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ORIGINAL ARTICLE
Breast

Wise Versus Vertical Mastopexy Pattern Skin-reducing Mastectomy With Immediate Breast Reconstruction: Systematic Review and Meta-analysis

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Background: This study compares postoperative outcomes of Wise and vertical mastopexy pattern skin-reducing/skin-sparing masctomy, hypothesizing that incision choice affects cosmetic outcomes and complication rates.

Methods: A systematic review and meta-analysis followed Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines, searching PubMed, MEDLINE, Embase, Web of Science, and StarPlus Library. Included studies documented skin-sparing mastectomy using Wise or vertical mastopexy patterns with immediate reconstruction. The primary outcome is total mastectomy flap necrosis. The secondary outcomes are major/minor necrosis, infection, hematoma, seroma, and wound complications. Bayesian and frequentist generalized linear mixed models were used for the meta-analysis, including studies with 0 events.

Results: Sixty-six studies were identified, with 39 included in the meta-analysis, comprising 1954 patients and 2311 breast reconstruction cases. The Wise group had a higher rate of mastectomy flap necrosis (14.2%; 95% confidence interval: 10%–20%; I^2 = 83%) compared with the vertical group (7.8%; 95% confidence interval: 5%–12%; I^2 = 0%) ($P < 0.05$). No significant differences were found in other domains. Subgroup analysis favored vertical mastopexy for wound-related complications ($P = 0.04$).

Conclusions: The Wise pattern shows significantly higher mastectomy flap necrosis than the vertical pattern. However, there were no significant differences in major necrosis, minor necrosis, infection, hematoma, or seroma. Future studies should focus on larger, high-quality randomized controlled trials to better understand the impact of incision techniques on postoperative outcomes. *(Plast Reconstr Surg Glob Open 2025;13:e6584; doi: 10.1097/GOX.0000000000006584; Published online 14 March 2025.)*

INTRODUCTION

Breast-conserving procedures improve aesthetic outcomes.[1–5] Skin-sparing mastectomy (SSM) and skin-reducing mastectomy (SRM) were proven to be oncologically safe.[6–9] SSM allows immediate breast reconstruction (IBR), with higher patient satisfaction and quality of life.[10–12] Mastopexy patterns address the challenges of ptotic and large breasts in SSM and IBR. Although the Wise pattern allows resecting the excess skin, it is associated with higher postoperative wound healing issues, wound dehiscence, and "T-junction" breakdown.[13–17] Current literature estimates the incidence of mastectomy skin flap necrosis to range from 10% to 26%.[18,19] The Lejour technique, or vertical mastopexy pattern, offers reduced scarring.[18,20] It offers comparable aesthetic outcomes to the Wise pattern, while potentially resulting in lower incidence of minor mastectomy flap necrosis, minor wound dehiscence, and recovery time.[17,21]

Although many studies report on the application of Wise pattern and vertical pattern in SSM/SRM, evidence

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of their effectiveness and safety remains limited.[22] The lack of randomized controlled trials makes it difficult to reach a definitive conclusion. This study aims to synthesize current literature on SSM/SRM with IBR, comparing postoperative outcomes associated with the Wise pattern and vertical mastopexy pattern. We hypothesize that the choice of incision technique significantly influences cosmetic outcomes and complication rates.

METHODS

Protocol

This systematic review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses.[23] The Population, Intervention, Comparison, Outcome, Study design criteria included patients with ptotic or hypertrophic breasts and breast cancer. Interventions involved SSM/SRM using Wise or vertical mastopexy patterns with immediate reconstruction, compared with SSM/SRM with vertical mastopexy. The outcomes assessed were postoperative complications. The review and protocol were registered on PROSPERO (CRD 42024571301).

Inclusion and Exclusion Criteria

All articles meeting the Population, Intervention, Comparison, Outcome, Study design criteria were considered, with no language restrictions. All journal types, except review papers, were included. Studies had to specify postoperative complication numbers. Cohort studies reporting other incision types but including outcomes for Wise or vertical mastopexy patterns were considered. Studies describing SSM/SRM with nipple-areolar complex retention were included. All IBR techniques, including autologous, implant-based, and staged reconstructions, were included. All articles were considered for meta-analysis, excluding those with fewer than 20 breast reconstruction cases. Articles were excluded if they focused on staged mastopexy and mastectomy or on delayed breast reconstruction following SSM/SRM, as this review targets complications in primary reconstruction. Other exclusions included case reports, reviews, duplicate articles, preliminary reports, and studies not specifying postoperative complications for the treatments.

