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REVIEW ARTICLE

Comparing Electrocautery to Sharp Dissection in Flap Raising for Mastectomy: A Systematic Review and Meta-analysis

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ABSTRACT

Background: Postoperative seroma prolongs hospital stay and increases the cost of healthcare, particularly in resource-constrained settings, where patients are often kept on admission for drain care after mastectomy. The choice of instrument could affect the seroma rate after mastectomy. Hence, we compared postoperative complications between sharp dissection (scalpel and scissors) and diathermy for raising flaps in mastectomy for breast cancer.

Methodology: We performed a systematic review of studies that compared sharp dissection (using scalpels and scissors) and diathermy, adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. PubMed and Google Scholar were used for the literature search. RevMan 5.4 was used for the analysis. The outcomes compared were seroma formation, total effluent volume, duration of surgery, and occurrence of flap necrosis between the two groups, as reported in the retrieved studies.

Result: We incorporated data from ten randomised control studies involving 791 patients. The seroma rate was low when sharp dissection (scalpel or scissors) was used during mastectomy (OR = 3.09 (2.11 to 4.53), $p < 0.001$, $I2 = 0\%$). However, the duration of the operation was prolonged in the sharp dissection cohort compared to the diathermy cohort [MD = 24.59 minutes (3.07 to 46.11) $p = 0.03$, $I^2 = 99\%$]. There was no difference between the two techniques when the total volume of effluent and occurrence of flap necrosis were analysed.

Conclusion: The outcomes of our study underscore the importance of considering the techniques used for flap raising in mastectomy. This finding challenges the prevailing over-reliance on diathermy, particularly in resource-constrained settings. This study provides valuable insights for surgical decision-making in the overall management of breast cancer.

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INTRODUCTION

Seroma is a common postoperative complication of mastectomy, and several risk factors[1] have been associated with its occurrence. The choice of the instrument for flap raising during mastectomy could have an impact on the incidence of seroma. Although the surgeon can have precise control over the scalpel during flap-raising, diathermy has been associated with charring and desiccation because of its wide thermal spread.[2] Furthermore, it is ineffective in a pool of blood, and it cannot seal vessels smaller than 1 mm in diameter.[3] Hence, following mastectomy, morbidity could be as high as 50% in patients who had diathermy used for flap raising.[4] In developing countries, there are numerous challenges associated with the routine use of diathermy in surgical practice. These challenges, such as burns, fire accidents, and navigating equipment shortages in low-income regions, are compounded by the fact that no study has ever determined the optimal current setting for reducing complications associated with flap-raising in mastectomy.[5] Moreover, the presence of living bacteria and viruses in diathermy smoke has led to an increased risk of infection transmission,[6] which has been exacerbated by the absence of smoke extractors in several operating rooms,[7] especially in developing countries. Furthermore, many surgical trainees in developing nations lack sufficient education and training on the fundamental principles of routine diathermy use.[8,9,10]

There is reduced surgical site infection and seroma with better wound healing[11] in patients who have undergone mastectomy with sharp dissection (scalpel and scissors) during mastectomy.[11,12] The use of sharp dissections for flap raising, compared to diathermy, might promote better cosmesis and faster postoperative recovery, which will allow early commencement of adjuvant chemotherapy and radiotherapy. However, its occasional use is hindered by the entrenched surgical dogma and a paucity of high-quality evidence comparing it with diathermy. While surgical techniques could play a role in reducing the rate of seroma in mastectomy, there is still controversy regarding the best option between diathermy and sharp dissection for raising the flap in mastectomy. This debate could be resolved by a meta-analysis of randomised controlled studies comparing the two techniques for raising flaps.

Furthermore, in several countries in sub-Saharan Africa, many post-mastectomy patients would have extended hospital stays while awaiting drain removal[13] to allow staff nurses to monitor drain effluents and assess flap viability. However, this concept is challenged by the rising population and increasing treatment costs, which have put pressure on healthcare facilities.[14,15] Hence, there is a need to determine the flap-raising technique associated with the lowest volume of effluent post-mastectomy. This might enable the selective use of such a technique for patients at higher risk of prolonged effluent drainage, allowing for early drain removal and discharge from the hospital bed. This could reduce the overall treatment cost, a practical implication of our research that could significantly impact health care management.

