

A Prospective Comparative Study Between Quilting Technique and Conventional Closure in Preventing Seroma Formation After Ventral Hernia Repair

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ABSTRACT

Introduction: Seroma formation is one of the most common complications following ventral hernia repair and is associated with patient discomfort, delayed wound healing, prolonged drain placement, and increased risk of wound infection. Quilting sutures have been proposed as a simple technique to obliterate dead space and reduce postoperative fluid accumulation. This study aimed to compare the quilting technique and conventional closure in patients undergoing ventral hernia repair.

Methods: This prospective comparative study was conducted in the Department of General Surgery, Rajiv Gandhi Government General Hospital, Chennai, over a period of 12 months. A total of 60 patients undergoing elective ventral hernia repair were included and equally allocated into two groups: quilting closure (n=30) and conventional closure (n=30). All patients underwent on-lay mesh repair with closed suction drain placement. Postoperative drain output, duration of drain placement, hospital stay, and postoperative complications were assessed. Statistical analysis was performed using SPSS version 26.0. Continuous variables were compared using the independent samples t-test, while categorical variables were analysed using the Chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Results: Baseline demographic and clinical characteristics were comparable between the two groups. Postoperative drain output, used as an indirect indicator of postoperative fluid accumulation, was significantly lower in the quilting group on postoperative day 1 (41.0 ± 12.4 ml vs 51.7 ± 6.5 ml, $p=0.0001$), postoperative day 2 (21.7 ± 8.5 ml vs 34.0 ± 8.4 ml, $p<0.0001$), postoperative day 3 (13.0 ± 8.5 ml vs 25.8 ± 7.0 ml, $p<0.0001$), and in total drain output (75.7 ± 23.5 ml vs 111.5 ± 19.4 ml, $p<0.0001$). The quilting group also demonstrated earlier drain removal (3.7 ± 0.8 days vs 4.8 ± 0.7 days, $p<0.0001$), shorter hospital stays (4.0 ± 1.0 days vs 6.6 ± 1.1 days, $p<0.0001$), lower surgical site infection rates (23.3% vs 73.3%, $p=0.0001$), and no cases of late infection compared with 60.0% in the conventional closure

group ($p < 0.0001$). These findings suggest reduced postoperative fluid accumulation and potentially lower seroma formation in patients undergoing quilting closure.

Conclusion: Quilting closure following ventral hernia repair was associated with lower postoperative drain output, earlier drain removal, shorter hospital stays, and reduced postoperative wound complications compared with conventional closure. The findings suggest that quilting sutures are an effective and simple technique for reducing postoperative fluid accumulation and improving recovery following ventral hernia repair.

Keywords: ventral hernia repair, quilting technique, seroma formation, on-lay mesh repair, drain output, surgical site infection, postoperative complications, conventional closure.

INTRODUCTION

Ventral hernias are defects of the abdominal wall that occur outside the inguinal and diaphragmatic regions and result from weakness or disruption of the fascial structures [1,2]. Surgical repair remains the primary definitive approach for restoring the integrity of the abdominal wall in affected individuals [3].

A seroma refers to the postoperative accumulation of serous fluid within a potential or dead space, with the collected fluid consisting predominantly of plasma and lymphatic components [4,5]. Although commonly encountered after abdominal wall procedures, seroma formation has also been documented following laparoscopic inguinal hernia repair, with reported rates of approximately 17.6% [6].

Postoperative seromas can produce local pain, discomfort, and patient distress and may require additional clinical assessment, outpatient interventions, or hospitalisation, thereby contributing to increased healthcare utilisation and costs. In some cases, persistent fluid collections can be associated with wound-related complications, including wound separation and flap necrosis, and may necessitate further surgical management. Seromas have also been linked to subsequent wound infection and abscess formation [7].

Conventional fascial closure during hernia repair typically involves approximation of the abdominal wall layers using standard continuous suturing techniques [8]. Quilting, in comparison, involves strategically fixing the elevated tissue planes, particularly the subcutaneous flaps, to the underlying fascia

or mesh with absorbable sutures. By reducing the potential dead space between tissue planes, quilting may limit postoperative fluid accumulation and potentially reduce dependence on prolonged drainage [9].

