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Original Article

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

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Abstract: Background: Although there is plentiful evidence favoring the fixation of the skin flaps to the underlying muscles (quilting) to prevent seroma formation after axillary lymph node dissection (ALND), there is a paucity of study concerning its treatment effect. Several randomized controlled trials (RCTs) demonstrated quilting group did not require significantly more operative time than no-quilting group though more studies were against it. Methods: RCTs comparing quilting with no-quilting for prevention of seroma formation after ALND were searched. Results: Eight prospective RCTs were included in the meta-analysis. Compared with no-quilting group, quilting after ALND significantly decreased seroma rate, total amount of fluid drained and duration of drain placed, but performed no significant difference in the operative time, postoperative complication, assessment of shoulder function and psychological morbidity. Conclusion: The current evidence supports the use of quilting to prevent seroma formation and quilting may be an alternative to closed suction drain after ALND. Quilting did not require additional operative time that was an important obstruct for surgeons to perform dead space closure.

Keywords: Axillary dissection, flap fixation, breast cancer, seroma

Introduction

Breast cancer remains the commonest malignancy tumor among women in many advanced countries [1, 2], which has been listed the second leading cause of death next to lung cancer in USA [3]. Many women with breast cancer would receive excision of the primary tumor by mastectomy or wide local excision with ALND [4], which is no longer a standard treatment but reserved for specific subgroups of node positive patients. However, the extensive axillary dissection will result in a large dead space beneath the flap that makes it difficult for flaps to adhere, which increase the seroma rate [5].

Following surgical excision, conventional surgical method involving insertion of suction drains deep to mastectomy flaps and in the axilla but no obliteration of the dead space is widely performed with the purpose of reducing seroma after breast cancer surgery [6]. The drain is generally removed when the volume of seroma has decreased to less than 30-50 ml within 24 h, when discharge from hospital is usual [7]. The length of postoperative hospital stay is one of the most important factors associated with the cost of medical care after breast cancer surgery [7, 8], and the use of a drain is one of the biggest obstacles for early discharge from hospital [9]. Despite the use of suction drains, seroma requiring aspiration still occur following drain removal in more than half of patients undergone axillary dissection [10].

In 1913, Halsted [11] first advocated fixation of the skin flaps to the deep structures at the edge to cover the contents of the axilla, obliterating dead space under the clavicle. With advances in technology, several studies introduced subcutaneous suture fixation [12, 13], absorbable material [14], axillary padding [15-17] and other similar techniques [4, 18-22] to cover the shortage of flap fixation. Axillary flap fixation had a relatively more consistent success in this regard, but had not gained widespread acceptance, possibly because of additional effort and operative time required [12, 14, 18]. However,

It was reported in some studies that quilting did not require more operative time [9, 24] and had no significantly different effect on seroma prevention [23, 24] compared with conventional method.

The purpose of the meta-analysis is to systematically review the efficacy and the operation time of quilting versus conventional method following ALND in breast cancer patients.

Methods

Search strategy

RCTs comparing quilting with no-quilting for seroma prevention after ALND were retrieved from Medline, Embase, Cochrane Library database and Chinese Biological Medline using the terms "breast cancer", "mastectomy", "suturing method", "suture", "cancer surgery", "surgical technique", "seroma", "postoperative complication" (exploded Emtree terms for Medline and Embase) and "breast neoplasms", "Drainage", "lymph node excision", "Mastectomy", "surgical flaps", "postoperative complication", "seroma" (exploded Mesh terms for cochrane library) and "breast cancer", "breast neoplas*", "breast carcinoma*", "breast tumor*", "mastectomy", "lumpectomy", "breast preserving surgery", "breast conserving surgery", "ALND", "MRM", "BCS", "BCT", "axillary dissection", "axillary clearance", "axillary lymphadenectomy", "drain*", "sutur*", "quilt*", "dead space clos*", "dead space obliterat*", "seroma*", "hospital stay", "complication" (free text terms in title/abstract/keywords) in combination with the Boolean operators AND or OR.

Selection criteria

All abstracts identified by the search strategy were screened manually by two authors (Dezhi Chen, Zonghuan Li) and full-text articles were then reviewed for closer examination. Studies were included if: 1) The study was a prospective RCT (randomization method was appropriate or was unclear but mentioned randomization in the article). 2) Patients with breast cancer in both groups received ALND during operation. 3) Study reports the efficacy of quilting with or without additional procedures versus no-quilting (conventional method, inserting suction drains deep to mastectomy flaps or in the axilla but not to obliterate the dead space). 4) Studies containing two or more comparative arms were included if the results for quilting and conventional method were separately reported. Patients with application of fibrin sealant, immediate breast reconstruction, quilting in other sites were excluded.

