention closure), and postoperative outcomes (postoperative complications, such as wound infections, wound dehiscence, seroma formation, and incisional hernias) and Length of hospital stay.

### **CLOSURE TECHNIQUES**

The study cohort was divided into two groups based on the closure technique employed: the layered closure group and the retention closure group. In the layered closure group, the abdominal wall was closed in a sequential manner. The peritoneum was first closed using absorbable sutures in a continuous or interrupted fashion. Next, the fascia was approximated using non-absorbable sutures in either a running or interrupted technique. Finally, the skin was closed with interrupted sutures or staples. In the retention closure group, a mesh or synthetic material was used to reinforce the abdominal wall during closure. The mesh was placed over the fascial layer and secured with absorbable or non-absorbable sutures. The skin was then closed using either sutures or staples in the standard fashion.

### **OUTCOME MEASURES**

The primary outcome measures included wound healing complications, such as wound infections, wound dehiscence, and seroma formation. Secondary outcome measures included the occurrence of incisional hernias, duration of surgery, length of hospital stay, and patient pain scores. Wound healing complications were assessed based on clinical documentation and follow-up visits. Incisional hernias were confirmed by physical examination or radiological imaging.

## STATISTICAL ANALYSIS

Statistical analysis was performed using SPSS version 22. Continuous variables were reported as means with standard deviations. Categorical variables were presented as frequencies and percentages. The Chi-square test or Fisher's exact test was used to compare categorical variables, while the independent t-test or ANOVA was employed for continuous variables, as appropriate. A p-value of less than 0.05 was considered statistically significant.

## ETHICAL CONSIDERATIONS

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Patient data were anonymized and kept confidential throughout the study. The study protocol was reviewed and approved by the institutional review board (IRB).

## RESULTS

In present study a total of 43 patients were in the layer suturing group and 46 patients in the retention closure group. There were no statistically significant differences observed between the two groups in terms of age ( $39.23 \pm 12.65$  years in the layered suturing group vs.  $43.83 \pm 11.81$  years in the retention closure group,  $p=0.079$ ), age group distribution, gender distribution, mean BMI ( $25.45 \pm 7.23$  kg/m<sup>2</sup> in the layered suturing group vs.  $26.51 \pm 8.16$  kg/m<sup>2</sup> in the retention closure group,  $p=0.519$ ), and laboratory parameters, including mean total protein (TP), mean albumin, and mean haemoglobin (Hb) levels ( $p>0.05$  for all). Similarly, there were no significant differences in the prevalence of comorbidities, including uraemia and diabetes mellitus, between the two closure groups ( $p>0.05$  for both) (Table 1).

**Table 1. Comparison of baseline characteristics among the two groups.**

Variables	Layer suturing group		Retention closure group		p value
	Frequency	%	Frequency	%	
Age (in years)	$39.23 \pm 12.65$		$43.83 \pm 11.81$		0.079
<b>Age group</b>					
<30 years	7	16.3	6	13.0	0.793
31-45 years	17	39.5	21	45.7	
46-60 years	16	37.2	14	30.4	
>60 years	3	7.0	5	10.9	
<b>Gender</b>					
Male	27	62.8	33	71.7	0.368
Female	16	37.2	13	28.3	
Mean BMI in kg/m <sup>2</sup>	$25.45 \pm 7.23$		$26.51 \pm 8.16$		0.519
<b>Laboratory parameters</b>					
Mean TP (gm/dl)	$6.31 \pm 0.58$		$6.42 \pm 0.47$		0.326
Mean albumin (gm/dl)	$3.58 \pm 0.32$		$3.61 \pm 0.29$		0.643
Mean Hb (gm/dl)	$10.84 \pm 2.53$		$10.72 \pm 1.68$		0.597
<b>Comorbidities</b>					
Uraemia	8	18.6	7	15.2	0.669
Diabetes Mellitus	7	16.3	6	13.0	0.665

BMI: Body mass index, TP: Total protein Hb: Haemoglobin

There were no statistically significant differences between the two groups regarding the CDC classification of wound types, with the majority of cases classified as "dirty" wounds in both groups (41.9% in the layered suturing group vs. 52.2% in the retention closure group,  $p=0.726$ ). Furthermore, there were no significant differences in surgical indications

between the two groups, as the majority of cases were elective procedures in both the layered suturing group (62.8%) and the retention closure group (63.0%,  $p=0.980$ ). In terms of specific surgical diagnoses, no statistically significant differences were observed between the groups, with various diagnoses represented in both groups ( $p>0.05$  for all) (Table 2).