While previous investigations have explored the effectiveness of quilting sutures in preventing postoperative seroma and other wound-related complications, data from Indian patient populations remain relatively scarce. Variations in patient profiles, operative techniques, and healthcare practices may influence postoperative outcomes and highlight the need for evidence from the local setting. Accordingly, this study was designed to compare quilting closure with conventional closure in patients undergoing ventral hernia repair, with particular emphasis on postoperative seroma formation and associated wound complications.

MATERIALS & METHODS

Study Design and Setting

This was a prospective comparative study conducted in the Department of General Surgery, Rajiv Gandhi Government General Hospital, Chennai. The study was carried out over a period of 12 months from 2024 to 2025. The objective of the study was to compare postoperative outcomes between patients undergoing quilting closure and those undergoing conventional closure following ventral hernia repair.

Ethical Considerations

The study protocol was reviewed and approved by the Institutional Ethics

Committee prior to commencement of the study (IEC Approval number: MMC /Approval/47092024). Written informed consent was obtained from all participants before enrolment. Confidentiality of patient information was maintained throughout the study.

Study Population and Sample Size

The study population consisted of adult patients diagnosed with ventral hernia who underwent elective ventral hernia repair in the Department of General Surgery. The sample size was calculated based on previous studies evaluating the effect of quilting sutures on postoperative seroma formation. Assuming a significance level of 5%, a study power of 80%, and an expected difference in postoperative outcomes between the two groups, the minimum required sample size was estimated to be 30 patients per group. Accordingly, a total of 60 patients were included in the study and equally allocated into two groups, with 30 patients in the quilting group and 30 patients in the conventional closure group.

Inclusion and Exclusion Criteria

Patients aged 18 years and above diagnosed with ventral hernia and planned for elective on-lay mesh repair were included in the study. Patients presenting with recurrent ventral hernia, strangulated or obstructed hernia requiring emergency surgery, active surgical site infection, severe systemic illness precluding surgery, or refusal to provide consent were excluded from the study.

Preoperative Evaluation

All patients underwent detailed clinical evaluation before surgery. Demographic details, clinical history, and physical examination findings were recorded. Routine laboratory investigations including complete blood count, renal function tests, liver function tests, blood glucose levels, coagulation profile, and viral markers were performed. Ultrasonography of the abdomen was carried out when indicated to assess the

hernia defect and its contents. All patients were evaluated for fitness for anaesthesia prior to surgery.

Surgical Procedure

All patients underwent ventral hernia repair under either general or spinal anaesthesia. After adequate exposure of the hernia defect, adhesiolysis was performed whenever necessary. The hernial defect was closed using non-absorbable sutures, followed by placement of a polypropylene mesh in the on-lay position with an overlap of 3-5 cm beyond the margins of the defect. A closed suction drain was placed in all patients before wound closure.

Patients were allocated into two groups based on the method of closure. In Group A (Conventional Closure Group), wound closure was performed after placement of the closed suction drain without the use of quilting sutures. In Group B (Quilting Group), wound closure was performed after placement of the closed suction drain along with quilting sutures. Quilting was carried out using multiple interrupted 2-0 polypropylene sutures placed between the undersurface of the subcutaneous tissue and the underlying anterior rectus sheath with the fixed mesh. Sutures were placed approximately 5 cm apart until the dead space was completely obliterated. Following achievement of haemostasis, the wound was closed in layers according to standard surgical practice.

Postoperative Management

Following surgery, all patients were monitored for vital signs, drain output, pain, and wound-related complications. Intravenous antibiotics and analgesics were administered according to institutional protocol. Early ambulation and oral feeding were encouraged as tolerated. Drain output was measured daily and recorded until drain removal. Patients were followed up during the postoperative period for detection of seroma formation, surgical site infection, and other complications.

