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Systematic Review

Systematic review and meta-analysis of the use of quilting to prevent seroma formation after mastectomy

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Objective: Mastectomy is still a rational option for many women with breast cancer. However, the extensive dissection will lead to a large dead space beneath the flap that hampers the adherence to the tissue bed, which increase the seroma rate. Including flap quilting, several surgical techniques have been used to obliterate the dead space. However, there are conflicting results in the effectiveness at reducing the incidence of seroma. This meta-analysis was conducted to better assess the role of the use of quilting in seroma formation after mastectomy. *Data sources, methods of study selection*: An extensive literature search was performed in the PubMed, Embase and Cochrane databases. Pooled Odds ratio (OR) with 95% confidence intervals (CI) was analyzed. *Tabulation, integration and results*: A total of 8 trials involving 984 patients were included. Flap quilting showed seroma rate benefit of 20.1% vs 38.4% (OR 0.24, 95% CI 0.10–0.59, $p = 0.002$). *Conclusion*: Quilting significantly decreased the seroma rate in patients with breast cancer undergone mastectomy, and flap quilting is a valuable option for patients.

Keywords

Breast cancer; Mastectomy; Seroma; Quilting

1. Introduction

Breast cancer remains the commonest malignancy tumor among women in many advanced countries. At present, mastectomy is still a rational option for many women with breast cancer, which is no longer a standard treatment but reserved for specific subgroups [1]. However, the extensive dissection will lead to a large dead space beneath the flap that hampers the adherence to the tissue bed, which increase the seroma rate [2–4].

Although seroma is one of the commonest complications for patients undergone mastectomy, it can result in significant morbidity such as wound haematoma, wound infection, wound dehiscence, delayed wound healing, flap necrosis, prolonged hospitalization, delayed recovery and initiation of adjuvant therapy [5]. Therefore, decreasing lower seroma rate remains a goal for us. Including flap quilting, several surgical techniques have been used to obliterate the dead space [6]. However, based on the existing data of several trials [7–19], there are conflicting results in the effectiveness at reducing the incidence of seroma.

To provide up-to-date evidence on this controversial topic, this systematic review and meta-analysis of randomized controlled trials (RCTs) have been conducted in order to better assess the role of the use of quilting in seroma formation after mastectomy.

2. Methods

2.1 Searching strategy

A systematic search of literature was carried out in the PubMed, Embase and Cochrane databases without any restriction on language or publication year. The search syntax was tailored individually for each database but included the following main Medical Subject Headings (MeSH) and text words: 'Surgical Flaps', 'Island Flaps', 'Pedicled Flap', 'Mastectomy', 'Simple Mastectomy', 'Total Mastectomy', 'Subcutaneous Mastectomy', 'Radical Mastectomy', 'Halsted Mastectomy', 'Meyer Mastectomy', 'Extended Radical Mastectomy', 'Modified Radical Mastectomy', 'Modified Mastectomy', 'Patey Mastectomy', 'Prophylactic Mastectomy', 'seroma', and 'Seromas'.

2.2 Inclusion and exclusion criteria

Studies included in the meta-analysis met the following criteria: (1) randomized controlled trials (RCTs) including two or more treatment groups of quilting and non-quilting; (2) Adult (18 years and above) breast cancer patients; (3) had seroma formation as outcomes. Studies excluded from the meta-analysis had the following criteria: (1) patients with application of fibrin sealant; (2) breast conserving surgery; (3) patients with immediate breast reconstruction; (4) studies with incomplete data; (5) from repeated publication of studies, we took the latest, with the most complete data.

Two authors independently conducted citations search and identified trials that met the inclusion criteria. In cases of disagreement, discrepancies were resolved by consensus.