Search Strategy

We systematically performed the search through June 24, 2024, reviewing all articles relevant to our predefined protocol. The search was conducted in 4 databases and 1 registry: PubMed, MEDLINE (1860 to June 24, 2024), Embase (1860 to June 24, 2024), Web of Science, and StarPlus Library (University of Sheffield). We also performed citation, reference, and manual searches across databases, journal proceedings, and Google to ensure comprehensive coverage. (**See appendix, Supplemental Digital Content 1**, which displays a detailed overview of our search strategy, **http://links.lww.com/PRSGO/D891**.)

Takeaways

Question: How do the Wise and vertical mastopexy patterns compare in skin-sparing/skin-reducing mastectomy with immediate reconstruction for breast cancer patients?

Findings: A meta-analysis of 39 studies (1954 patients and 2311 reconstructions) revealed higher mastectomy flap necrosis rates with the Wise pattern (14.2%) versus the vertical pattern (7.8%), but no differences in other complications, highlighting the need for robust randomized trials.

Meaning: The Wise pattern may carry a higher risk of flap necrosis than the vertical mastopexy pattern in these procedures, though current evidence is limited by study biases, underscoring the need for high-quality randomized controlled trials to confirm these findings.

Primary Screening and Data Extraction

Two independent authors (Sxe Chang Cheong and John Maliekkal) screened the eligible studies, resolving disagreements with a third author (Wei Shao Tung) until a consensus was reached. Studies were included only if all 3 authors agreed. We retrieved papers from journals, uploaded them to RAYYAN, and contacted authors for any articles not freely available. After initial title and abstract screening, we retrieved all articles meeting the inclusion criteria.

Data were extracted into a piloted Excel spreadsheet. Only information related to the group of interest (ie, Wise or vertical) was extracted. For ambiguities in the results section or missing information, we contacted the authors via email for clarification.

In cases where a patient experienced multiple complications (eg, wound dehiscence, infection leading to flap necrosis, and implant removal), all outcomes were recorded as a single event in the extraction sheet. For 2-staged reconstructions (primary-delayed), complication rates from the first stage, involving the tissue expander, were extracted when available; otherwise, overall complication rates for the 2 stages were used.

Evidence Synthesis and Statistical Analysis

The primary outcomes included overall mastectomy flap necrosis, whereas secondary outcomes comprised major necrosis, minor necrosis, hematoma and seroma formation, infections, wound-related and prosthesis-related complications, and cosmetic outcomes of breast reconstruction. Cosmetic outcomes were reported using both quantitative and narrative methods, including Likert scores and visual analog scales. We conducted a meta-analysis of single means (MRAW) for each BREAST-Q domain, covering satisfaction with reconstructed breasts, physical well-being, psychosocial well-being, and sexual well-being, with scores from 0 to 100.

All data analyses were performed in R version 4.1.1 (The R Foundation for Statistical Computing, Vienna, Austria).[24] Bayesian generalized linear mixed models were used due to small sample sizes and high anticipated population heterogeneity. Estimates were calculated

