Efficacy of mastectomy flap fixation in minimizing seroma formation after breast cancer surgery

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Background
Seroma formation is considered the most frequent postoperative complication after breast cancer surgery. Serous fluid is collected just under the skin flaps or in the axillary pace immediately following mastectomy preventing adherence of the flaps to the underlying fascia and muscles leading to delay wound healing, infected wound due to repeated aspiration, wound dehiscence, prolonged hospital stay, delay of adjuvant treatment, and finally generating additional costs.
Patients and methods
A randomized, controlled study was carried out among 138 female patients, who were candidates for mastectomy and axillary clearance. A control group without quilting (69 patients) had a traditional wound closure and the intervention (quilted) group (69 patients) had a sutured flap fixation.
Results
There were significant differences regarding seroma formation between both groups since it was detected in 22 (31.9%) of the 69 in the suture group and in 39 (56.5%) of 69 in the control group ($P<0.004$). There were significant differences between means of the number of seroma aspirations among patients with seroma ($n=61$) by study groups being significantly reduced in in the quilting group (4.3%) versus (18.8%) in the nonquilting group in comparison to the nonquilting group with P value less than 0.008. The range of operative time was 146 (80–160) in the quilting group and 100 (70–135) in the control group.
Conclusion
Quilting sutures postmastectomy is the most advised technique to minimize seroma formation and its complications. Hence, we recommend quilting of flaps as a routine step at the end of any mastectomy.

Keywords:
breast cancer, flap fixation, mastectomy, quilting, seroma

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Introduction

Seroma formation is a common side effect after surgery for breast cancer, with a highly variable cited incidence of 3% to more than 90% [1].

Postmastectomy seroma can be defined as a collection of serous fluid just under the skin flaps or in the axillary pace immediately following mastectomy with axillary dissection that can be detected either clinically or sonographically [2].

Seroma prevents adherence of the flaps to the underlying fascia and muscles leading to delay wound healing, infected wound due to repeated aspiration, wound dehiscence, prolonged hospital stay, delay of adjuvant treatment, and finally generating additional costs [3].

Risk factors for seroma formation postmastectomy include increasing body weight, obesity, and hypertension [4]. Extensive dissection in mastectomy and axillary lymphadenectomy damages several blood and lymphatic vessels and subsequent oozing of the blood and lymphatic fluid from a large surface area leads to seroma [4].

There are five types or classifications of seromas developed by Morales-Conde [5] (Table 1).

It is believed that meticulous attention applied to techniques of the breast surgery to minimize leakage from dissected blood and lymphatic vessels and to obliterate the dead space may reduce the incidence of seroma formation [6].

Halsted [7] first advocated creating a short superior flap and suturing it with interrupted silk to the fascia below the first rib and skin grafting the remaining part of the defect.

It is hypothesized that minimizing the dead space through fixation of the skin flaps to the underlying muscles (quilting) lowers the incidence of seroma [8].

Aim of the work

The present study was performed to clarify and evaluate the efficacy of flap fixation using sutures in reducing seroma after mastectomy for breast cancer in the 2 years following surgery.

Patients and methods

A total of 138 breast cancer patients were analyzed in the present study. This study was carried out in Zagazig University Hospitals between October 2015 and June 2018. All patients agreed to do mastectomy with axillary clearance surgery and consented to participate in this study. Female patients, older than 18 years of age and suffering from invasive breast cancer were included in this study. Patients undergoing breast-conserving therapy, those undergoing direct breast reconstruction, those who received prior chemotherapy or breast irradiation, and those with poorly controlled diabetes were excluded from this study.

Sample size calculation

Power analysis was performed using the χ^2 test for independent samples on frequency of seroma, because it was the main outcome variable in the present study. A pilot study was done before starting this study. According to the van Bastelaar and colleagues study, frequency of seroma was 35.9% in the flap fixation group and 59.1% in historical control (conventional wound closure). At power of 0.8 and alpha error of 0.05, a minimum sample size of 69 patients was required in each group. A total of 138 patients were included in the study that randomly allocated between the study arms using physical randomization with balance.

