

Original Article

Investigating Post-Mastectomy Seroma Formation: A Comparative Analysis of Quilting Suturing and Conventional Wound Closure

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Abstract

Objective: To compare the frequency of early post-mastectomy seroma formation between quilting-suturing and conventional wound closure in patients undergoing unilateral mastectomy.

Methodology: This randomized controlled trial was conducted at general surgery department, LUMHS from November 2024 to October 2025, on sixty patients aged 35–60 years undergoing unilateral mastectomy equally divided in quilting suturing and conventional closure groups. Patients were assessed for post mastectomy incidence of seroma formation within 7 days postoperatively. All the data was entered and analyzed in SPSS version 25, applying chi-square test to compare the seroma formation across the groups, taking p-value <0.05 as statistically significant.

Results: This study included 60 patients, with mean age of patients in Group A was 51.43 ± 5.7 years compared to 55.0 ± 5.32 years in Group B. Seroma formation was significantly higher in conventional wound closure group around (36.7%) compared quilting suturing group around (13.3%), ($p=0.001$). Additionally, the postoperative complications were statistically insignificant across the groups, whereas mean hospital stay was significantly shorter in Quilting suturing group around in contrast to conventional group, ($p=0.001$). Moreover, the frequency of seroma formation was statistically insignificant according to age of the patients, SES, comorbidities and residential status ($p>0.05$).

Conclusion: Quilting suture technique observed to be the superior modified radical mastectomy compared to the conventional wound closure modified radical mastectomy, with significantly lower rates of seroma formation, short Hospital stay and postoperative complications.

Keywords: Mastectomy, Quilting sutures, Wound closure, Seroma.

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Introduction

Breast carcinoma remains the most frequently diagnosed malignancy among women worldwide and poses a substantial global health burden. In 2022, approximately 2.3 million new cases and 670,000 deaths due to female breast cancer were reported globally, with annual incidence rates increasing by 1%–5% in nearly half of the countries studied.¹ Despite rapid advances in systemic therapies and targeted treatments, surgical intervention, particularly mastectomy, remains the cornerstone of definitive management for early-stage and locally advanced breast cancer. Approximately 33% of patients with stage I or II breast cancer undergo

mastectomy, highlighting its continued clinical importance in modern oncological practice.² However, mastectomy is associated with several postoperative complications that may occur during different stages of recovery.

Among these complications, seroma formation is the most common and clinically challenging postoperative morbidity. It is defined as the abnormal accumulation of serous fluid, consisting of plasma and lymphatic fluid, within the postoperative dead space, with reported incidence rates ranging from 15% to 85% following mastectomy.³ Although the exact pathogenesis of

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seroma formation remains incompletely understood, it is generally attributed to disruption of lymphatic and vascular drainage caused by extensive soft-tissue dissection, resulting in the accumulation of serum and inflammatory exudate within the dead space.³

Although seroma is rarely life-threatening, its consequences extend well beyond the operative site. It may delay the initiation of adjuvant chemotherapy and radiotherapy, increase the risk of wound infection, impair wound healing, and contribute to upper-limb lymphedema, thereby resulting in significant morbidity and compromised patient outcomes.⁴ In some patients, repeated aspirations are required, increasing the risk of secondary infection and patient discomfort.⁵ Growing evidence suggests that mechanical obliteration of the postoperative dead space is one of the most reliable and consistently effective strategies for preventing seroma formation. The quilting suture technique, in which the mastectomy skin flaps are fixed to the underlying pectoral muscle to eliminate dead space, has been shown to significantly reduce the incidence of postoperative seroma in several studies.⁶ Specifically, this technique converts the dead space into smaller compartments, thereby minimizing fluid accumulation and reducing the likelihood of seroma formation.⁷

Numerous randomized controlled trials and prospective studies have demonstrated the superiority of quilting sutures over conventional wound closure. One comparative study reported clinically significant seroma formation in only 12.9% of patients who underwent quilting compared with 62.3% in the conventional closure group. In addition, surgical site infections and the duration of hospital stay were significantly lower in the quilting group.⁸ Similarly, other international studies comparing quilting sutures with conventional wound closure after total mastectomy with axillary dissection have consistently reported significantly lower rates of seroma formation with the quilting technique.^{9, 10}