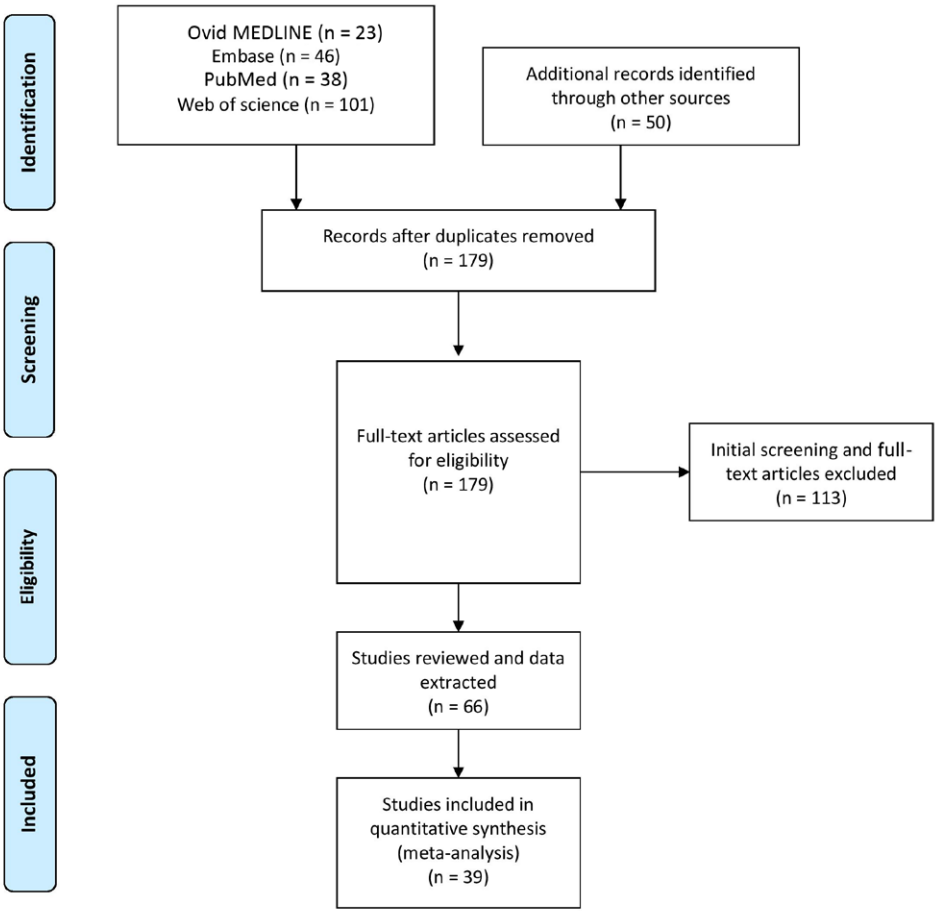

Fig. 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

using logit-transformed data.[25] Noninformative priors were used so that pooled estimates were determined completely by the study data, and not influenced by other prior assumptions. Alternative models, such as the frequentist generalized linear mixed model and Tukey arcsine transformation, were used to validate the results. Incidence of complications was reported in proportions (*P*), and heterogeneity between sets of data and complication measured were assessed using *I*-squared (I^2) and Tau-squared (τ^2).[26] Leave-one-out sensitivity analysis assessed the stability of results, and publication bias was evaluated using a funnel plot, the Begg test, and the Egger test.[27] A Bayesian zero-inflated random-effect model was conducted to ensure a comprehensive evaluation of the outcomes.[28] Forest plots were used for data visualization. The statistical significance level was set at α equal to 0.05.

Definition

Overall mastectomy flap necrosis is reported as an overall sum of incidence of major or minor necrosis. Major necrosis involves significant tissue necrosis, such as full-thickness mastectomy flap necrosis, and cases requiring immediate reoperation, debridement, or removal of implants or autologous tissue. Minor necrosis refers to partial-thickness necrosis of the mastectomy skin flap. Wound-related complications include wound dehiscence, skin epidermolysis, and delayed wound healing. Prosthesis removal or exchange refers to cases where tissue expanders or implants were removed due to complications unmanageable by conservative methods.

RESULTS

The initial search identified 208 studies. After removing 79 duplicates and excluding 113 studies based on title, abstract, and full-text screening, 24 studies met the inclusion criteria. An additional 50 studies were found through citation and hand searches. The selection process is outlined in Figure 1.

Sixty-six studies met the eligibility criteria: 47 retrospective case series, 4 prospective case series, 11 retrospective cohort studies, 3 prospective cohort studies, and 1 case report. The earliest review was undertaken between 1984 and 1989, whereas the latest was from February 2020 to February 2023. Of the 66 studies initially identified, 39 described SSM techniques, 19 focused on SRM techniques, and 8 covered nipple-sparing mastectomy techniques.

Summary of Characteristics for Studies Included in Meta-analysis

Of the 66 studies included, 27 were excluded from the meta-analysis for a small participant size (<20). (**See appendix, Supplemental Digital Content 2**, which displays a summary of the overall complication rates, **http://links.lww.com/PRSGO/D892**.) The remaining 39 studies,[7,10,15,17,29–49] comprising 1954 patients and 2311 breast reconstruction cases, were analyzed. Most studies originated from the United States (n = 18).[7,21,30,31,34,38,40,42,43,45,47,49–55] This is followed by the United Kingdom (n = 6),[15,29,35,37,39,56] Italy (n = 6),[33,36,41,46,57–59] Turkey (n = 2),[32,44] France (n = 1),[17] Australia (n = 1),[60] Greece (n = 1),[48] Brazil (n = 1),[10] Canada (n = 1),[61] and Korea (n = 1).[62]

Reported follow-up periods ranged from the shortest with 1 month[54] to the longest with 139 months.[38] Six studies had follow-up periods of less than 13 months.[32,37,53,54,59,61] Seven studies reported follow-up periods in the 12–24 months range.[15,29,36,45,49,58,62] Five studies reported follow-up periods in the 24–36 months range.[35,39,47,49,63] Nine studies reported an average extended follow-up period exceeding 36 months.[7,17,30,38,39,46,51,57,60] Eight studies did not explicitly report specific follow-up durations,[10,21,31,40,42–44,55] but reported an approximate range[40,42,44] or greater than 6 months.[21]