2.3 Data extraction

Two authors independently extracted the data from each study using predefined data extraction sheet to obtain the following information: (1) baseline demographics: author and year of publication; (2) characteristics of the study, including

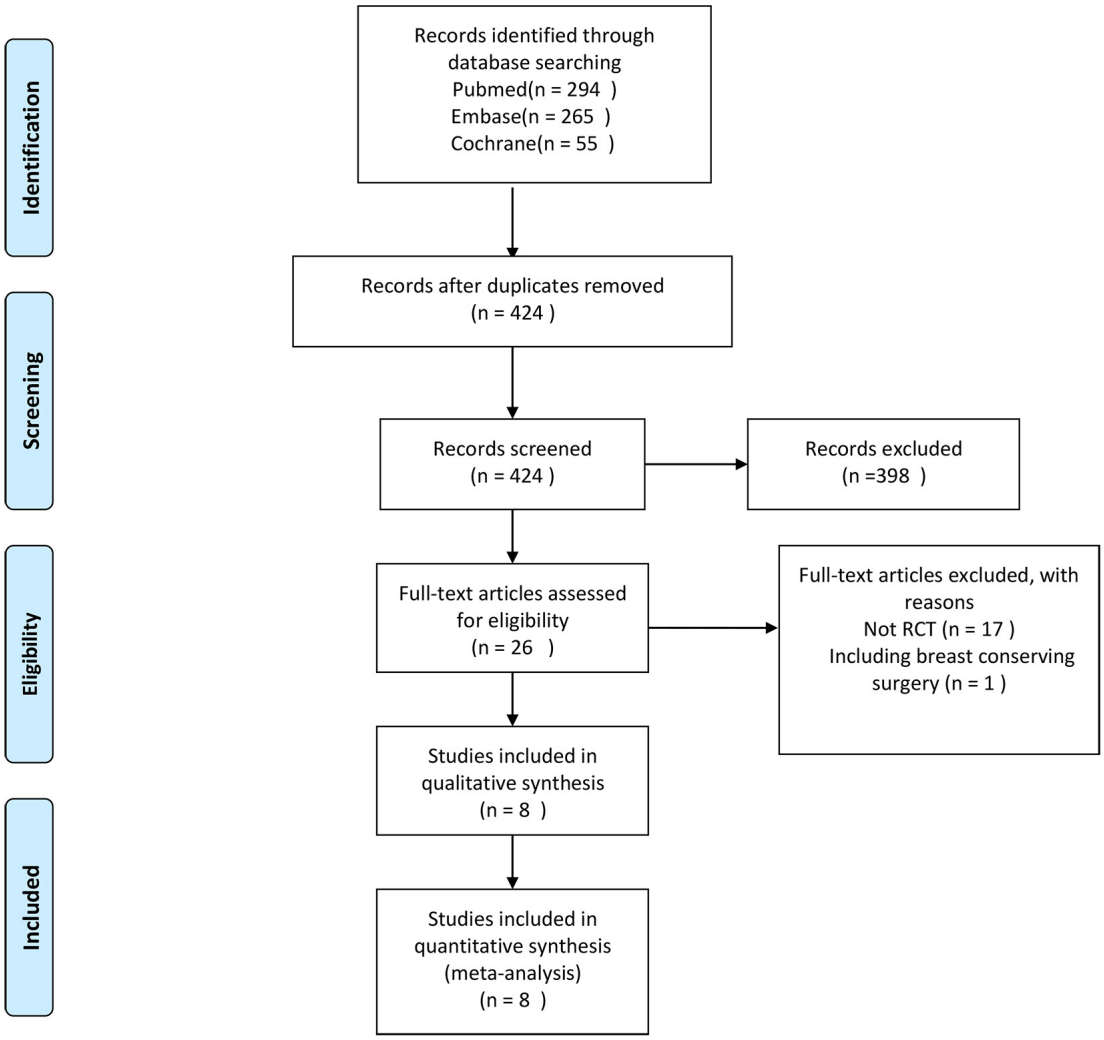

Fig. 1. Flow-chart of the literature search.

the number of patients in each group, the suture thread, the technique of closing dead space, the number of drains used in the study group and the time of drain removal in the study group.