Data extraction

Data were independently extracted by two investigators (Dezhi Chen, Jian Song) from the articles and checked by the other authors. Discrepancies were resolved by consensus.

Surgical outcome endpoint, general study information, characteristics of the study, baseline characteristics of the patient and definition of outcome measurement will be extracted from each eligible study. Median presented in the article was estimated to mean value and range or inter-quartile range in the value of variable was used to calculate standard deviation (S.D) [25, 26] if the sample size was large enough. For studies that separately provided data for mastectomy and wide local excision with axillary dissection, a pooled estimate of two was used to calculate overall mean and standard deviation [26]. Data for continuous outcome were not extracted in the meta-analysis if standard deviations or standard errors of mean were not reported or could not been calculated. All data were extracted from the studies using a data extraction form.

Assessment of risk of bias

Two reviewers (Dezhi Chen, Zonghuan Li) independently assessed the risk of bias according to guidelines of the Cochrane collaboration [26]. Six terms have been considered relevant including random sequence generation, allocation concealment, baseline characteristic, eligibility criteria, description of loss to follow-up and drop-out, intention-to-treat analysis. Studies with one or two negative answers were regarded at a moderate risk of bias and studies with three or more negative answers were qualified at high risk of bias.

Statistical analysis

Statistical studies were conducted using Revman 5.3 provided by the cochrane collaboration. Pooled odds radio (OR) with 95% confidence interval (CI) was calculated for dichotomous outcomes including incidence of seroma, incidence of postoperative complication, and

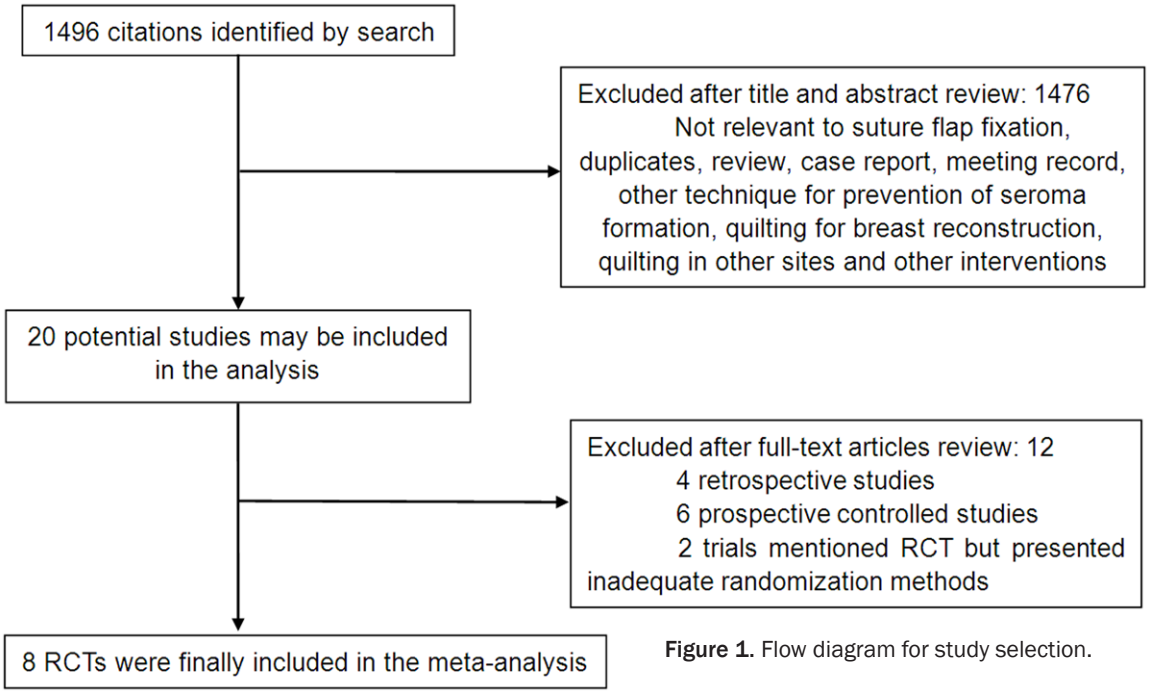

Figure 1. Flow diagram for study selection.

mean difference (MD) was calculated for continuous outcomes including total amount of fluid drained, duration of drain placed, total volume of aspiration, mean time of surgery and length of hospital stay. We performed std. mean difference (SMD) for postoperative abduction of shoulder when there was a large difference of definitions. We performed the random-effects model in the procedure of all statistical studies [27]. A *P* value of <0.05 was considered statistically significant.