Outcome Measures

The primary outcome measure was postoperative drain output recorded on postoperative day 1, postoperative day 2, postoperative day 3, and total drain output. Postoperative drain output was used as an indirect indicator of seroma formation, as increased fluid accumulation within the surgical dead space is reflected by higher drain volumes. Secondary outcome measures included duration of drain placement, length of hospital stay, surgical site infection on postoperative day 10, and late infection on postoperative day 30.

Data Collection

Data were collected prospectively using a structured proforma designed for the study. Information recorded included demographic characteristics, clinical findings, hernia type, defect size, flap thickness, operative details, daily drain output, duration of drain placement, hospital stay, and postoperative complications. All relevant perioperative data were documented during admission and follow-up visits.

Data Management

All collected data were entered into Microsoft Excel (Microsoft Corporation, Redmond, Washington, USA) for storage and organization. Data were checked for completeness and accuracy before analysis. Confidentiality of patient information was maintained throughout the study.

Statistical Analysis

Statistical analysis was performed using Statistical Package for the Social Sciences (SPSS) software version 26.0 (IBM Corp., Armonk, New York, USA). Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were expressed as frequencies and percentages. Comparisons between the two groups were performed using the Independent Samples t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables wherever appropriate. Effect size was calculated using

Cohen's d for continuous variables and odds ratio for categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULT

A total of 60 patients with ventral hernia who underwent ventral hernia repair were included in the study and were equally divided into two groups. The study group underwent closure using the quilting technique, whereas the control group underwent conventional closure without quilting. The baseline demographic and clinical characteristics were comparable between the two groups. The mean age was 51.1 ± 12.6 years in the study group and 47.5 ± 13.3 years in the control group. The study group comprised 6 (20.0%) males and 24 (80.0%) females, while the control group comprised 12 (40.0%) males and 18 (60.0%) females. The mean defect size was 2.9 ± 1.2 cm² in the study group and 2.7 ± 1.0 cm² in the control group. The mean flap thickness was 4.8 ± 0.8 cm in the study group and 4.9 ± 0.7 cm in the control group. Umbilical hernia was observed in 13 (43.3%) patients in the study group and 17 (56.7%) patients in the control group, whereas incisional hernia was observed in 17 (56.7%) and 13 (43.3%) patients, respectively. These findings indicate that the baseline demographic and clinical characteristics were broadly similar between the two groups (**Table 1**). There were no statistically significant differences in the baseline demographic and clinical characteristics between the study and control groups ($p > 0.05$), indicating that the two groups were comparable at baseline.

Postoperative drain output was lower in the quilting group throughout the postoperative period. On postoperative day 1, the mean drain output was 41.0 ± 12.4 ml in the study group compared with 51.7 ± 6.5 ml in the control group ($p = 0.0001$). On postoperative day 2, the mean drain output was 21.7 ± 8.5 ml in the study group and 34.0 ± 8.4 ml in the control group (p

<0.0001). Similarly, on postoperative day 3, the mean drain output was 13.0 ± 8.5 ml in the study group compared with 25.8 ± 7.0 ml in the control group ($p < 0.0001$). The total drain output was significantly lower in the quilting group (75.7 ± 23.5 ml) than in the conventional closure group ($111.5 \pm$

19.4 ml), with a mean difference of 35.8 ml ($p < 0.0001$). These findings demonstrate a consistent reduction in postoperative fluid accumulation among patients who underwent quilting closure (**Table 2**).

Table 1. Demographic distribution and clinical characteristics

Variable	Study group (n=30)	Control group (n=30)
Mean age (years)	51.1 ± 12.6	47.5 ± 13.3
Sex (%)	Male: 6 (20%) Female: 24 (80%)	Male: 12 (40%) Female: 18 (60%)
Defect size (cm ²)	2.9 ± 1.2	2.7 ± 1.0
Flap thickness (cm)	4.8 ± 0.8	4.9 ± 0.7
Hernia type	Umbilical: 13 (43.3%) Incisional: 17 (56.7%)	Umbilical: 17 (56.7%) Incisional: 13 (43.3%)