2.4 Risk of bias assessment

The methodological quality of each study was assessed independently by two researchers according to the Cochrane Collaboration bias assessment tool for systematic review of interventions. Selection bias, performance bias, detection bias, attrition bias, reporting bias and other bias were evaluated. The risk of bias was stratified into three levels, consisting of high risk, low risk and unclear.

2.5 Publication biases

To evaluate the degree of potential publication bias, funnel plots was performed. It was measured with Begg's test in Stata version 15.1 software (Stata, College Station, TX, USA). p value of <0.05 was deemed to be statistically significant.

2.6 Statistical analysis

Data management and statistical analysis were performed via Review Manage (Version 5.3.5; the Cochrane Collaboration, Oxford, UK). We used the analytical statistics of odds ratio (OR) and 95% confidence interval (CI) to determine the effect size. In addition, a Chi squared-based Q statistic test was used to assess heterogeneity of treatment effect. When the p value was more than 0.10 in the Q-test, the fixed-effect model was applied. If not, the random-effect model was performed. $p < 0.05$ was considered statistically significant. To estimate the influence of individual trials on the overall effect, sensitivity analyses were used.

3. Result

3.1 Searching result

Based on the predefined search strategy, a total of 8 trials involving 984 patients were included in the meta-analysis. The flow diagram of the literature retrieval and selection is shown in Fig. 1. The general characteristics of the 8 eligible trials are shown in Table 1 (Ref. [8–10, 15–19]).

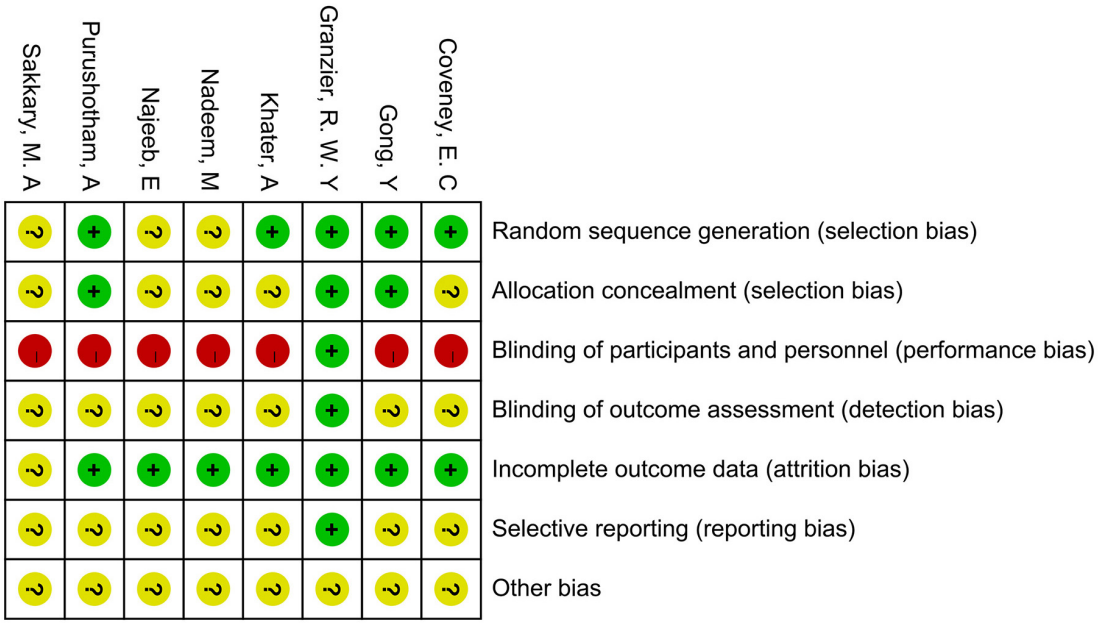

Fig. 2. Quality assessment for risk of bias.