We aimed to provide a conclusive comparison of postoperative complications between scalpel and diathermy after mastectomy for breast cancer using a meta-analytic method. The absence of a meta-analysis comparing the effectiveness of different instruments in raising flaps in mastectomy underscores the urgency of this review. Therefore, this review highlights the non-inferiority of sharp dissections (scalpels and scissors) for modified radical mastectomy in patients with breast cancer, providing a much-needed resolution to the ongoing debate.

METHODOLOGY

Study design

This systematic review examined studies published in the English language that compared diathermy to sharp dissection (using scalp and/or scissors). The study population included females with breast cancer who had undergone modified radical mastectomy. The primary outcome was the seroma

rate after modified radical mastectomy. The secondary outcomes were the duration of surgery, rate of flap necrosis, and volume of drain output. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used for this study.[16] The review question: What effect does scalpel or diathermy have on seroma formation post-mastectomy? We registered this review in the PROSPERO registry for systematic review. The registration number is CRD 42023491896.

Eligibility criteria

We included randomized controlled trials published in English since 1980 that compared sharp dissection (scalpel and dissecting scissors) and electrocautery for flap-raising in modified radical mastectomy. There was no need to contact any author, as we were able to assess all studies. We used randomized controlled trials to reduce bias in the meta-analysis. The exclusion criteria were Studies comparing axillary clearance alone, simple mastectomies, breast-conserving surgeries, and mastectomy performed in conjunction with breast reconstruction were excluded. Other exclusion criteria were abstracts, reviews, conference presentations, and studies in foreign languages.

Search strategy

We assessed databases and search engines such as PubMed and Google Scholar for studies that met the inclusion criteria. Additional studies were manually obtained from studies retrieved from the databases. The search was initiated on December 9, 2023. The search strategy included the "scalpel", "scissors", "diathermy", "electrocautery", and "mastectomy". The advanced search feature of Google Scholar was used (the exact phrase" randomized control trial' and studies dated between 1990 and 2025). We (The investigators) conducted the last literature search on May 29, 2025. [see Supplementary Table1] We did a manual search of the references of the articles deemed important to the outcomes of this review was done to retrieve other studies that might compare sharp dissection to diathermy use in mastectomy.

Study selection and study quality appraisal

The retrieved studies underwent screening by two different authors (O.A and O.I) using the Rayyan software.[17] All arguments and differing opinions about article selection were settled by the first author (O.S) and by referring to the inclusion guideline. The data for the primary and secondary outcomes were extracted from the included studies.[18] These were transferred into an Excel spreadsheet and compared for consensus and accuracy. The RoB 2 tool was used. This was performed independently by O.S., O.I., and A.A. It was eventually harmonised and incorporated into the RobVis tool, after which summary and traffic plots were generated.[19]

Data extraction

We retrieved data (including basic information, demographic information, and outcomes) from the included studies. These were then imported into an Excel spreadsheet. The basic information collected included study name, study location, and year of publication. The Demographic information collected included the number of study subjects in each group, follow-up period, and the mean age of each study group. The outcome information assessed was the seroma, duration of surgery, flap necrosis, and volume of drain effluent. Missing data were excluded from the meta-analysis.

Measurement of outcomes

Data for seroma, duration of surgery, flap necrosis, and volume of drain effluent were retrieved from the included studies. The seroma rate was defined as the accumulation of serous fluid underneath the flaps after mastectomy. Dichotomous data (seroma and flap necrosis) were analysed using odds ratios, while continuous data (volume of drain effluent and duration of surgery) were assessed using the mean difference.

Heterogeneity and publication bias

We assessed the heterogeneity of the included data using I2 statistics. Substantial heterogeneity was considered when I^2 was greater than 50%. The random effects model was used to determine the

total volume of the drain output and the duration of surgery. Publication bias was assessed by using funnel plots. Publication bias was not considered if the funnel plot showed a symmetrical distribution.