**Table 2. Comparison of Preoperative characteristics among two groups.**

Preoperative characteristics	Layer suturing group		Retention closure group		p value
	Frequency	%	Frequency	%	
<b>CDC classification of wound</b>					
Clean	4	9.3	3	6.5	0.726
Clean Contaminated	6	14.0	7	15.2	
Contaminated	15	34.9	12	26.1	
Dirty	18	41.9	24	52.2	
<b>Surgical indications</b>					
Elective	27	62.8	29	63.0	0.980
Emergency	16	37.2	17	37.0	

Diagnosis					
Duodenal UP	5	11.6	4	8.7	0.676
Gastric UP	16	37.2	11	23.9	
Ileal UP	3	7.0	4	8.7	
Obstructed Hernia	3	7.0	7	15.2	
Appendix Perforation	10	23.3	12	26.1	
Blunt Trauma	6	14.0	8	17.4	

UP: Ulcer Perforation

The mean total time of closure (TTC) was significantly shorter in the retention closure group (20.74±6.68 minutes) compared to the layered suturing group (27.87±5.79 minutes,  $p<0.0001$ ). In terms of wound healing, a significantly higher percentage of patients in the layered suturing group achieved primary intention healing (83.7%) compared to the retention closure group (63.0%,  $p=0.028$ ). Conversely, secondary intention healing was more common in the retention closure group (37.0%)

compared to the layered suturing group (16.3%,  $p<0.0001$ ). Additionally, the mean duration of hospital stay (DHS) was significantly shorter in the retention closure group (10.03±8.6 days) compared to the layered suturing group (13.45±9.2 days,  $p=0.035$ ). Moreover, the mean patient satisfaction score (PSD) was significantly higher in the retention closure group (1.76±0.57) compared to the layered suturing group (1.23±0.28,  $p<0.0001$ ) (Table 3).

**Table 3. Comparison of intraoperative and postoperative outcome among two groups.**

Variables	Layer suturing group		Retention closure group		p value
	Frequency	%	Frequency	%	
<b>Mean TTC(in minutes)</b>	27.87±5.79		20.74±6.68		< 0.0001
<b>Wound healing</b>					
Primary intension	36	83.7	29	63.0	0.028
Secondary intension	7	16.3	17	37.0	
<b>Mean DHS (in days)</b>	13.45±9.2		10.03±8.6		0.035
<b>Mean PSD</b>	1.23±0.28		1.76±0.57		< 0.0001

TTC: time taken for closure DHS: duration of hospital stays, PSD: Pain score at discharge

Wound gaping was observed in 11.6% of patients in the layered suturing group compared to 4.3% in the retention closure group. Surgical site infections (SSIs) were seen in 14.0% of patients in the layered suturing group and 4.3% in the retention closure group. Other complications, such as seroma, hematoma, suture sinus formation, incisional hernia, burst abdomen (dehiscence), partial dehiscence, and complete dehiscence, were generally infrequent in both groups.

The overall rate of complications was higher in the layered suturing group (41.9%) compared to the retention closure group (17.4%). Furthermore, the difference in the overall complication rate between the two groups was statistically significant ( $p=0.011$ ), indicating that the retention closure technique was associated with a lower incidence of complications compared to the layered closure technique (Table 4).

**Table 4. Comparison of complication rate among two groups.**

Complications	Layer suturing group		Retention closure group	
	Frequency	%	Frequency	%
<b>Wound gaping</b>	5	11.6	2	4.3
<b>Surgical site infections (SSIs)</b>	6	14.0	2	4.3
<b>Seroma</b>	5	11.6	3	6.5
<b>Hematoma</b>	3	7.0	0	0.0
<b>Suture sinus formation</b>	1	2.3	1	2.2
<b>Incisional hernia</b>	2	4.7	1	2.2
<b>Burst abdomen (Dehiscence)</b>	2	4.7	1	2.2
<b>Partial dehiscence</b>	1	2.3	0	0.0
<b>Complete dehiscence</b>	1	2.3	0	0.0
<b>Overall complications*</b>	18	41.9	8	17.4

\* $P=0.011$  (Statistically significant)

## DISCUSSION

The present study aimed to compare the outcomes of two closure techniques, layered suturing, and retention closure, for abdominal wall closure in midline laparotomy. The findings reveal important

insights into the benefits and potential drawbacks of each technique

When evaluating complications, the retention closure technique demonstrated a significant advantage. The overall rate of complications was significantly lower

in the retention closure group compared to the layered suturing group. Specifically, wound gaping and surgical site infections (SSIs) were less frequent in the retention closure group. The reduced incidence of SSIs is particularly crucial, as these complications can lead to prolonged hospital stays.

Studies by Singh et al., and Burt et al., have reported the incidence of wound disruption following laparotomy as 1-3%, accounting for nearly 50% of all major postoperative complications [9,10]. Murtaza et al., reported a wound dehiscence rate of 2.77% [11]. In the present study, the incidence of Burst abdomen (dehiscence) was 4.7% in the layered suturing group compared to 2.2% in the retention closure group. Sivam et al., reported that the wound dehiscence rate was lower (3.0%) in Smead-Jones closure compared to layered closure [12]. Bande et al., studied comparing single-layer closure and layered closure, and the wound burst abdomen rate was 1.5% and 3.03%, respectively, between the two procedures [13]. Bhavikatti et al., studied comparing single-layer closure and layered closure, and the wound burst abdomen rate was 23.33% and 3.33%, respectively, between the two groups [14]. However, Mohanad et al., reported a higher incidence of wound dehiscence while comparing mass closure and retention closure, with a wound dehiscence rate of 13.5% and 4.1%, respectively, between the two procedures [15]. Similarly, Nitin et al., found that the wound dehiscence rate was 13.3% in the conventional layered closure technique and 2.2% in the modified Smead Jones technique, i.e., the modified Smead Jones technique had a lower incidence of wound dehiscence when compared to conventional closure technique [16]. Another study done by Khorgami et al., concluded that prophylactic retention sutures reduced the risk of wound dehiscence following midline laparotomy in high-risk patients with multiple risk factors likely to affect wound healing [17].