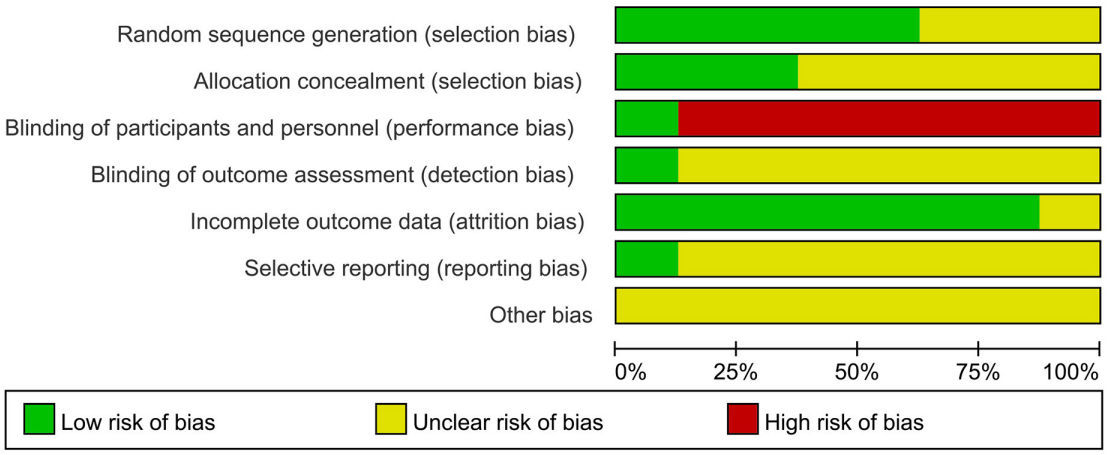

Fig. 3. Graphs of risk of bias.

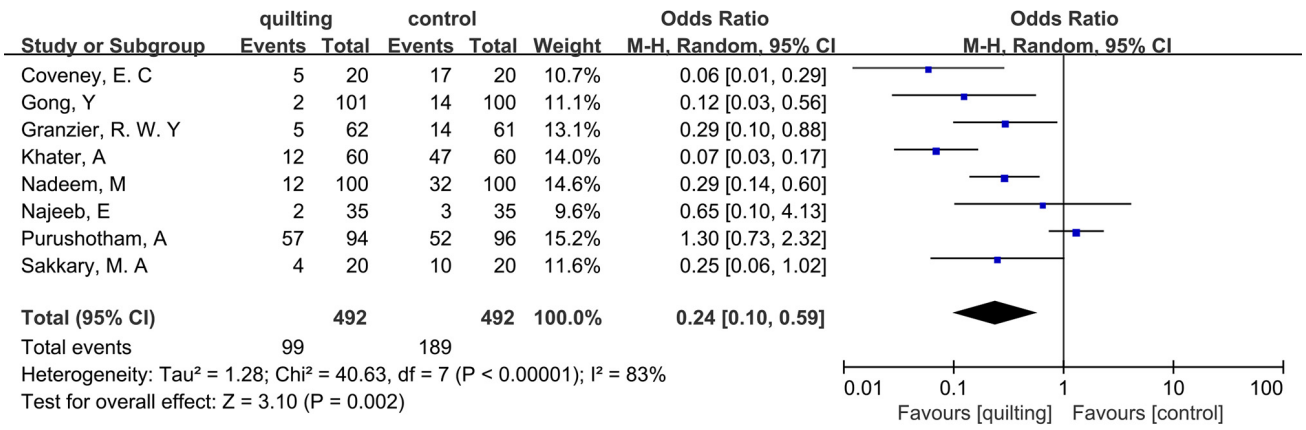

Fig. 4. Odds ratio for seroma formation of quilting versus no-quilting following mastectomy.