Statistical methods and analysis

Revman 5.4.1 was used to analyse the data. Dichotomous data were analysed using odds ratios, while continuous data were assessed using mean differences. We analysed diathermy as the control group and sharp dissection as the intervention group. The range and median were used to calculate the mean whenever not stated, using the formula derived by Hozo.[20]

RESULTS

A literature search was conducted for the retrieved articles. A review of the full text of the 696 studies was conducted. Data were derived from ten studies[2,12,21,22,23,24,25,26,27,28] that fit the inclusion criteria. All were randomized controlled trials involving 791 patients. The Cochrane RoB 2 tool was used to assess study bias. In two studies,[22,25] had a high risk of concern and only one study[12] had some risk of concern. Seven other studies had a low risk of bias. The traffic and summary plots provide a general picture of the risk.

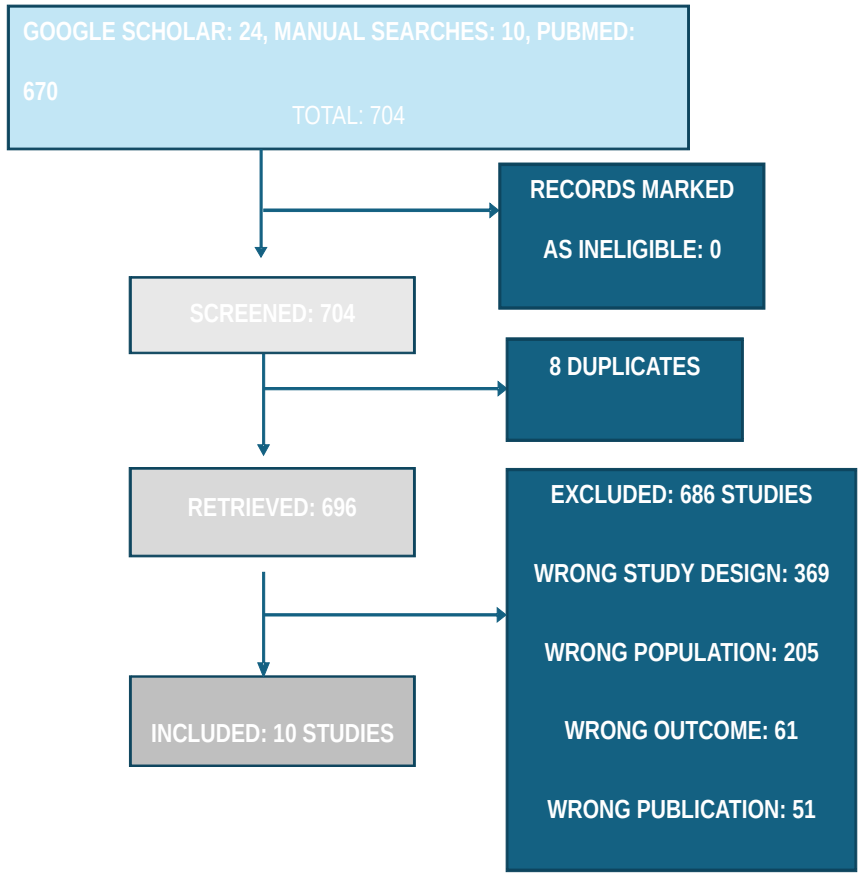

Figure 1: The Flow diagram of the Systematic review

Figure 2A: showing the traffic plot for risk of bias of the included studies

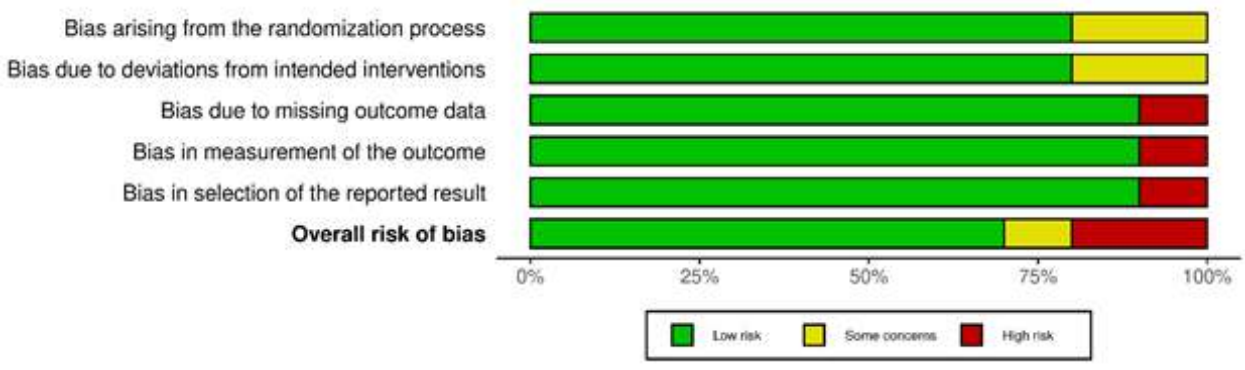

Figure 2 B: Summary plot of the included studies.

Ten studies reported the outcomes for seromas.[2,12,21,22,23,24,25,26,27,28] There was a higher incidence of seroma when diathermy was used for raising flaps in modified radical mastectomy for breast cancer [OR = 3.09, 95% CI (2.11 to 4.53), p < 0.001, I^2 = 0%].