The Q statistic and I^2 value were used to assess heterogeneity of treatment effect. A *P* value of <0.05 and I^2 value of >50% were used to indicate the presence of significant heterogeneity. Two subgroup analysis were performed to determine whether effect sizes varied based on number of closed suction drains applied in the study group (with or without a drain) and whether lymph vessel ligation was undergone in the study group (with or without lymph vessel ligation). We conducted a sensitivity analysis by excluding the study that was estimated to be high risk of bias and the rest were analyzed to evaluate whether the results were affected significantly. Otherwise, we presented a narrative synthesis when the surgical outcome was important to analyse but relevant data was inappropriate to combine.

Results

Description of eligible trials

Figure 1 shows the flow chart of studies retrieved and excluded. We searched 1496 potentially relevant articles from the published literature or the database. 1476 articles were excluded after screening title and abstract, and the remaining were analysed after reading the full text. Finally, 8 RCTs were determined to be eligible and were included in this meta-analysis.

Table 1 summarises the characteristics of included RCTs. Eight RCTs involving 947 cases in 946 patients met inclusion criteria. Of them, 470 patients were randomly assigned to the controlled group. The eight RCTs except one trial [24] indicated no significant difference in baseline.

Table 2 summaries detailed surgical technique and postoperative management. Most type of the surgery was modified radical mastectomy (MRM) combined with ALND. For patients in the study group, no drain was performed in two trials [4, 9] and one or more drains were performed in six trials [18, 23-25, 29, 30]. Definitions of outcomes in the eight RCTs were listed in **Table 3**.

Table 1. Characteristics of included randomized controlled trials in the meta-analysis

Study, year	Country	Study period	Number of patients			Mean age			Mean BMI			Mean number of lymph node removed		
			QG	NQG	*P* value	QG	NQG	*P* value	QG	NQG	*P* value	QG	NQG	*P* value
Sakkary [20], 2012	Egypt	June 2009-July 2010	20	20	NS	51	54	NS	-	-	-	18.9	20.8	NS
George [23], 2011	India	January 2006-June 2007	40	40	NS	-	-	-	-	-	-	16.36	15.85	NS
Gong [29], 2009	China	January 2007-December 2008	101	100	NS	49.83	50.63	NS	21.70	22.08	NS	15.45	14.06	NS
Benjasirichai [24], 2007	Thailand	May 2005-May 2006	8	8	NS	61.5	47.75	P<0.05	24.37	21.71	NS	-	-	-
Purushotham [4], 2002	Britain	-	185	190	NS	57.7	57.6	NS	-	-	-	-	-	-
Seenivasagam [30], 2013	India	July 2007-October 2009	49	48	NS	48	50	NS	24.8	25.4	NS	-	-	-
Classe [9], 2006	France	May 2001-August 2003	47	51	NS	60	58	NS	25	25	NS	-	-	-
Coveney [18], 1993	Ireland	-	20	20	NS	56	57	NS	-	-	-	16	19	NS

NS, not significant; -, data not available; QG, quilting group; NQG, no-quilting group; BMI, body mass index.

Table 2. Details of surgical technique and postoperative management in the eight RCTs