Eleven studies reported the use of a vertical mastopexy pattern.[21,29,30,32,38,42,44,45,47,60,62] Two studies reported both vertical and Wise patterns.[17,55] Twenty-seven studies reported the Wise pattern.[7,10,15,31,33–37,39,40,43,46,48–54,56–59,61,63] Of the 11 studies on vertical mastopexy, only 1 reported a 2-stage (primary-delayed) approach,[42] whereas 5 studies using the Wise pattern used this method.[7,35,43,50,54]

Overall Mastectomy Flap Necrosis (Minor and Major Necrosis)

There were 218 cases in the vertical group and 1476 cases in the Wise group. Subgroup analysis revealed a significant difference ($P = 0.04$), favoring the vertical group compared with the Wise group ($P = 0.08$; 95% confidence interval [CI]: 0.05–0.12; $I^2 = 0\%$ versus 0.14; 95% CI: 0.10–0.20; $I^2 = 83\%$).

Major Necrosis

Subgroup analysis reported no significant difference ($P = 0.32$) between Wise ($P = 0.08$; 95% CI: 0.05–0.12; $I^2 = 68\%$) and vertical groups ($P = 0.05$; 95% CI: 0.03–0.11; $I^2 = 6\%$) (Figs. 2, 3).

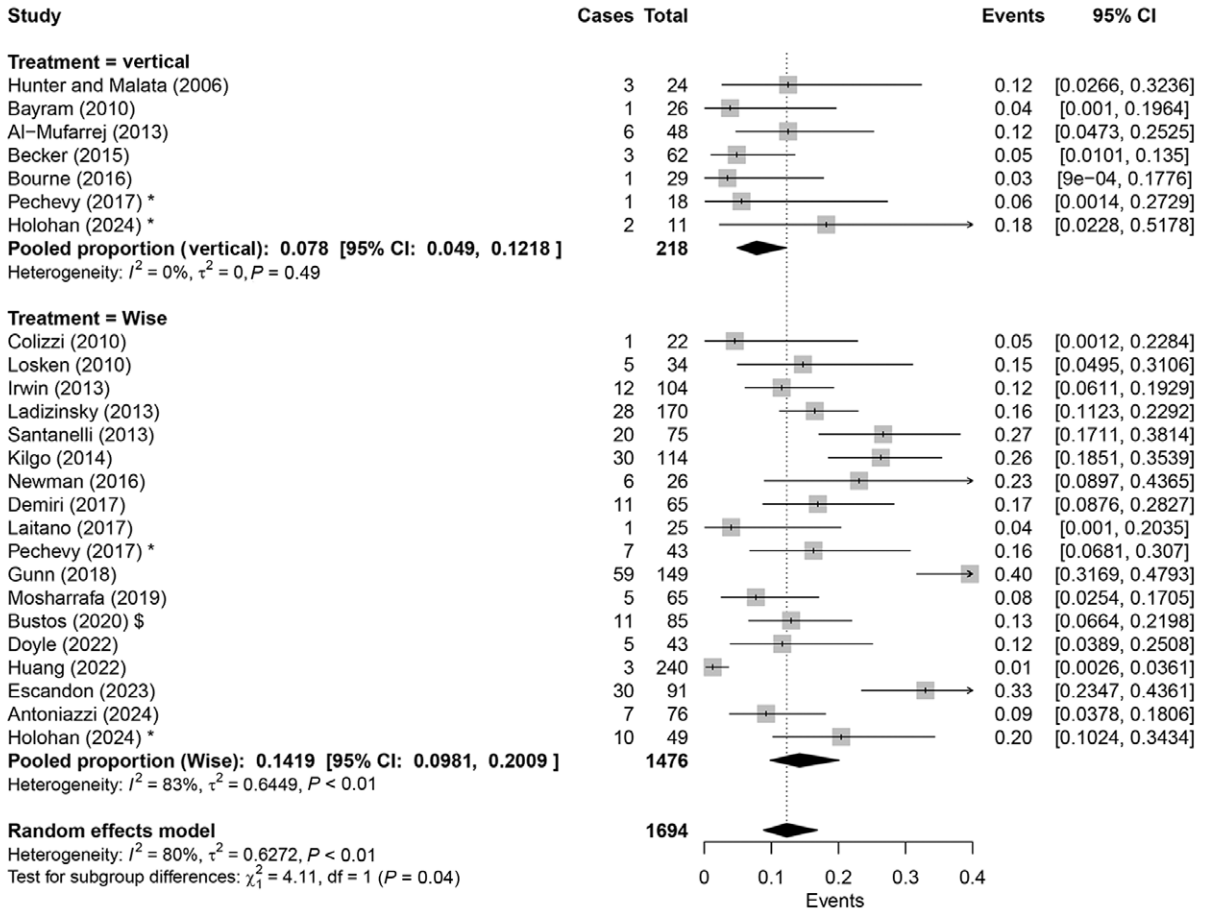

Fig. 2. Outcomes of overall mastectomy flap necrosis for vertical group vs Wise group. *Comparative studies with 2 arms (vertical and Wise). $First-stage IBR only (direct to implant).

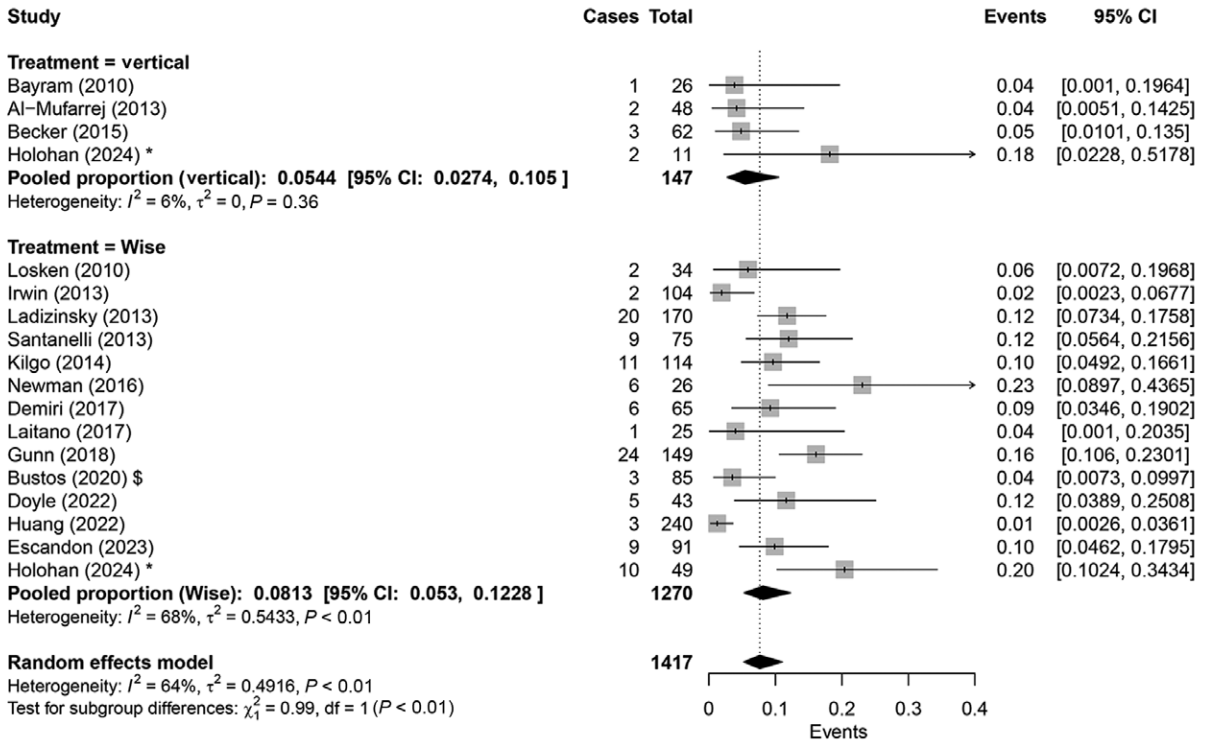

Fig. 3. Outcomes of major necrosis for vertical group vs Wise group. *Comparative studies with 2 arms (vertical and Wise). $First-stage IBR only (direct to implant).