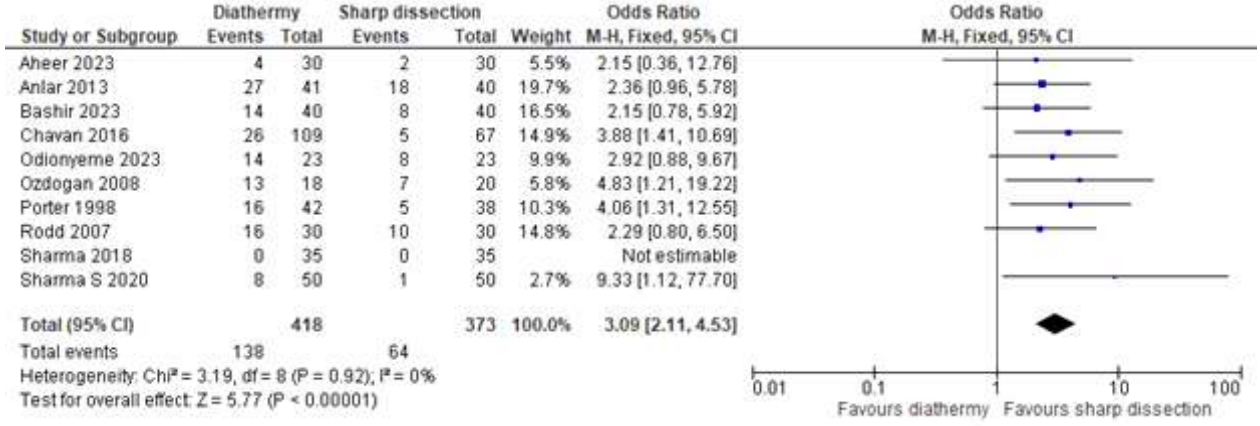

Figure 3A: Forest plot of seroma formation.

Figure 3 B: Forest plot of flap necrosis.

We did not find any difference between diathermy and sharp dissection with respect to flap necrosis (OR 1.85, 95% CI (0.79 to 4.37), p = 0.16, I2 = 0%) (Figure 3B). The data were derived from three studies.[23,24,28]

Data on the duration of surgery were derived from seven studies.[12,21,22,23,24,25,26,27,28] The average length of operation was found to be shorter in the sharp dissection group compared to the diathermy cohort [MD = 24.59 minutes, 95% CI (3.07 to 46.11) p = 0.03, I^2 = 99%] (see Supplementary Figure 1 which shows the Forest plot for the duration of surgery (in minutes). The results were statistically significant. Hence, the use of diathermy shortens the operative time during mastectomy for breast cancer. Data for the total volume of drain output were derived from five studies.[23,25,27,28] The difference was higher in the diathermy cohort, but it was not statistically significant [MD = 69.91 ml, 95% CI (-18.25 to 158.08), p = 0.12, I^2 = 98%] (see Supplementary Figure 2 that shows the Forest plot for the total volume of drain in ml). Symmetry was observed in the funnel plot for seroma (see Supplementary Figure 3 shows the Funnel plot for the rate of seroma). Hence, publication bias was reduced.