Study, year	Type of surgery	Suture thread	Technique of closing dead space	Number of drain used in the study group	Other surgical technique	External compression dressing	Shoulder movement
Sakkary [20], 2012	MRM, ALND	Absorbable sutures (vicryl 3/0)	Suturing tissues of the skin flaps to the underlying muscles at various parts of the flap and wound edge	One or more than one drain were applied	-	-	-
George [23], 2011	MRM, ALND	Interupted polyglacting sutures	Approximating the axillary skin flap to the underlying muscle on the lateral chest wall	Two drains, one was placed in the axilla and the second was placed below the superior flap pointing towards the axilla	-	Provided over the axilla for 72 hrs	Encouraged to do passive and active shoulder exercises from the first postoperative day
Gong [29], 2009	MRM, ALND	4-6 and 15 vicryl sutures	Fixing anterior edge of the latissimus dorsi muscles to chest wall and skin flap to the underlying muscle	One suction drain was inserted lateral axilla	Lymph vessel ligation	Provided over the axilla for the first 3 postoperative days	Encouraged to do active and passive shoulder exercises
Benjasirichai [24], 2007	MRM, ALND	Polyglacin (vicryl) 3-0	Suturing the skin flap to underlying muscle 3 points at mid axillary line	Two closed suction drains at the mastectomy site and axillary fossa	-	-	-
Purushotham [4], 2002	Mastectomy or BCS, ALND	Multiple rows of 3/0 undyed vicryl sutures (Ethicon, Edinburgh, UK)	The flap were sutured to the underlying pectoralis major and serratus anterior muscles	None	-	-	-
Seenivasagam [3], 2013	MRM, BCS, ALND	Multiple parallel rows of 2-0 vicryl sutures (Ethicon, Johnson and Johnson Ltd.)	Flaps were sutured to the underlying pectoralis major and serratus anterior muscles for mastectomy and axillary dissection flaps	Two drains were placed under the flaps and the axilla after MRM, but only one drain in the axilla after BCS	-	Wounds were dressed with standard dressing	Active shoulder movements were restricted for 1 week after the surgery
Classe [9], 2006	BCS, ALND	Three separate sutures	Suturing the edges of the axillary fascia to local muscles (axillary padding)	None	-	-	-
Coveney [18], 1993	Mastectomy, ALND	Interrupted 2/0 polyglactin 910 (vicryl, Ethicon, UK)	Skin flaps were sutured to underlying muscle in the line of wound closure	Two drains, one in the axilla and one beneath the pectoral skin flaps	-	A light dressing was applied	Commenced on the first postoperative day under the supervision of one physiotherapist

MRM, modified radical mastectomy; BCS, breast-conserving surgery; ALND, axillary lymph node dissection; -, not reported in the article.

Table 3. Definition of surgical outcomes in the eight RCTs

Study, year	Seroma	Time of drain removal in the study group	Time of surgery	Postoperative complication	Assessment of shoulder function
Sakkary [20], 2012	Presence of any collections via check of local chest wall ultrasound 2 weeks after removal of drains	The amount becomes less than 50 cc, or the drained fluid started to become infected	-	-	-
George [23], 2011	-	The amount was less than 20 ml	-	-	-
Gong [29], 2009	Defined as a fluid collection via palpation on clinical examination	Removed when the output was less than 20 ml in 24 hours	The time from onset of surgery to the end of wound closure	Flap necrosis: any visible necrosis along the edge of the wound Infection: any wound appearance that required antibiotic treatment	-
Benjasirichai [24], 2007	-	Removed when the lymphatic content was less than 30 cc/day for each drain	-	-	-
Purushotham [4], 2002	-	-	-	Recorded using the APEPSIS score	Abduction of shoulder: the reduction of angle from baseline to several postoperative periods
Seenivasagam [30], 2013	Any palpable fluid collection in the axilla after drain removal (sysptomatic or asymptomatic)	One subgroup (the data was extracted in our meta-analysis): removal of drain after the drain output was 20-30 ml/Another subgroup: 24 hours or after 7 days of surgery irrespective of drain output	-	-	-
Classe [9], 2006	A palpable fluid accumulation causing discomfort and needing aspiration	-	-	Wound infection: an inflamed wound with pyrexia and positive microbiology that needed antibiotic treatment	Evaluation of shoulder movement: defined by the score of Constant and Murley several times after surgery
Coveney [18], 1993	-	Drainage were left in situ for 72 h	-	-	Abduction of shoulder: a functional range of shoulder motion attained at six months after surgery

-, data not available.

Table 4. Assessment of the risk of bias for the eight trials

Study, year	Randomization method (whether it was appropriate)	Allocation concealment	Homogeneous baseline characteristic	Eligibility criteria	Loss to follow-up and drop-out described	Intention-To-Treat analysis	Score
Sakkary [20], 2012	Unclear	Unclear	Yes	Yes	No participant absent	Not needed	Moderate risk
George [23], 2011	Computer generated randomization table (Yes)	Unclear	Yes	Yes	No participant absent	Not needed	Moderate risk
Gong [29], 2009	Unclear	Randomly ordered sealed envelop	Yes	Yes	No participant absent	Not needed	Moderate risk
Benjasirichai [24], 2007	Unclear	Unclear	No	Yes	No	No	High risk
Purushotham [4], 2002	Randomly chosen block sizes of four and six (Yes)	Consecutively numbered opaque envelopes	Yes	Yes	Yes	Yes	Low risk
Seenivasagam [30], 2013	Computer pregenerated randomization list, Block randomization in blocks of six (Yes)	Unclear	Yes	Yes	Yes	No	Moderate risk
Classe [9], 2006	Blocks of six (Yes)	Unclear	Yes	Yes	Yes	Yes	Moderate risk
Coveney [18], 1993	Random table numbers (Yes)	Unclear	Yes	Yes	No participant absent	Not needed	Moderate risk