Despite the growing body of evidence supporting its effectiveness, quilting sutures have not been consistently adopted in routine surgical practice. Post-mastectomy seroma following axillary lymph node dissection remains a well-recognized complication, with reported incidence ranging from 15.5% to 90%, and no single preventive strategy has been universally accepted.¹¹ Although seroma remains an unavoidable complication in some patients despite advances in surgical techniques, quilting has emerged as a simple, practical, and effective method for reducing dead space

and minimizing seroma formation. Additional benefits include fewer postoperative aspirations, a lower risk of wound infection, reduced hospital visits, improved patient comfort, and decreased healthcare costs.¹² Given the wide variation in reported seroma rates and the lack of a universally accepted wound-closure protocol, particularly in the local setting, the present study was conducted to compare the incidence of post-mastectomy seroma formation between the quilting suture technique and conventional wound closure. The findings are expected to provide robust local evidence to guide surgical practice and improve postoperative outcomes by reducing seroma formation following modified radical mastectomy.

Methodology

This randomized controlled trial was conducted in Surgical Unit IV, Liaquat University of Medical and Health Sciences (LUMHS), Jamshoro, after obtaining ethical approval from the Ethical Review Committee (ERC) of LUMHS and synopsis approval from the College of Physicians and Surgeons Pakistan (CPSP). The study was carried out over one year, from November 2024 to October 2025.

A sample size of 60 patients was calculated using OpenEpi, assuming a 4% prevalence of seroma formation following mastectomy with quilting sutures, with a 95% confidence level and a 5% margin of error. A non-probability consecutive sampling technique was used.

Female patients aged 35–60 years with histopathologically confirmed unilateral breast carcinoma (N1 stage), who were suitable candidates for surgery, had no distant metastasis or local invasion of the overlying or underlying tissues, and were scheduled for modified radical mastectomy were included in the study.

Patients planned for immediate breast reconstruction or bilateral mastectomy, those with advanced-stage disease, pregnant women, patients requiring toilet surgery or having contaminated wounds, patients with active autoimmune or connective tissue disorders, known degenerative neuromuscular diseases with thoracic muscle involvement (including myasthenia gravis, multiple sclerosis, or Parkinson's disease), patients receiving anticoagulant therapy or having coagulation disorders, and those unwilling to participate were excluded.

The eligible patients were randomly allocated into Group A and Group B using the simple lottery method.

Patients in Group A underwent modified radical mastectomy with axillary lymph node dissection. Following completion of the procedure, no flap fixation was performed. The wound was closed in two layers using absorbable sutures for the subcutaneous tissue followed by skin closure with polypropylene (Prolene) sutures. Two closed-suction drains were placed, one beneath the skin flap and the other in the axillary region, before skin closure. Drain output was recorded daily until drain removal.

Patients in Group B underwent the same surgical procedure followed by the quilting suture technique. After completion of the resection, the subcutaneous tissue of the skin flaps was fixed to the underlying pectoralis major muscle using multiple parallel rows of continuous absorbable sutures. Suturing was performed from medial to lateral in a back-and-forth fashion, with rows placed approximately 2–3 cm apart in a cranio-caudal direction, thereby effectively obliterating the dead space. The skin was subsequently closed with intradermal absorbable sutures, and a single closed-suction drain was inserted.

All patients were followed for 7 postoperative days to assess seroma formation. Seroma was defined as the accumulation of fluid at the surgical site occurring more than 48 hours after surgery up to the seventh postoperative day, confirmed by clinical examination and/or ultrasonography. Data were collected using a structured study proforma.

Data were entered and analyzed using SPSS version 26. Quantitative variables were expressed as mean $\pm$ standard deviation, whereas categorical variables were presented as frequencies and percentages. Post-stratification analysis was performed for potential effect modifiers, including age, body mass index (BMI), residential status, socioeconomic status, diabetes mellitus, and hypertension, using the Chi-square test. A P-value <0.05 was considered statistically significant.

Results

A total of 60 patients were enrolled in the study, with 30 patients in each group. The mean age was significantly lower in Group A than in Group B (51.43 ± 5.70 vs. 55.00 ± 5.32 years; $P=0.008$). The mean BMI was comparable between the groups (25.50 ± 5.49 kg/m² in Group A vs. 24.26 ± 2.50 kg/m² in Group B; $P=0.257$). Similarly, the mean operative time did not differ significantly between the groups (92.80 ± 15.61 minutes in Group A vs. 94.33 ± 7.85 minutes in Group B; $P=0.502$). Baseline comorbidities and socioeconomic status are summarized in Table I.