Table 2. Postoperative Drain Output

Postoperative Day Drain Output	Study group	Control group	Mean difference	P-value
POD1 (ml, mean $\pm$ SD)	41.0 ± 12.4	51.7 ± 6.5	-10.7	0.0001
POD2 (ml, mean $\pm$ SD)	21.7 ± 8.5	34.0 ± 8.4	-12.3	<0.0001
POD3 (ml, mean $\pm$ SD)	13.0 ± 8.5	25.8 ± 7.0	-12.8	<0.0001
Total (ml, mean $\pm$ SD)	75.7 ± 23.5	111.5 ± 19.4	-35.8	<0.0001

Secondary outcome analysis showed favorable postoperative outcomes in the quilting group. The mean duration until drain removal was 3.7 ± 0.8 days in the study group compared with 4.8 ± 0.7 days in the control group ($p < 0.0001$). The mean duration of hospital stay was 4.0 ± 1.0 days in the study group and 6.6 ± 1.1 days in the control group ($p < 0.0001$). Surgical site infection on postoperative day 10 was observed in 23.3% of patients in the study group and 73.3% of patients in the control group ($p = 0.0001$). No cases of late infection were noted in the study group, whereas 60.0% of patients in the control group developed late infection by postoperative day 30 ($p < 0.0001$).

The effect size analysis demonstrated a substantial difference between the quilting and conventional closure groups. The effect size for total drain output was $d = 1.64$, indicating a very large reduction in postoperative drain output among patients who underwent quilting closure. The effect

size for duration of drain placement was $d = 1.46$, suggesting a very large reduction in the number of days the drain remained in situ in the quilting group. Similarly, the effect size for hospital stay was $d = 2.44$, indicating an extremely large reduction in the duration of hospitalization among patients treated with the quilting technique. For surgical site infection, the effect size was expressed as an odds ratio (OR) of 0.11, demonstrating markedly lower odds of postoperative wound infection in the quilting group compared with the conventional closure group. Although an effect size was not calculated for late infection, no cases were observed in the quilting group, whereas 60.0% of patients in the conventional closure group developed late infection by postoperative day 30. These findings indicate that the quilting technique was associated with clinically significant improvements in postoperative outcomes following ventral hernia repair (**Table 3**).

Table 3. Secondary Outcomes

Outcome	Study group (n=30)	Control group (n=30)	p-value	Effect size
Total drain output (ml)	75.7 ± 23.5	111.5 ± 19.4	<0.0001	d = 1.64
Drain removal (days)	3.7 ± 0.8	4.8 ± 0.7	<0.0001	d = 1.46
Hospital stay (days)	4.0 ± 1.0	6.6 ± 1.1	<0.0001	d = 2.44
Surgical site infection (POD-10)	7 (23.3%)	22 (73.3%)	0.0001	OR = 0.11
Late infection (POD-30)	0	18 (60.0%)	—	—

d=Cohen's d; OR=odds ratio

DISCUSSION

Ventral hernias may be either congenital or acquired, with acquired defects constituting the majority of cases. Several factors contribute to their development, including previous abdominal surgery resulting in incisional hernia, trauma, obesity, and increased intra-abdominal pressure acting on anatomically vulnerable sites of the abdominal wall, such as the umbilicus, semilunar line, stoma sites, inguinal regions, and esophageal hiatus. Recurrent stretching and weakening of the abdominal fascia, particularly in individuals with obesity or substantial fluctuations in body weight, may further predispose to ventral hernia formation [1,2].

The surgical management of ventral hernias generally involves reduction of the hernial contents, closure of the fascial defect, and reinforcement of the abdominal wall, most commonly with prosthetic mesh. These procedures may be performed through open or minimally invasive approaches, with the primary objectives of restoring abdominal wall integrity and minimizing the risk of recurrence [3].

Seroma is characterized by the postoperative accumulation of serous fluid, predominantly composed of plasma and lymphatic fluid, within a potential space created by surgical dissection. It represents one of the more frequently encountered complications following hernia repair and may result in discomfort, delayed wound healing, and an increased risk of infection. Seroma formation has been reported in approximately 17.6% of patients undergoing laparoscopic inguinal hernia repair. Although its precise pathogenesis is not fully established, extensive tissue dissection with disruption of lymphatic and vascular

channels is considered an important contributing factor, resulting in accumulation of serum and inflammatory exudate within the postoperative dead space [4-6].