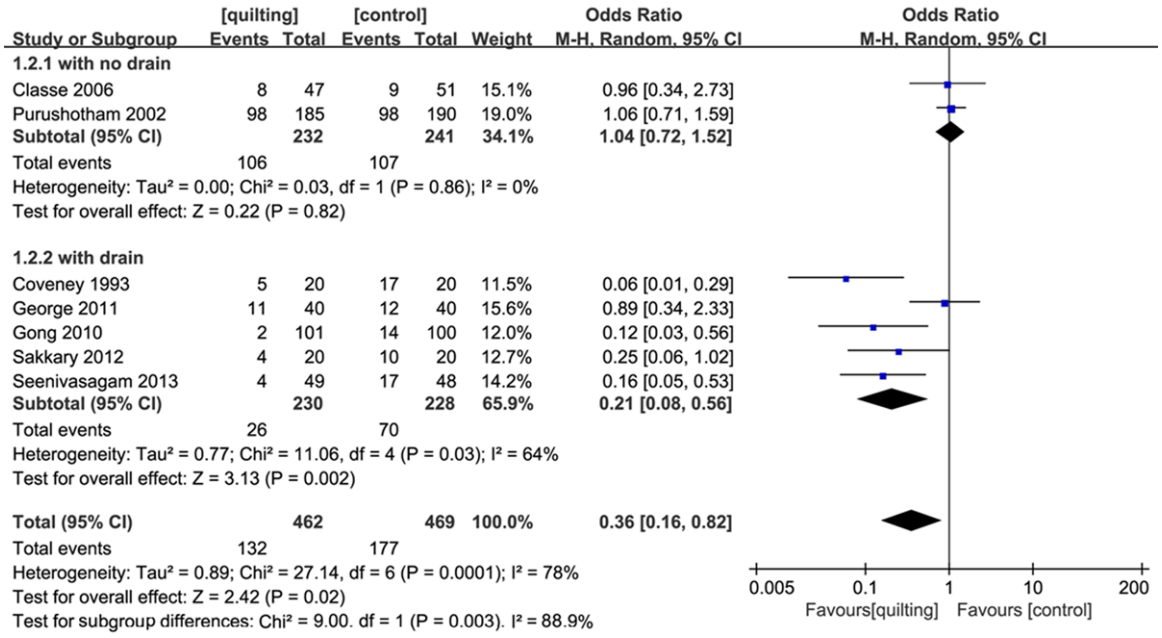

Figure 2. Forest plot for seroma formation of quilting versus no-quilting following axillary dissection. Odds ratios are shown with 95 per cent confidence intervals.

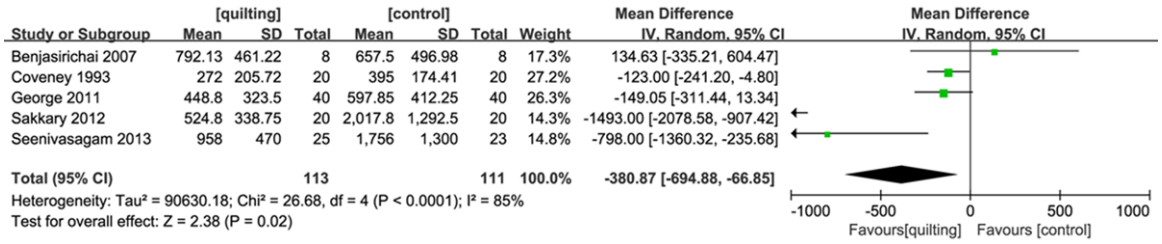

Figure 3. Forest plot for the total amount of fluid drained of quilting versus no-quilting following axillary dissection. Mean differences are shown with 95 per cent confidence intervals.

Quality of eligible trials

There was good agreement between the reviewers (Dezhi Chen, Zonghuan Li) about the selection criteria and quality assessment of the studies. **Table 4** lists assessment of the quality for the eight trials included.