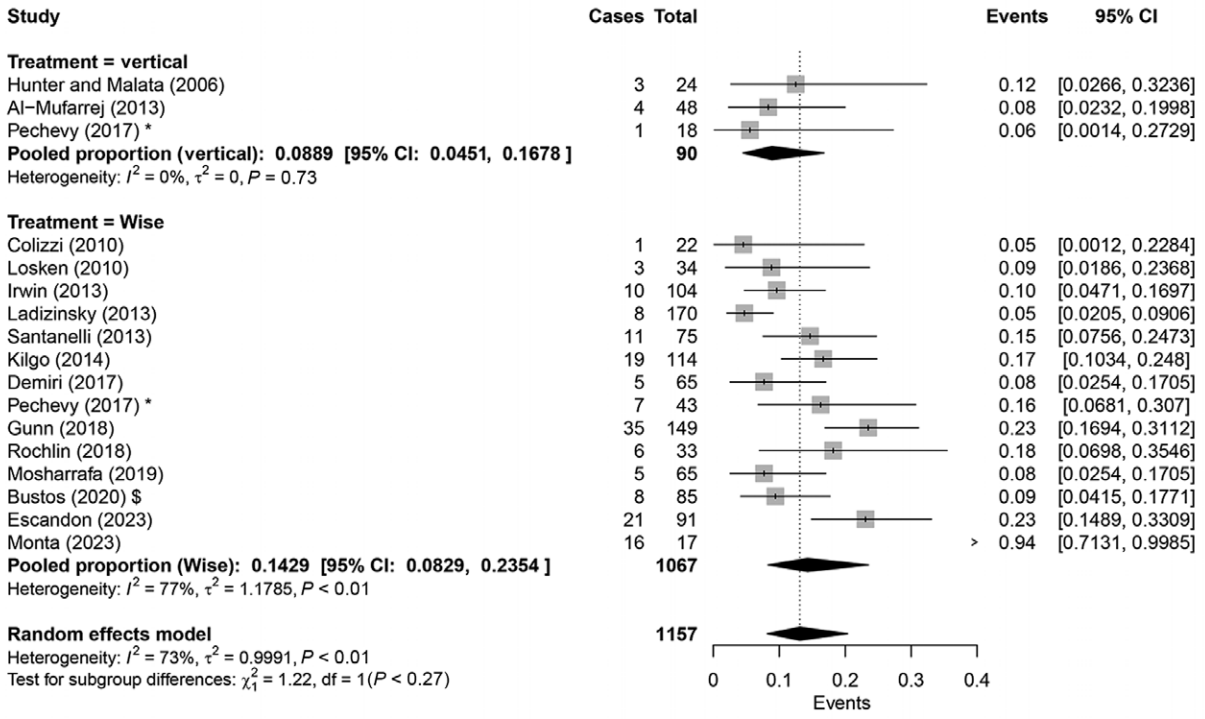

Fig. 4. Outcomes of minor necrosis for vertical vs Wise group. *Comparative studies with 2 arms (vertical and Wise). $First-stage IBR only (direct to implant).

Minor Necrosis

There is no significant difference between the Wise and vertical groups in terms of minor necrosis ($P = 0.14$; 95% CI: 0.08–0.23; $I^2 = 77\%$ versus 0.09; 95% CI: 0.05–0.17; $I^2 = 0\%$; $P = 0.27$) (Fig. 4).

Hematoma and Seroma

There is no significant difference between the Wise and vertical groups for hematoma and seroma cases (0.07; 95% CI: 0.05–0.11 versus 0.06; 95% CI: 0.04–0.10; $P = 0.66$) (Fig. 5).

Prosthesis Loss, Removal, and Exchange

There was no significant difference between the groups ($P = 0.64$) regarding prosthesis-related complications and loss (Fig. 6).

Infection

Infection risk was 7.5% (95% CI: 0.05–0.12; $I^2 = 84\%$) in the Wise group and 3.1% (95% CI: 0.01–0.08; $I^2 = 71\%$) in the vertical group. The pooled proportion did not show a significant difference between the groups ($P = 0.12$) (Fig. 7).

Flap Ischemia Rate for Alloplastic and Autologous Immediate Breast Reconstruction

Four studies examined the vertical pattern with autologous tissue flap reconstruction, and 8 focused on the vertical pattern with prosthesis reconstruction. Twenty studies investigated the Wise pattern with prosthesis reconstruction, whereas 2 utilized autologous tissue. Additionally, 5 studies (4 Wise and 1 vertical) reported mixed reconstruction techniques involving autologous tissue enhanced with prosthesis or a combination of both. Subgroup analysis across different mastopexy designs and reconstruction techniques initially found no subgroup differences (Fig. 8).

Wound-related Complications

Wound-related complications were 12.0% (95% CI: 0.05–0.28; $I^2 = 85\%$) for the vertical group and 13.4% (95% CI: 0.10–0.18; $I^2 = 18\%$) for the Wise group, with no significant difference between the groups ($P = 0.70$) (Fig. 9).