Study design

Trial is a randomized, controlled trial. Patients were randomized into two equal groups using a computer-generated random number. The first interventional (quilting) group will undergo flap fixation using sutures and placement of low vacuum drainage and the control (nonquilting) group will undergo conventional wound closure and low vacuum drainage.

Techniques

All patients were treated by modified radical mastectomy and axillary lymph nodes dissection. Surgeons used a standard electrocautery-based dissection technique. Thin skin flaps were preserved cranially and caudally.

Axillary clearance was performed through the same mastectomy incision (i.e. done after mastectomy). Major nerves (brachial plexus, nerve to serratus anterior muscle, and nerve to latissmus dorsi muscle), axillary artery, veins (axillary and cephalic), and other structures were protected, and then all of the surrounding tissue (including the lymph nodes) were removed. The axillary clearance in our study encompassed only levels I and II (lateral to and behind the pectoralis minor muscle) in all patients. Axillary clearance of level 3 lymph nodes was not done in our study for fear of brawny edema of the arm (more interruption of lymphatics is accompanied by more seroma) rather than no adding more benefit for the survival rate.

In the quilting group, after mastectomy and axillary clearance completion, multiple interrupted sutures were taken starting in the lower flap (skin/subcutaneous) from medial to lateral between the mastectomy flap and the underlying pectoralis muscle tacking between them using 2/0 Vicryl suture to obliterate the dead space underneath the mastectomy flap. The distance between all sutures is 4–5 cm. Care will be taken to prevent dimpling of the skin. The same was done for the upper flap. The axillary area is not approximated using sutures.

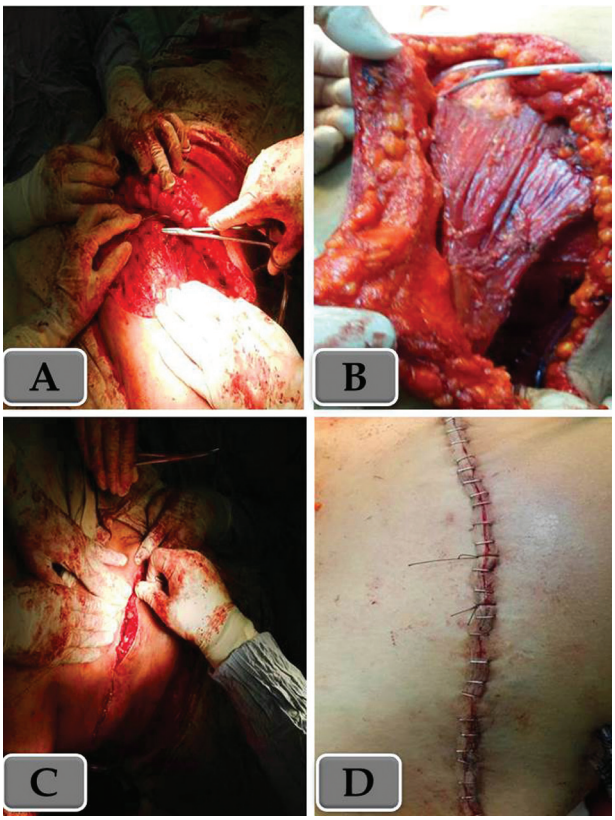
In both groups, the skin incision was closed in a double-layer fashion. Inverted 2/0 Vicryl stitches on the subcutaneous were used to approximate the wound margins. Skin stapler was then used to close the wound as shown in (Fig. 1d).

Our center experience in Zagazig University Hospitals regarding breast cancer operations postmastectomy and axillary clearance, included inserting a redivac drain with one limb in the axilla and the other under the flaps (anterior to the pectoralis muscle), then closure of the skin in two layers without making use of the flap fixation technique. Since we started the flap fixation method in our center, we found less seroma formation in our patients, which is the most common complication that occurred in our center, so we insisted to do that study to make flap fixation technique to be the trend in our center.

Patients' follow-up

All patients were followed up routinely for immediate and late complications including hemorrhage, flap necrosis, and wound sepsis.