In eight trials, five trials performed appropriate randomization by randomization table or block randomization. Adequate allocation concealment was applied in only two trails and the baseline characteristics were similar between two groups in all but one trial. All RCTs specified the eligibility criteria for patients to be enrolled in. Four studies except one specified numbers of loss to follow-up and drop-out in each group and intention-to-treat (ITT) analysis was performed in two trials. Blinding was not applied in these trials because of the nature of the intervention. Of the eight studies, one trial [4] was regarded at a low risk of bias and another trial [24] with only 16 patients was considered to be at a high risk of bias.

Seroma formation

Seven of the eight trials involving 930 patients reported data for the incidence of seroma except one trial [24] offered the data of thickness of seroma at axilla that could not be pooled to calculate. There was significant statistical heterogeneity between trials (P= 0.0001). A subgroup analysis was performed based on whether the drain was applied in the quilting group (with or without the drainage). Compared with no-quilting, quilting with drains inserted to the surgical sites significantly decreased the incidence of seroma formation (pooled OR 0.21, 95% CI, 0.08 to 0.56, P=

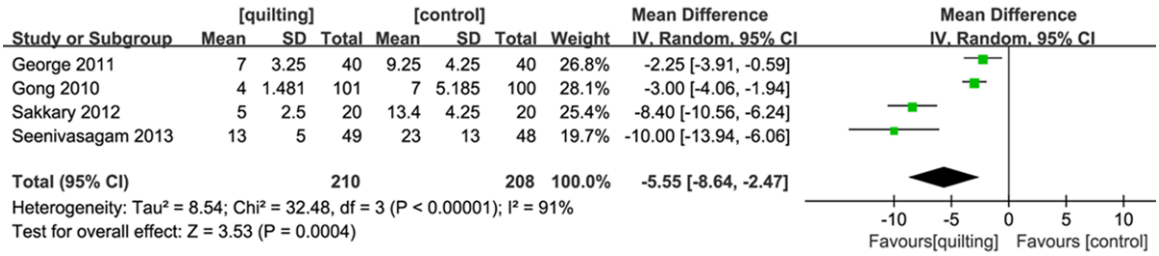

Figure 4. Forest plot for the duration of drain placed of quilting versus no-quilting following axillary dissection. Mean differences are shown with 95 per cent confidence intervals.

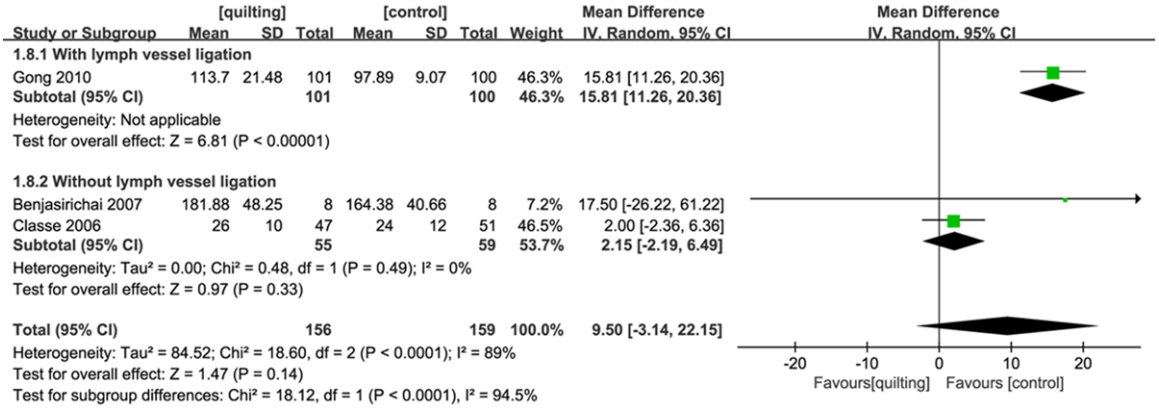

Figure 5. Forest plot for the mean time of surgery of quilting versus no-quilting following axillary dissection. Mean differences are shown with 95 per cent confidence intervals.

0.002) and quilting with no drain used performed no significant difference (pooled OR 1.04, 95% CI, 0.72 to 1.52, P=0.82) (**Figure 2**).

Total amount of fluid drained

Five trials [18, 23, 24, 28, 30] involving 207 patients reported the data for total amount of fluid drained. In the random-effects model, quilting significantly decreased total amount of fluid drained (MD-380.87, 95% CI, -694.88 to -66.85, P=0.02). Heterogeneity of treatment effects was significant (P<0.0001). A sensitivity analysis was performed by excluding the study [24] for the high risk of bias, the conclusion was confirmed (**Figure 3**).