Clinically significant seromas may cause pain and discomfort and can prolong wound healing, occasionally necessitate additional outpatient visits or interventions and thereby increase healthcare expenditure. Persistent fluid collections may also predispose to wound-related complications, including surgical site infection, wound dehiscence, flap necrosis, and abscess formation [7]. Conventional closure involves approximation of the abdominal wall layers using standard suturing techniques [8]. In contrast, quilting involves fixation of the subcutaneous tissue to the underlying fascia or mesh, thereby reducing the potential dead space and limiting postoperative fluid accumulation [9].

The findings of the present study are consistent with those reported by Suresh Kumar et al. and Sridhar J et al., who demonstrated that the use of quilting sutures was associated with reduced seroma formation, lower postoperative drain output, earlier drain removal, and improved postoperative recovery following ventral hernia repair [10]. Similarly, in the present study, patients undergoing quilting closure demonstrated lower postoperative drain output, earlier removal of drains, a shorter duration of hospitalisation, and fewer surgical site infections compared with patients undergoing conventional closure. The lower drain output observed in the quilting group may reflect reduced postoperative fluid accumulation, supporting the proposed mechanism by

which quilting sutures eliminate potential dead space and limit seroma formation.

Comparable observations were reported by J. P. Cossa et al., who found that quilting was associated with a reduction in both the incidence and severity of postoperative seromas [11]. Although their study evaluated an endoscopic-assisted bilayer repair technique, the underlying principle of reducing postoperative dead space was similar to that used in the present study. N. M. Posielski et al. also reported successful repair of massive ventral hernias using a quilt-like mesh configuration, with durable outcomes and no additional morbidity attributable to the technique [12]. Although their approach involved mesh configuration rather than subcutaneous quilting, both studies illustrate the potential clinical value of incorporating quilting principles into abdominal wall reconstruction.

Taken together, the findings of the present study and those of previous investigations suggest that techniques aimed at reducing postoperative dead space may help minimize fluid accumulation and facilitate postoperative recovery following ventral hernia repair. In the present study, quilting closure was associated with lower drain output, earlier drain removal, shorter hospitalisation, and a lower incidence of surgical site infection compared with conventional closure. These findings indicate a potential benefit of quilting sutures in reducing postoperative fluid-related complications and improving short-term postoperative outcomes.

The present study has several limitations. First, the relatively small sample size may have limited the statistical power to detect differences in less frequent postoperative complications. Second, the study was conducted at a single tertiary care centre, which may restrict the generalizability of the findings to other patient populations and healthcare settings. Furthermore, long-term follow-up was not undertaken; therefore, the effect of the closure technique on late complications, particularly hernia recurrence, could not be assessed. Larger

multicentric studies with longer follow-up are warranted to confirm these findings and to evaluate the long-term effectiveness and safety of quilting closure in ventral hernia repair.

CONCLUSION

Postoperative seroma is a frequent concern following ventral hernia repair, particularly because surgical dissection and mesh placement can result in the formation of potential spaces within the abdominal wall. Minimizing these spaces may help reduce postoperative fluid accumulation and the complications associated with seroma formation.

In this study, quilting closure was associated with reduced postoperative drain output, earlier drain removal, shorter hospitalisation, and a lower incidence of surgical site infection compared with conventional closure. The lower drain output in the quilting group may indicate reduced fluid accumulation within the operated area and supports the proposed role of quilting sutures in minimizing residual dead space. Thus, quilting may represent a practical and relatively simple adjunct during ventral hernia repair, with potential benefits for short-term postoperative recovery.

Further prospective, multicentre studies involving larger patient populations and extended follow-up are needed to confirm these observations and determine whether the benefits of quilting are sustained over the long term, including its effect on recurrence and other late postoperative outcomes.

Declaration

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