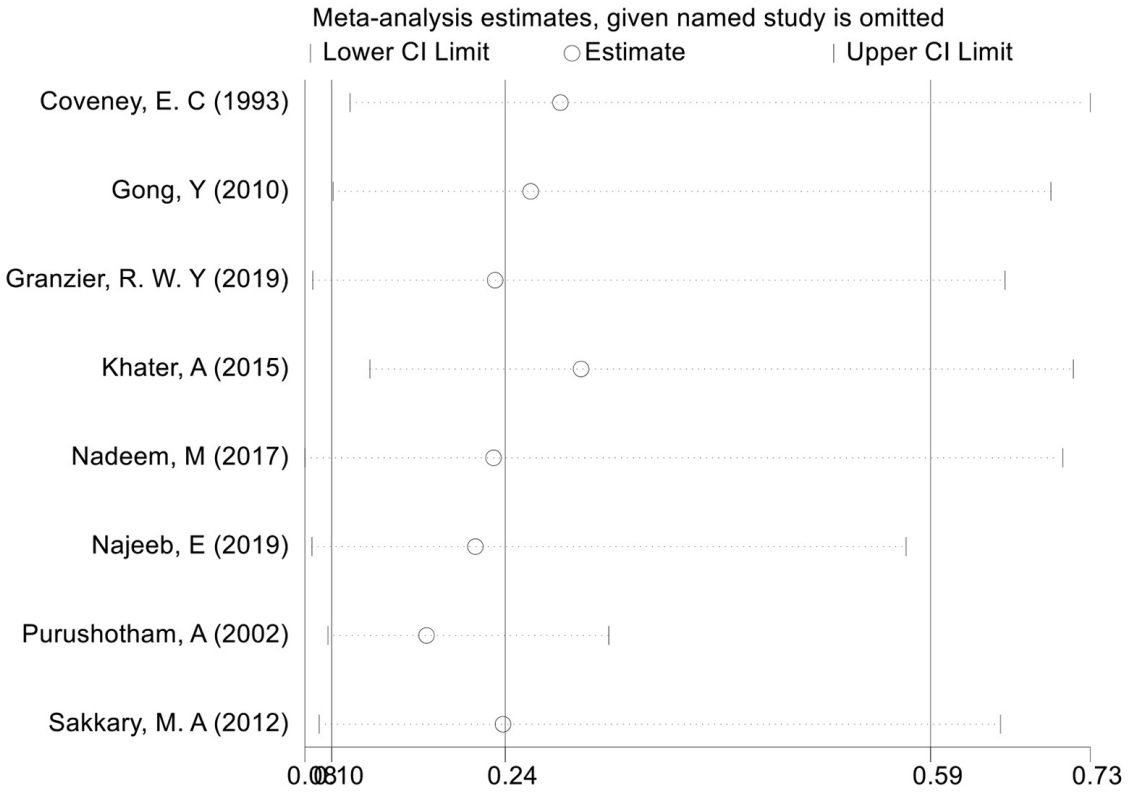

Fig. 5. Forest plot for sensitivity analysis (random effects model with 95% confidence interval).