Duration of drain placed

Four trials [23, 28-30] involving 418 patients reported the data for duration of drain placed. In the random-effects model, quilting significantly shortened days of drain placed (MD-5.55, 95% CI, -8.64 to -2.47, P=0.0004). Heterogeneity of treatment effects was significant (P<0.00001) (**Figure 4**).

Mean time of surgery

Three trials [9, 24, 29] involving 315 patients reported the data for mean time of surgery. There was significant statistical heterogeneity between trials (P<0.0001). A subgroup analysis was performed based on whether lymph vessel ligation was applied in the quilting group (with or without lymph vessel ligation). Compared with no-quilting, quilting with lymph vessel ligation applied significantly prolonged the mean time of surgery (MD 15.81, 95% CI, 11.26 to 20.36, P<0.00001), but that without lymph vessel ligation undergone demonstrated no significant difference (MD 2.15, 95% CI, -2.19 to 6.49, P=0.33) (**Figure 5**).

Postoperative complication rate

Seven trials [4, 9, 18, 23, 24, 28, 29] involving 849 patients reported the data for postoperative complication rate. In the random-effects model, quilting did not increase the incidence of postoperative complication including flap necrosis and wound infection compared with no-quilting (pooled OR 1.16, 95% CI, 0.74 to

Figure 6. Forest plot for postoperative complication of quilting versus no-quilting following axillary dissection. Odds ratios are shown with 95 per cent confidence intervals.

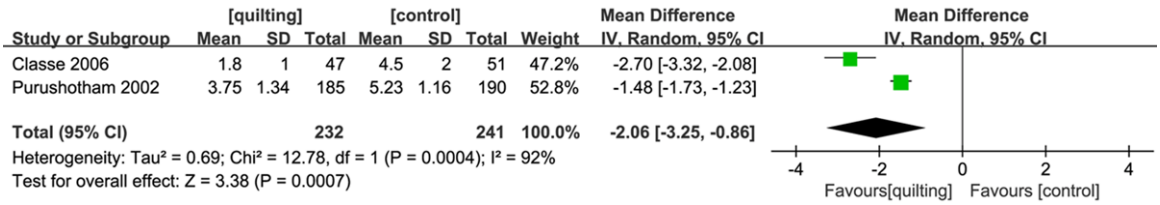

Figure 7. Forest plot for length of hospital stay of quilting versus no-quilting following axillary dissection. Mean differences are shown with 95 per cent confidence intervals.

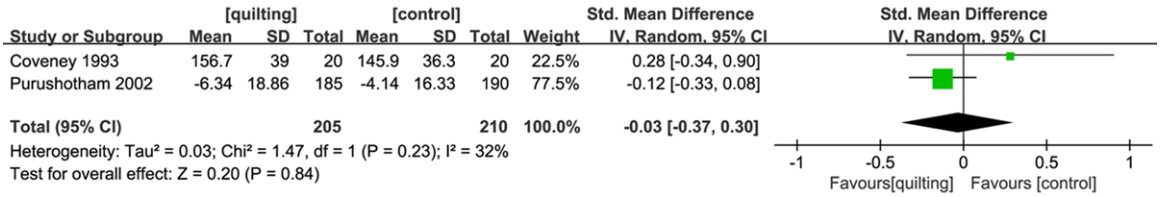

Figure 8. Forest plot for the abduction of shoulder of quilting versus no-quilting following axillary dissection. Std. mean differences are shown with 95 per cent confidence intervals.

1.80, P=0.52). Heterogeneity of treatment effects was not significant (P=0.74) (**Figure 6**).

Length of hospital stay

Only two [4, 9] of the eight trials involving 473 patients reported the data for length of hospital stay. They received no drain in the quilting group. In the random-effects model, quilting with no drain applied significantly promoted earlier discharge from hospital (MD-2.06, 95% CI, -3.25 to -0.86, P=0.0007). Heterogeneity of treatment effects was significant (P=0.0004) (**Figure 7**).

Assessment of shoulder function

Postoperative evaluation of shoulder function was reported in three trials. One trial [4] with 375 patients defined it as the reduction of angle from baseline to postoperative several periods and the trial [18] with 39 patients defined evaluation of shoulder abduction as a functional range of shoulder movement attained at six months after surgery. In another trial [9] with 98 patients, comprehensive assessment of shoulder function was performed several times after surgery using Constant and Murley scoring.

Postoperative abduction of shoulder was evaluated in two trials [4, 18] involving 414 patients. In the random-effects model, there was no significant statistical difference in the postoperative abduction of shoulder between two methods (SMD -0.03, 95% CI, -0.37 to 0.3, P=0.84). Heterogeneity of treatment effects was not significant (P=0.84) (**Figure 8**).