Risk Indicators for Complications

Seventeen studies were reviewed to evaluate the relationships between patient demographics and complications in SSM using Wise or vertical pattern with IBR.[16,17,38,40,41,43,46,48–50,53,54,59,63–66] Implant-based IBR was

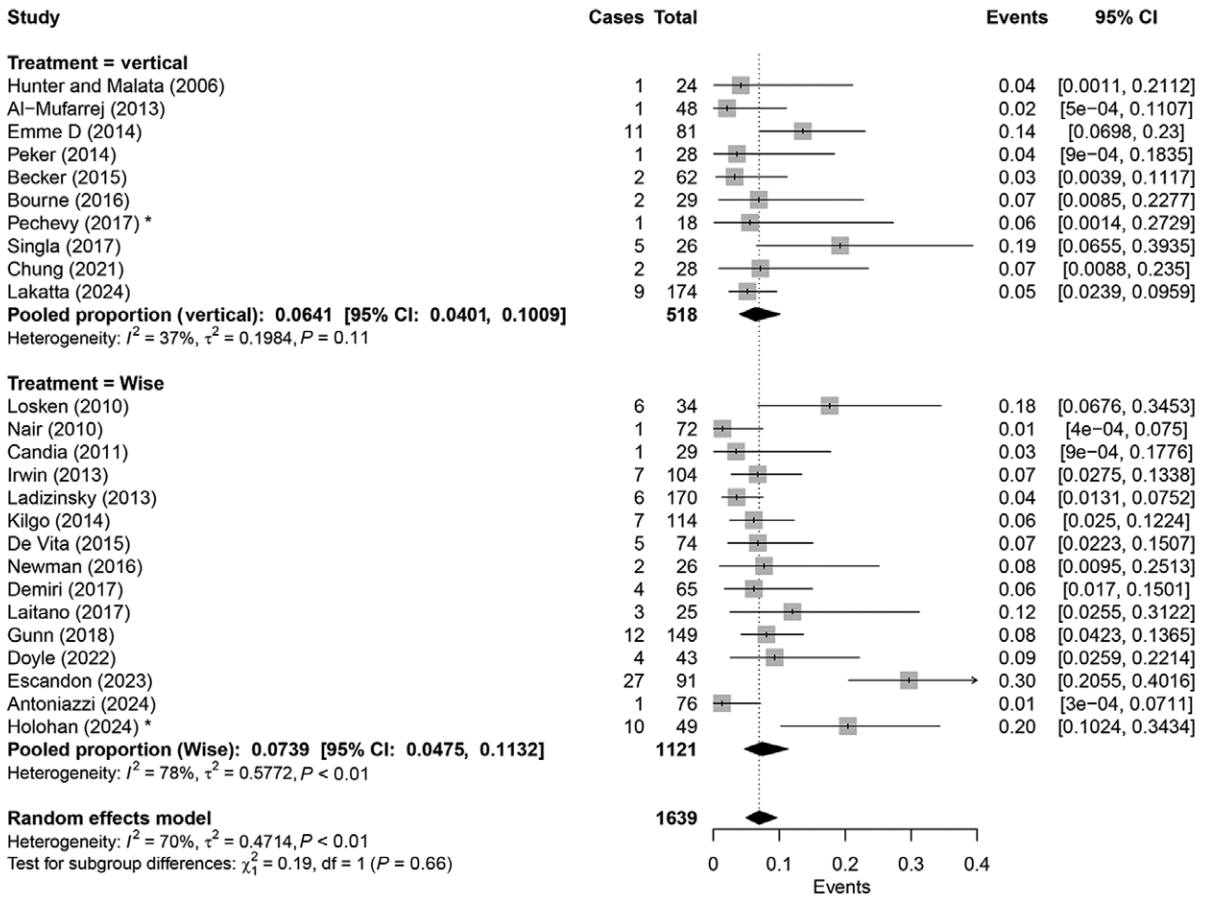

Fig. 5. Outcomes for hematoma and seroma for vertical vs Wise group. *Comparative studies with 2 arms (vertical and Wise).