Figure 1



Flap fixation technique showing: (a) taking sutures to the pectoralis major muscle, (b) fixation of the upper flap to the underlying muscle, (c) closing the subcutaneous tissue, and (d) closing the skin.

Seroma was recorded when detected either clinically or sonographically. If seroma was diagnosed, the total number of aspirations till resolution was recorded. Furthermore, the patients' pathological data were also recorded.

Statistical analysis

Continuous variables were expressed as the mean±SD and median (range) and the categorical variables were expressed as a number (percentage). Continuous variables were checked for normality by using the Shapiro–Wilk test. Percent of categorical variables were compared using the χ^2 test or Fisher's exact test when appropriate. All tests were two sided. All data were analyzed using the Statistical Package for the Social Sciences for Windows, version 20.0 (SPSS Inc., Chicago, Illinois, USA). A P value less than 0.05 was considered statistically significant.

Results

A planned number of 138 operable female patients who were candidates for mastectomy and axillary clearance were enrolled in this study. The patients were randomized; 69 in the flap fixation suture group and 69 in the control group. Regarding sociodemographic characteristics of patients as shown in Table 2, the results show that there was a significant difference regarding the mean age of patients (44.82±7.29) in the quilting group versus 48.97±9.36 in the control group (P=0.004). Of the breast cancer patients, 29.7% were overweight and 43.4% were in the obese range, 13.7% of breast cancer patients were smokers, and there were 13.7% of breast cancer patients who had positive family history. Significant difference was detected in hypertensive patients in both groups, 42% in the quilting group comparable to the nonquilting group (17.4%) (P<0.002).

Table 1 Seroma classification

Type 0	No clinical evidence of seroma, but postoperative patient
Type 0a	No clinical or radiological evidence of seroma, but postoperative
Type 0b	Radiological evidence of seroma
Type 1	Clinical evidence of seroma lasting <1 month
Type 2	Clinical evidence of seroma lasting >1 month
Type 2a	A seroma lasting between 1 and 3 months
Type 2b	A seroma lasting between 3 and 6 months
Type 3	Symptomatic seroma requiring minimal intervention
Type 4	Urgent seroma requiring immediate medical treatment

Postoperative complications are listed in Table 3. There were significant difference regarding seroma formation between both groups since it was detected in 22 (31.9%) of 69 in the suture group and in 39 (56.5%) of 69 in the control group (P<0.004). There were significant differences between means of the number of seroma aspirations among patients with seroma (n=61) by study groups being significantly reduced in the quilting group 4.3% versus 18.8% in the nonquilting group in comparison to the nonquilting group with P value less than 0.008. Nonsignificant difference was detected in patients developing surgical site infection in both groups. Surgical site infection was detected in 11.6% in the quilting group comparable to the nonquilting group (17.4%) (P<0.333). Nonsignificant difference was detected in patients developing hematoma that was detected in 18.8% in the quilting group comparable to the nonquilting group (24.6%) (P<0.409). Nonsignificant difference was detected in patients developing flap necrosis. Flap necrosis was detected in 7.2% in the quilting group comparable to the nonquilting group (10.1%) (P<0.546). Significant difference was detected in patients developing wound dehiscence. Wound dehiscence was detected in 1.4% in the quilting group comparable to the nonquilting group (13%) (P<0.009). The range of

Table 2 Sociodemographic characteristics

Basic characteristics	Quilting group (*N*=69)	Nonquilting group (*N*=69)	*P* value
Age (years)			
Mean±SD	44.82±7.29	48.97±9.36	0.004[a]
Median (range)	45 (32–59)	48 (32–66)	
BMI (kg/m^2)			
Mean±SD	28.06±5.09	27.01±5.31	0.002[b]
Median (range)	30 (18–35)	27 (18–35)	
Average	16 (23.2)	21 (30.4)	0.229[c]
Overweight	18 (26.1)	23 (33.3)	
Obese	35 (50.7)	25 (36.2)	
Smoking			
Nonsmoker	59 (85.5)	60 (87)	0.805[c]
Smoker	10 (14.5)	9 (13)	
Menstrual state			
Premenopausal	55 (79.7)	42 (60.9)	0.015[c]
Postmenopausal	14 (20.3)	27 (39.1)	
Diabetes mellitus			
Absent	49 (71)	51 (73.9)	0.703[c]
Present	20 (29)	18 (26.1)	
Hypertension			
Absent	40 (58)	57 (82.6)	0.002[c]
Present	29 (42)	12 (17.4)	
Family history			
Negative	61 (88.4)	58 (84.1)	0.459[c]
Positive	8 (11.6)	11 (15.9)	
Tumor stage (T)			
T1	18 (26.1)	14 (20.3)	0.663[c]
T2	38 (55.1)	39 (56.5)	
T3	13 (18.8)	16 (23.2)	