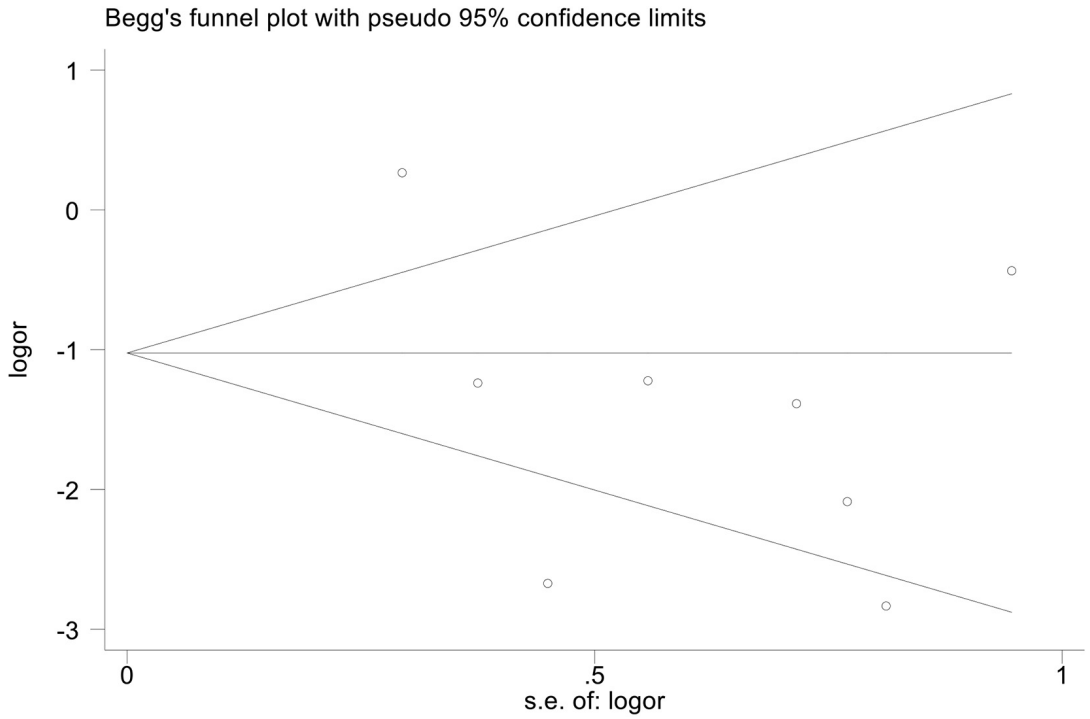

Fig. 6. Funnel plots for publication bias.

Table 1. Characteristics of eligible studies considered in this meta-analysis.

Characteristic	Coveney, E. C [19]	Gong, Y [18]	Granzier, R. W. Y [10]	Khater, A [15]	Nadeem, M [16]	Najeeb, E [8]	Purushotham, A [9]	Sakkary, M. A [17]
Year	1993	2010	2019	2015	2017	2019	2002	2012
Quilting sample size	20	101	62	60	100	35	94	20
Control sample size	20	100	61	60	100	35	96	20
Suture thread	Interrupted 2/0 polyglactin 910 (vicryl, Ethicon, UK)	4–6 and 15 vicryl sutures	Absorbable polyfilament sutures (Vicryl 3.0)	Vicryl 2/0 suture	-	Absorbable braided suture (vicryl 3/0)	Multiple rows of 3/0 undyed vicryl sutures (Ethicon, Edinburgh, UK)	Absorbable sutures (vicryl 3/0)
Technique of closingdead space	Skin flaps were sutured to underlying muscle in the line of wound closure	Fixing anterior edge of the latissimus dorsi muscles to chest wall and skin flap to the underlying muscle	The flap were sutured to the pectoral muscle	The flap were sutured to the pectoral fascia and the serratus anterior fascia	The flap were sutured to the underlying muscles	The flap were sutured to the pectoral fascia or pectoralis major muscle	The flap were sutured to the underlying pectoralis major and serratus anterior muscles	The flap were sutured to the underlying muscles
Number of drain used in the study group	Two drains, one in the axilla and one beneath the pectoral skin flaps	One drain was inserted lateral axilla	One drain was placed lateral to the pectoral muscle	One drain was inserted in the axilla	Two drains, one in the axilla and one beneath the skin flap	Two drains, one in the axilla and one beneath the skin flap	None	Unclear
Time of drain removal in the study group	Drainage were left *in situ* for 72 hours	Removed when the output was less than 20 mL in 24 hours	Removed when the output was less than 50 mL in 24 hours or after a maximum of five days and 48 h for patients with axillary clearance and without axillary clearance respectively	Removed when the output was less than 50 mL in 24 hours	Removed when the output was less than 50 mL in 24 hours	Removed when the output was less than 50 mL in 24 hours	-	Removed when the output was less than 50 mL in 24 hours or the drained fluid started to become infected