DISCUSSION

The use of sharp dissection to raise the flap during mastectomy has been appealing to some surgeons in

low-income countries, mainly because of the challenges[29,30] and ethical dilemmas[31] associated with the acquisition of hospital equipment. Therefore, this review may assist surgeons in making informed decisions. Nonrandomized trials were excluded to reduce the risk of residual confounding. The exclusion of studies reported in foreign languages did not constitute significant bias, as indicated by the symmetry of the funnel plot in Figure 3E. The use of diathermy to raise flaps during mastectomy is a risk factor for seromas.[2] This might be due to the heat acting on the subcutaneous fat[32] and incomplete sealing of the lymphatic vessels.[33] This has been confirmed by the results of this meta-analysis, which have shown that diathermy may predispose patients to postoperative seroma, perhaps due to the opening of the subdermal lymphatic vessels. In addition, the seroma arising from electrocautery might also be associated with an acute anti-inflammatory response, as suggested by Ozdogan *et al.*[12]

Although it has been postulated that sharp dissection during mastectomy is associated with better wound healing,[11] no difference was observed in the occurrence of flap necrosis between electrocautery and sharp dissection. Hence, sharp dissection may not be superior to diathermy in reducing wound complications after mastectomy. The occurrence of flap necrosis after mastectomy may depend on the surgeon's expertise rather than the instrument used to raise the flaps. There was a prolonged duration of surgery with the use of a scalpel or scissors to raise flaps during mastectomy due to the use of suture ligation to secure haemostasis during surgery. Hence, raising the flaps during mastectomy with diathermy will result in a shorter duration of surgery. Therefore, diathermy is preferable to scissors or a scalpel in patients who cannot tolerate prolonged surgery because of underlying comorbidities.

A network meta-analysis[34] of studies comparing sharp dissection, diathermy, and other forms of energy devices has shown that sharp dissection (using a scalpel and/or dissecting scissors) was the most effective technique with the lowest rate of seroma in modified radical mastectomy. Therefore, surgeons should be pragmatic in the selection of energy devices for raising flaps during mastectomy, especially in low-income countries, where many patients are admitted for drain care after surgery due to a lack of community-based nurses. The results of our review confirmed that sharp dissection (using a scalpel and/or dissecting scissors) is more effective than electrocautery in reducing the incidence of seromas. However, the use of sharp dissection (scalpel and/or dissecting scissors) for modified radical mastectomy requires proper patient selection and an appropriate balance must be achieved between prolonged postoperative drainage and reduced blood loss during mastectomy.

This study has some limitations. They included a small number of patients recruited in the studies used for analysis and were unable to compare perioperative blood loss between the two patient cohorts. In addition, several studies included in this systematic review were conducted in Asia. Asians have smaller and less dense breasts compared to Caucasians,[35] which could introduce a bias into the findings of this review. Furthermore, the follow-up duration was not reported in approximately half of the included studies. The restriction of the included studies to English language could have also introduced some bias to this review. This study may have been enhanced by conducting a trial of sequential analysis to determine the minimum number of patients required for the meta-analysis. There is still a need for future research to compare the cost effectiveness between scalpel and diathermy in the Sub-Saharan region of Africa.

CONCLUSION

In regions where diathermy generators are scarce or smoke extractors are absent, surgeons face untenable choices between adhering to global standards and adapting to local conditions. Diathermy has no adverse effects on necrosis of the mastectomy flaps. In addition, the use of diathermy to raise flaps during modified radical mastectomy shortens the operative time. However, the rate of

seroma was higher in patients with diathermy. Hence, this review reinforced the hypothesis that using diathermy for modified radical mastectomy is a risk factor for seroma formation.

DECLARATION

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Authors' contributions: S.O was involved in conceptualisation, literature search, data analysis and drafting of manuscript. A.A was involved in literature search and conceptualisation. I.O. was involved in literature search and data analysis. All the authors were involved in writing and reviewing of the manuscripts.

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