N=total number of patients in each group; quantitative data were expressed as mean±SD and median (range); qualitative data were expressed as *n* (%). [a]Independent samples Student's *t* test. [b]Mann–Whitney *U* test. [c]χ^2 test. *P* value less than 0.05 is significant.

Table 3 Outcome of treatment

Outcome of treatment	Quilting group (*N*=69)	Nonquilting group (*N*=69)	*P* value
Operative time (min)			
Mean±SD	142.24±16.61	103.01±19.32	<0.001[a]
Median (range)	146 (80–160)	100 (70–135)	
Seroma			
Absent	47 (68.1)	30 (43.5)	0.004[b]
Present	22 (31.9)	39 (56.5)	
Need of seroma aspiration			
No	66 (95.7)	56 (81.2)	0.008[b]
Yes	3 (4.3)	13 (18.8)	
Hematoma			
Absent	56 (81.2)	52 (75.4)	0.409[b]
Present	13 (18.8)	17 (24.6)	
Surgical site infection			
Absent	61 (88.4)	57 (82.6)	0.333[b]
Present	8 (11.6)	12 (17.4)	
Flap necrosis			
Absent	64 (92.8)	62 (89.9)	0.546[b]
Present	5 (7.2)	7 (10.1)	
Wound dehiscence			
Absent	68 (98.6)	60 (87)	0.009[b]
Present	1 (1.4)	9 (13)	

N=total number of patients in each group; quantitative data were expressed as mean±SD and median (range); qualitative data were expressed as *n* (%). [a]Mann–Whitney *U* test. [b]χ^2 test. *P* value less than 0.05 is significant.

operative time was 146 (80–160) in the quilting group and 100 (70–135) in the control group.

Discussion

Seroma is an abnormal collection of serous fluid in the dead space after mastectomy. The source of this fluid is both acute inflammatory exudates and lymphorrhea following lymphatic disruption [9].

There are however measures that can be taken to reduce seroma significantly, through good use of drains, mechanical dead space closure, and delaying physiotherapy. No single method is considered to be constantly effective. At present we recommend, especially in patients with increased risk factors, to utilize a combination of proven seroma-reducing measures [8].

The concept of suturing the skin flaps to the underlying muscle and obliteration of the axillary space is not new [10].

This study demonstrates that reduction of the dead space after mastectomy using flap fixation reduces seroma formation and seroma aspirations. Retrospective and prospective studies have demonstrated the higher incidence of seroma formation in patients not undergoing mechanical flap fixation [11].

Effectively, few articles have been published on the occurrence of seroma and its sequelae in patients undergoing flap fixation after mastectomy for patients with breast cancer [12].

Coveney *et al.* [13] clarified significantly less drainage in the group of patients, where skin flaps were sutured down to the chest wall muscles compared with just conventional skin flap closure.

Van Bastelaar *et al.* [11] have started a prospective, randomized, controlled trial (seroma reduction after mastectomy) to evaluate the effects of flap fixation, including seroma formation and its sequelae, as well as long-term outcome measures, such as cosmesis, shoulder function, patient satisfaction, quality of life, and cost-effectiveness.

Halsted [7] was the first to advocate fixation of the skin flaps to the deeper structures at the edge to cover the contents of the axilla and to obliterate dead space under the clavicle in order to reduce seroma formation (Table 4).