In addition, the trial [4] also demonstrated no significant difference in the degree of flexion, internal rotation and external rotation. In anoth-

er trial [9], it also demonstrated no significant difference in comprehensive assessment of shoulder function. However, it was showed in the trial [18] that quilting with drains inserted to surgical sites had a significant advantage in the elevation and external rotation over conventional method ($P<0.05$) but no significant difference in internal rotation ($P>0.05$).

Psychological morbidity

Two trials involving 473 patients reported psychological morbidity, in which one trial [9] assessed postoperative pain using a 10-point visual analogical scale (VAS) several times before and after surgery, and another trial [4] reported the result of psychological distress assessed by General Health Questionnaire (GHQ-28) several times after surgery. Both trials demonstrated no difference in the psychological morbidity ($P>0.05$).

Discussion

This meta-analysis demonstrated that quilting significantly decreased seroma rate, duration of drain placed and volume of fluid drained, and did not increase mean time of surgery, incidence of postoperative complication, risk of shoulder dysfunction and postoperative psychological morbidity.

Seroma formation is a common complication occurring after ALND. Though it is not lethal, excessive fluid accumulation usually causes patient discomfort, postoperative complications and prolongation of hospital stay. It is widely accepted to insert the drain deep to the flaps or in the axilla but not obliterate the dead space to prevent seroma formation [6]. Although many previous studies have demonstrated that quilting had larger advantage than no-quilting, many surgeons did not accept it possibly for the reason of longer operative time required [12, 14, 18]. However, this meta-analysis demonstrated no significant difference in the operative time between two groups according to the three trails [9, 24, 29] involving 315 patients.

In the present meta-analysis, use of a closed suction drain was so important a confounding variable in these trials that we analysed the results respectively based on whether the drain was used in the quilting group. We may note that quilting without drains used offered a significant benefit over drain-alone group in the length of stay but no increase of operative time, extra treatment and risk of a bad prognosis. Besides, there was no significant difference in seroma rate, assessment of shoulder function. In other words, quilting may be an alternative to closed suction drain after ALND though more studies for it were needed.

The other important outcomes to consider are medical cost and cosmetic surgery. It was sorry that no medical economics and cosmetic surgery reported in the eight trails but economic impact can be estimated by reducing hospitalization for breast cancer patients [7, 8]. That early drain removal or no drain to remove by quilting did not increase postoperative complication and requirement of extra treatment, indicating early discharge from hospital for patients received this surgical procedure. So conclusion is that quilting may have an important effect on decreasing medical cost that is associated with length of stay [7, 8] though there is no direct evidence to prove it.

In the meta-analysis, it is interesting that there is no significant difference in the operative time which may be explained by the difference of study year. The three trials [12, 14, 18] were undergone respectively before year 2000, and the three trials [9, 24, 29] included in the meta-analysis were undergone several years ago respectively in year 2006, year 2007 and year 2010. With advances in surgical technique and experience, it may cost surgeons less and less time to undergo flap fixation, leading to no significantly more time required to perform this procedure.

In the analysis, several limitations should be considered. First, there were evidences of heterogeneity between trials which may be owing to different surgical techniques, surgeon skill mixes and postoperative management strategies. So we performed two subgroup analyses to examine the source of heterogeneity. However, these variables could not thoroughly explain the source of heterogeneity. Second, language bias should be considered. Though we applied adequate search strategies of no language restriction, all trials were collected by language limitation to Chinese and English, thus may lead to weaken the applicability of conclusions.

It is important for future studies to make progress in these following aspects. First, future trials should pay attention to allocation concealment and describe related method used. Second, it should give clear definition of outcomes, especially for measure of operative time and length of hospital stay. Third, the trials should accurately report the outcomes including cosmetic results and medical cost that were not reported in the eight trails. More related studies reported length of hospital stay and operative time are also required for the reliable of conclusion. Furthermore, full blinding of outcome assessment should be performed for such research, especially important for seroma formation, presence of postoperative complication, length of stay, evaluation of shoulder function and cosmetic results.

In conclusion, quilting performed a large advantage over no-quilting in decreasing medical cost and improving the outcome. Besides, quilting may be an alternative to closed suction drain after ALND, which should be carefully chosen by surgeons and patients considering comfortable, efficacy and economic. In addition, Additional operative time may be not an important obstacle of performing flap fixation any more for breast cancer patients.

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Disclosure of conflict of interest

None.

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