The incidence of postoperative seroma formation was significantly higher in the conventional wound closure group (36.7%) than in the quilting suture group (13.3%) ($P=0.001$), indicating that the quilting suture technique was significantly more effective in reducing post-mastectomy seroma formation (Figure 1).

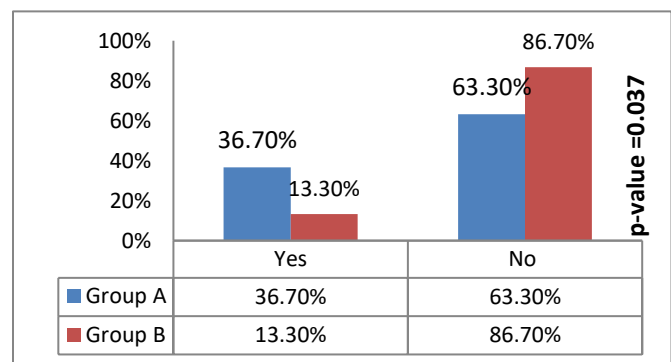


Figure 1. Seroma formation among patients undergoing mastectomy in both groups. (n=60)

Postoperative complications, including wound infection, hematoma, and flap necrosis, were more frequent in Group A than in Group B; however, these differences were not statistically significant ($P>0.05$). In contrast, the mean hospital stay was significantly shorter in the quilting suture group than in the conventional wound closure group (5.6 ± 1.2 vs. 7.8 ± 1.5 days; $P=0.001$) (Table II).

Table I: Baseline and clinical characteristics of patients.

Variable	Group A	Group B	p-value
Mean Age (years)	51.43 $\pm$ 5.7	55.0 $\pm$ 5.32	0.008
BMI (kg/m ²)	25.5 $\pm$ 5.49	24.26 $\pm$ 2.5	0.257
Comorbidities	Diabetes mellitus	3 (10.0%)	0.177
	Hypertension	00	
	No	27(90.0%)	
Socioeconomic status	Poor	13 (43.3%)	0.010
	Middle	17 (56.7%)	
	Upper	00	
Mean operative time (minutes)	92.80 $\pm$ 15.61	94.33 $\pm$ 7.85	0.502

Post-stratification analysis demonstrated that the frequency of seroma formation was not significantly associated with patients' age, socioeconomic status, comorbidities, or residential status ($P>0.05$), as shown in Table III.

Table II: Postoperative Complications and hospital stay. (n=60)

Complication	Group A (n=30)	Group B (n=30)	p-value
Wound infection	3 (10.0%)	1 (3.3%)	0.30
Hematoma	2 (6.7%)	1 (3.3%)	0.55
Flap necrosis	1 (3.3%)	0 (0%)	0.31
Mean hospital stay	7.8 ± 1.5	5.6 ± 1.2	0.001

Table III: Post-stratification analysis for seroma formation. (n=60)

Variables		Seroma formation		Total	p-value
		Yes	No		
Age groups	35 -45 years	1	3	4	1.000
		6.7%	6.7%	6.7%	
	46-60 years	14	42	56	
Socioeconomic status		93.3%	93.3%	93.3%	0.472
	Poor	7	25	32	
		46.7%	55.6%	53.3%	
	Middle	6	18	24	
		40.0%	40.0%	40.0%	
	Upper	2	2	4	
Comorbidities		13.3%	4.4%	6.7%	0.110
	Diabetes mellitus	4	3	7	
		26.7%	6.7%	11.7%	
	Hypertension	1	3	4	
		6.7%	6.7%	6.7%	
	No	10	39	49	
Residential status		66.7%	86.7%	81.7%	0.873
	Rural	10	31	41	
		66.7%	68.9%	68.3%	
	Urban	5	14	19	
		33.3%	31.1%	31.7%	

Discussion

The modified radical mastectomy is one of the most important performed surgical procedures in the management of breast carcinoma, however it is linked to several postoperative complications, of which seroma formation is the most frequent and clinical challenge.