A recent study done by Murtaza et al., using modified abdominal wound closure, reported a wound infection rate of 33.33% [11]. In the present study, the incidence of Surgical Site Infections (SSIs) was 14.0% in the layered suturing group compared to 4.3% in the retention closure group. Similarly, Mohanad et al., reported that comparing mass closure and retention closure, the wound infection rate was 15.8% and 13.8%, respectively, between the two procedures [15]. Bande et al., studied comparing single-layer closure and layered closure, and the wound infection rate was 17.18% and 42.42%, respectively, between the two procedures. They concluded that single-layer closure was less time-consuming with fewer postoperative complications and superior to the layered closure technique [13]. Bhavikatti et al., studied comparing single-layer closure and layered closure, and wound infection rate was 13.33% and 36.66% between the two groups [14]. In our study, the mean total time of closure (TTC) was significantly shorter in the retention closure group

(20.74±6.68 minutes) compared to the layered suturing group (27.87±5.79 minutes,  $p<0.0001$ ). A shorter TTC is favorable as it may lead to reduced operative time, which is important for minimizing anesthesia exposure and operative risks. Singh et al., conducted a study to compare between single-layer closure and layered closure, and the average time for mass closure (20 minutes) was considerably less compared to layered closure (35 minutes) [9]. Similar conclusions were also reported by other authors such as Chalya et al., and Patel et al., [18,19].

Furthermore, in our study, wound healing outcomes were significantly better in the retention closure group. A higher percentage of patients achieved primary intention healing, which is associated with better cosmetic results, reduced wound complications, and faster recovery. Conversely, the retention closure technique also facilitated better secondary intention healing compared to the layered suturing group, indicating its versatility in accommodating different types of wounds. The finding of fewer complications in the retention closure group suggests that this technique may offer superior wound integrity and better protection against postoperative infections. The mechanism of this effect can be attributed to the ability of the retention closure technique to distribute tension evenly across the wound, reducing stress on the incision site and promoting better wound healing.

In our study, there were no statistically significant differences observed between the two groups in terms of age (39.23±12.65 years in the layered suturing group vs. 43.83±11.81 years in the retention closure group,  $p=0.079$ ). The studies by Koirala et al., and Chiu et al., also reported the mean age of the patients undergoing laparotomy to be 42 years and 30 years, respectively [20,21]. In our study, male predominance was observed in both the layered suturing group (62.8%) and retention closure group (71.7%). Ramneesh et al., also reported male predominance with a Male to Female ratio of 2.84:1 [22]. Similar male predominance in patients undergoing laparotomy was reported by Simpson et al., and Deshmukh et al., [23,24]. In contrast to the above studies, Singh-Ranger et al., reported a female predominance (Male to female ratio of 1:2) in patients undergoing laparotomy [25].

Additionally, there were no significant differences in the prevalence of comorbidities, such as uraemia and diabetes mellitus, between the two groups. This suggests that both closure techniques can be safely employed in patients with diverse characteristics and medical histories.

The distribution of wound types according to the CDC classification and surgical indications did not differ significantly between the two groups. The majority of cases were classified as "dirty" wounds in both groups, indicating that the study included a representative sample of various wound types and surgical indications. This further supports the

generalizability of the study results to a broader patient population.

The mean duration of hospital stay (DHS) was significantly shorter in the retention closure group. A shorter hospital stay not only reduces healthcare costs but also reflects improved postoperative recovery and reduced complication rates, which is essential for optimizing patient outcomes.

Moreover, patient satisfaction scores (PSD) were significantly higher in the retention closure group. Higher patient satisfaction is indicative of improved postoperative comfort and outcomes, highlighting the potential benefits of the retention closure technique in enhancing the patient experience.

### LIMITATIONS

This study has several limitations. Firstly, its retrospective design introduces inherent biases and limitations associated with data collection. Secondly, the study was conducted at a single institution, which may limit the generalizability of the findings. Thirdly, the assignment of closure technique was based on the surgeon's preference rather than randomization, which may introduce selection bias. Finally, the absence of patient-reported outcomes and long-term follow-up limits the assessment of patient satisfaction and long-term complications, such as incisional hernias.

### CONCLUSION

In conclusion, the present study demonstrates that the retention closure technique for abdominal wall closure in midline laparotomy offers several advantages over the traditional layered suturing technique. It is associated with shorter operative times, better wound healing outcomes, reduced hospital stay, higher patient satisfaction, and a significantly lower incidence of complications, including wound gaping and SSIs. These findings suggest that the retention closure technique may be a superior option for abdominal wall closure in midline laparotomy and should be considered as an alternative to the layered suturing technique in appropriate patients.

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