For the Granzier, R. W. Y study [10], it involved three groups. Meanwhile, Purushotham, a study was designed as two parallel randomized controlled trials following the same protocol, one for women undergoing mastectomy and one for women undergoing breast-conserving surgery [9]. Only the data of the qualified groups were extracted and deemed to be a separate study in the final calculation

3.2 Quality assessment

As shown in Fig. 2, we found that all studies randomly assigned patients to the treatment groups, and five studies involved the definite randomization methods [9, 10, 15, 18, 19]. Seven of the eight RCTs were open label, and only one study claimed that it was blinding for participants and personnel throughout the study course [10]. Only one study had registration information [10]. Taken together, these characteristics suggested moderate risks of study design bias (Fig. 3).

3.3 Seroma formation

Overall, including all the eight RCTs, 288 of 984 (29.3%) patients underwent seroma after mastectomy, 99 of 492 (20.1%) patients in the quilting group and 189 of 492 (38.4%) patients in the control group. As shown in Fig. 4, a significant statistically difference was observed (OR 0.24, 95% CI 0.10–0.59, $p = 0.002$). Studies have high heterogeneity ($I^2 = 83\%$, $p < 0.001$) and evaluation with random effects model was done.

3.4 Sensitivity analysis

The sensitivity analysis was performed by omitting each study at a time. As shown in Fig. 5, the result demonstrated a stability of pooled OR estimates.

3.5 Publication bias

As shown in Fig. 6, no publication bias was detected by funnel plot (Begg's test, $p = 0.711$).

4. Discussion

In order to appraise the role of the use of quilting in seroma formation after mastectomy, we conducted a systemic review and meta-analysis between flap quilting and conventional wound closure. Our results demonstrated that quilting significantly decreased the seroma rate.

Seroma formation after mastectomy is still a persistent problem much to the annoyance of surgeon and patient alike, despite advances in surgical techniques and haemostasis. However, the pathogenesis of seroma has not been fully illuminated [20]. Extensive dissection and the dead space beneath the flap in mastectomy are very important for seroma [11, 21]. Several preliminary or retrospective studies [6, 22–24], and prospective studies [14, 25–27], as well as RCTs [12], have revealed it useful to close the dead space and reduce seroma formation by securing the flaps to the chest wall with sutures. Likewise, our meta-analysis revealed that breast cancer patients undergone mastectomy would benefit from the flap quilting. A significant absolute 18.3% decreased the seroma rate was observed with the use of quilting (OR 0.24, 95% CI 0.10–0.59, $p = 0.002$).

Unlike our study, Almond LM found that flap quilting had no statistically significant effect on reducing frequency of seroma formation [7]. However, unlike the previous trial, suction drains were used both in the experimental groups and the control groups during seven of the eight RCTs. Additionally, the sample size in our study was larger. These differences may account for the different results.

However, this study had some limitations that should be discussed. First, the number of included patients was not large enough. Second, seven studies included in this meta-analysis were open label. Third, other techniques, such as tissue dissection techniques and external compression dressing, which were also very important to the seroma formation, have not been evaluated in our study. So future researches should pay more attention to the designs of RCTs, such as enough sample size, strictly blind and allocation concealment to ensure balance between intervention groups and to prevent potential selective bias.

5. Conclusions

In conclusion, our results strongly suggest that quilting significantly decreased the seroma rate in patients with breast cancer undergone mastectomy, and flap quilting is a valuable option for patients.

Author contributions

ZYL and YF designed the study, YLD and SHW conducted the selection of relevant studies and data extraction separately, ZZ and XZC evaluated the quality of each study independently, YLD and SHW performed the statistical analysis. ZZ and XZC drafted the manuscript. ZYL and YF contributed to the interpretation of the results and critically reviewed the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Not applicable.

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Conflict of interest

The authors declare no conflict of interest.

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