This study was therefore planned to compare the incidence of post-mastectomy seroma formation between quilting suture technique and conventional wound closure, and finding of the study showed that quilting suture technique significantly more effective in reducing post-mastectomy seroma formation compared to conventional wound closure, with seroma incidence 13.3% of patients in quilting suture group versus 36.7% in conventional wound closure group ($p=0.001$). The findings were strongly consistent with the study by van

Zeelst LJ et al⁶ where incidence of seroma formation was significantly lower in 12.9% of quilting suture technique group compared to 62.3% in the non-quilted cohort ($p<0.001$) in a combined prospective and retrospective study of 254 cases undergoing mastectomy and axillary lymph node dissections. Consistently another study conducted by ten Wolde B et al¹⁴ to assess the effect of quilting on the incidence of seroma formation and SSI, where they reported that the incidence of seroma significantly declined from 80.5% to 22.5% ($p = 0.01$), and the average number of aspirations required was decreased from 4.86% to 2.40% ($p = 0.015$). In aligns to our series Khan F et al¹⁵ reported that the seroma formation was only 3.3% of patients in the quilting group compared with 26.7% in the conventional suture group ($p = 0.026$). Jayalal JA et al¹⁶ also reported that incidence of seroma formation was significantly decreased around 19% in the quilting group compared to the conventional group around 47.6% ($p < 0.05$).

Moreover, in a prospective multicenter randomized trial by Foulon et al¹⁷ demonstrated that the seroma incidence of 30.8% in the quilting group compared to 52.5% in the conventional closure group ($p=0.05$), indicating the protective role of dead space obliteration through flap fixation. On the other hand Raju A et al¹⁸ reported that the incidence of seroma formation was significantly decrease in the flap fixation by suture study group compared to conventional clouser (11.1% versus 41.7%) respectively, indicating that flap fixation with axillary exclusion does not increase morbidity while provided that acceptable outcomes of cosmetics. Moreover, in a systematic review and meta-analysis by Morarasu et al. comprising 21 studies and 3,473 patients observed the significantly lower seroma frequency, total drainage volume, days to removal of drains and length of hospital stay in the quilting suture group compared to conventional closure, strongly endorsing the quilting suture technique as the reliable intraoperative procedure.¹⁹

In the support of our findings few other studies also observed that the Quilting technique of mastectomy flaps is effective in terms of significantly decrease seroma formation, reduce postoperative drain output, pain, and the decreased duration of hospital stay.^{6,20} Overall consistently of the lower seroma formation rates across the studies and the this study may due to the fundamental mechanical principle underlying quilting suture technique, that the direct fixation of skin flaps to the pectoralis major muscle effectively eliminates the dead space, thus preventing lymphatic and

accumulation of serous fluid that would otherwise drive formation of seroma following conventional wound closure technique.

Furthermore, in this study according to postoperative complications including wound infection, hematoma, flap necrosis and prolonged hospital were higher in conventional, while the differences were statistically insignificant. These findings were supported by the Drivas et al,²¹ whose meta-analysis consisting 1,748 patients reported that the hematoma, surgical site infection, and flap necrosis rates did not differ significantly between quilting suture and conventional closure techniques, indicating that the quilting does not adversely increase wound-related complications. Our findings were also supported by the Morarasu et al¹⁹ who demonstrated that the quilting sutures significantly decreased the duration of stay in hospital stay ($P < 0.001$) along with reductions in rate of seroma formation and the volume of drainage. Overall the findings of this study strongly align with national and international evidence, proving that quilting suture technique is a safe, reliable and more effective surgical modification that significantly reduces rate of seroma formation and shortens stay in hospital following modified radical mastectomy, without raising the risk of other complications postoperatively.

Though, the present study carries some limitations, like relatively limited sample size of the study, lack of the detailed risk factor analysis, and limited previous national evidence on the subject, may limit the accuracy of the. Hence, it is important to conduct the, multicenter randomized controlled trials specifically at local level to establish the strong national evidence and for wound closure following modified radical mastectomy.

Conclusion

As per conclusive findings of the study, quilting suture technique observed to be the superior modified radical mastectomy compared to the conventional wound closure modified radical mastectomy, with significantly lower rates of seroma formation, short Hospital stay and postoperative complications. Being simple and cost-effective quilting suturing technique should be promoted as the standard wound closure technique following the modified radical mastectomy, specifically in limited resources settings of surgery.

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