Our study is to evaluate whether dead space obliteration affects seroma formation during follow-up after subcutaneous resection. This approach offers many advantages such as: (a) it can be easily performed by any breast surgeon; (b) requires no supplementary material; and (c) very low cost.

Quilting the skin flaps with sutures will reduce seroma formation and number of aspirations and not seem to influence shoulder function and/or range of motion, thus simplifying postoperative management and facilitating early discharge. This technique may preclude the use of drains in breast surgery, especially in the breast-conserving surgery [20].

A prospective, randomized controlled trial by Khater and colleagues was published in 2015. Patients undergoing modified radical mastectomy (n=120) were randomized into one of the two groups. In the first group, quilting was applied to the skin flaps using a Vicryl 2/0 suture. In the second group, mastectomy was performed in the same manner without quilting of the skin flaps. All patients received a 18-Fr tube drain. Seroma was present in 20% of the patients that underwent quilting and in 78.3% of the patients in the drain-only group (P<0.001). There was a significantly higher number of aspirations in the drain-only group (4.7 vs. 2.1, P<0.001). Postoperative hematoma formation and skin flap necrosis were indifferent. Patients in the intervention group had a significantly longer operative time in comparison to the drain-only group (127 vs. 105 min, P<0.001) [10].

Table 4 Lists selected studies that studied obliteration of dead space using suturing

References	Type of study	Intervention	Total patients	Drain	Result
Aitken and Minton [14]	Retrospective	MRM	204	+	↓ seromas and infection
Hamy *et al.* [15]	RCT	BCS	53	_	↓ seromas, good cosmetic results
Chilson *et al.* [16]	RCT	MRM	351	+	↓ seroma formation
Coveney *et al.* [13]	RCT	MRM	39	_	↓ seroma formation, drain volume
Schuijtvlot *et al.* [17]	Prospective	BCS	97	+	↓ seroma formation
Benjasirichai *et al*. [18]	RCT	MRM	18	+	↓ seroma formation
Ten Wolde *et al.* 2014 [19]	Retrospective	MRM	176	+	↓ seroma formation

BCS, breast conserving surgery; MRM, modified radical mastectomy; RCT, randomized, controlled trial.

Ten Wolde *et al.* [19] identified the increase in surgery time and the potential increase in postoperative pain as potential drawbacks of the quilting technique. Our technique of suturing the flap with absorbable sutures in multiple rows is easily reproducible and adds only about 10 min more to the operative time. In our study, the incidence of seroma in the suturing group was significantly lower than the control group (P=0.004). Our data suggest closing subcutaneous wounds carefully with dead space obliteration being important.

The surgical interruption of lymphatic channels provides an extensive source of drainage fluid that weeps into the surgical site [21].

We exclude patients who received prior chemotherapy from our study as there are many studies such as that study done by Ranisavljević *et al.* [22] regarding the impact of neoadjuvant chemotherapy on wound complications after breast surgery and concluded that the incidence of postoperative wound complications after neoadjuvant chemotherapy and breast cancer surgery was 27% and only 10% after surgery without neoadjuvant chemotherapy. Also, he found that the average reduction of tumor volume after neoadjuvant chemotherapy was 30%, most common complications were prolonged seroma formation and minor skin necrosis. For this reason, we exclude patients who had neoadjuvant chemotherapy from our study.

Conclusion

From our study, we can conclude that quilting or tacking mastectomy flap to the underlying muscles obliterating the surgical dead space tends to shorten suction drainage duration, reduces seroma formation, and the need for aspiration punctures. It should be routinely integrated in mastectomy procedures.

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Conflicts of interest

There are no conflicts of interest.

References

1 Carless PA, Henry DA. Systematic review and meta-analysis of the use of fibrin sealant to prevent seroma formation after breast cancer surgery. Br J Surg Inc Eur J Surg Swiss Surg 2006; 93:810–819.

2 Sakkary MA. The value of mastectomy flap fixation in reducing fluid drainage and seroma formation in breast cancer patients. World J Surg Oncol 2012; 10:8.

3 Pogson CJ, Adwani A, Ebbs SR. Seroma following breast cancer surgery. Eur J Surg Oncol 2003; 29:711–717.

4 BurakJr WE, Goodman PS, Young DC, Farrar WB. Seroma formation following axillary dissection for breast cancer: risk factors and lack of influence of bovine thrombin. J Surg Oncol 1997; 64:27–31.

5 Morales-Conde S. A new classification for seroma after laparoscopic ventral hernia repair. Hernia 2012; 16:261–267.

6 Gong Y, Xu J, Shao J, Cheng H, Wu X, Zhao D, Xiong B. Prevention of seroma formation after mastectomy and axillary dissection by lymph vessel ligation and dead space closure: a randomized trial. Am J Surg 2010; 200:352–356.

7 Halsted WS. Developments in the skin grafting operations for cancer of the breast. JAMA 1913; 60:416–418.

8 van Bemmel AJM, van de Velde CJH, Schmitz RF, Liefers GJ. Prevention of seroma formation after axillary dissection in breast cancer: a systematic review. Eur J Surg Oncol 2011; 37:829–835.

9 Al-Shalah ANM. Role of quilting technique of mastectomy flap in prevention and reduction of seroma complication in breast cancer patients. Biomed Res 2018; 29:2342–2346.

10 Khater A, Elnahas W, Roshdy S. Evaluation of the quilting technique for reduction of postmastectomy seroma: a randomized controlled study. Int J Breast Cancer 2015 287398.

11 van Bastelaar J, Beckers A, Snoeijs M, Beets G, Vissers Y. Flap fixation reduces seroma in patients undergoing mastectomy: a significant implication for clinical practice. World J Surg Oncol 2016; 14:66.

12 Van Bastelaar J, van Roozendaal L, Granzier R, Beets G, Vissers Y. A systematic review of flap fixation techniques in reducing seroma formation and its sequelae after mastectomy. Breast Cancer Res Treat 2018; 167:409–416.

13 Coveney EC, O'Dwyer PJ, Geraghty JG, O'Higgins NJ. Effect of closing dead space on seroma formation after mastectomy-a prospective randomized clinical trial. Eur J Surg Oncol J Eur Soc Surg Oncol Br Assoc Surg Oncol 1993; 19:143–146.

14 Aitken DR, Minton JP. Complications associated with mastectomy. Surg Clin North Am 1983; 63:1331–1352.

15 Hamy A, Bouchot-Hermouet FB, Bouchot O, Drianno JC, Guillard Y. Wadding of the axilla in the conservative treatment of cancer of the breast. Prevention of lymphocele. J Chir (Paris) 1990; 127:99–102.

16 Chilson TR, Chan FD, Lonser RR, Wu TM, Aitken DR. Seroma prevention after modified radical mastectomy. Am Surg 1992; 58:750–754.

17 Schuijtvlot M, Sahu AK, Cawthorn SJ. A prospective audit of the use of a buttress suture to reduce seroma formation following axillary node dissection without drains. Breast 2002; 11:94–96.

18 Benjasirichai V, Piyapant A, Pokawattana C, Dowreang J. Reducing postoperative seroma by closing of axillary space. J Med Assoc Thai 2007; 90:2321–2325.

19 Ten Wolde B, Van Den Wildenberg FJH, Keemers-Gels ME, Polat F, Strobbe LJA. Quilting prevents seroma formation following breast cancer surgery: closing the dead space by quilting prevents seroma following axillary lymph node dissection and mastectomy. Ann Surg Oncol 2014; 21:802–807.

20 Kuroi K, Shimozuma K, Taguchi T, Imai H, Yamashiro H, Ohsumi S, Saito S. Effect of mechanical closure of dead space on seroma formation after breast surgery: review article. Breast Cancer 2006; 13:260–265.

21 Lindsey WH, Masterson TM, Spotnitz WD, Wilhelm MC, Morgan RF. Seroma prevention using fibrin glue in a rat mastectomy model. Arch Surg 1990; 125:305–307.

22 Ranisavljević M, Selaković V, Lukić D, Radovanović Z, Vicko F. Impact of neoadjuvant chemotherapy on wound complications after breast surgery. Arch Oncol 2013; 21:105–108.