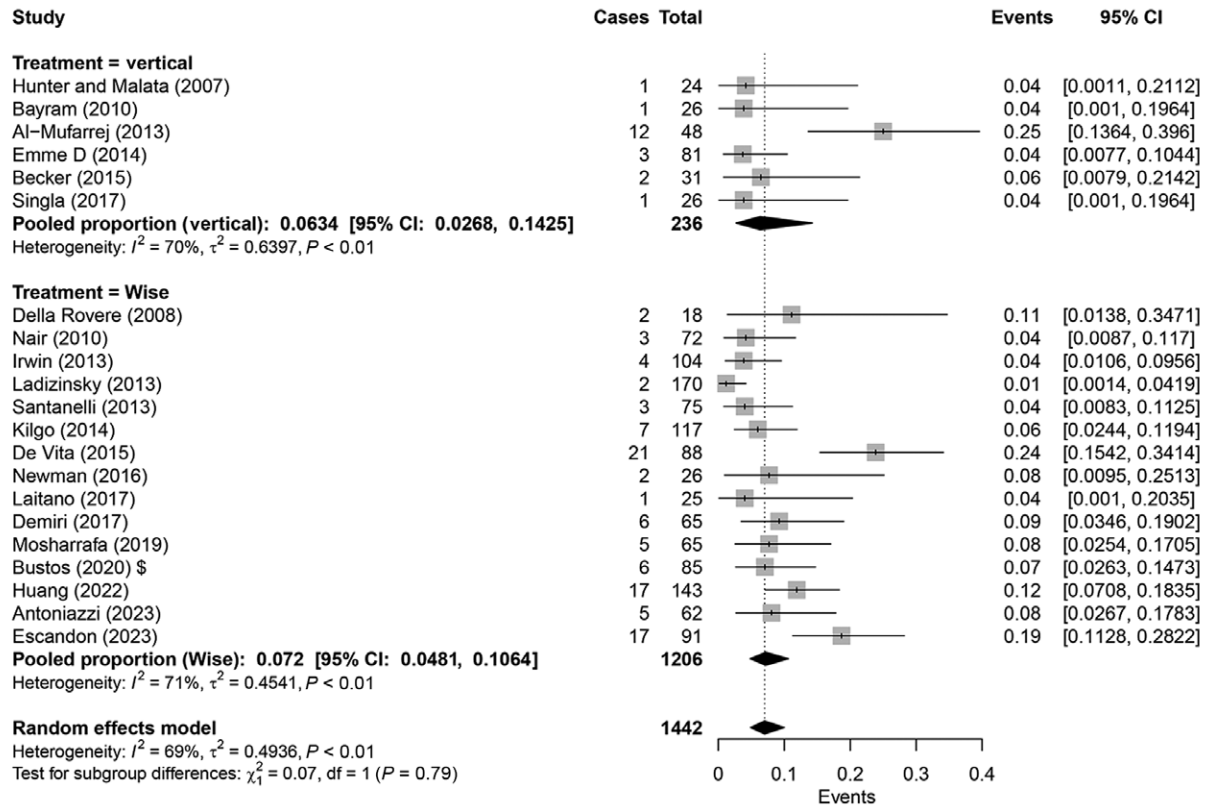

Fig. 6. Outcomes for implant loss and removal for vertical vs Wise group. $First-stage IBR only (direct to implant).

associated with higher risks of minor (hazard ratio [HR]: 2.83; 95% CI: 1.22–7.02) and major complications (HR: 4.03; 95% CI: 1.93–8.83).[50] Smoking increased the risk of skin flap necrosis,[17,48,63,64] wound dehiscence,[17] and overall complications.[40,46] Diabetes significantly increased major (HR: 2.68; 95% CI: 1.11–5.86)[50] and overall complications.[46] High-grade ptosis[46] was linked to major flap-related complications (HR: 2.64; 95% CI: 1.01–9.06).[50] Adjuvant chemotherapy increased risks of major complications (HR: 1.97; 95% CI: 1.51–5.72)[50] and skin flap necrosis (P = 0.001).[17,46]

Five studies[15,41,54,59,65] identified resected breast tissue weight as a significant risk factor for major flap-related complications,[15,59,65] overall complications,[54,59] and skin necrosis.[41] A breast mass greater than 750 g increased flap-related complications (P = 0.0049),[65] and every 100 g increase raised major skin complication risk by 60% (odds ratio [OR]: 1.6; 95% CI: 1.1–2.3; P = 0.02).[15]

Overweight or obesity was linked to higher rates of overall complications,[40,46,54] skin flap necrosis, and wound dehiscence.[65] Other factors increasing complication risks included the use of autoderm (OR: 2.27; 95% CI: 1.12–4.59; P = 0.02),[54] extended drain time (OR: 1.03; 95% CI: 1.00–1.05; P = 0.029),[54] pectoralis major muscle division (skin flap necrosis; OR: 1.32; 95% CI: 1.12–1.55),[49] axillary clearance (postoperative infection; OR: 5.8; 95% CI: 1.3–26.0; P = 0.021), permanent implants (overall complication; P = 0.029),[40] large prosthesis (skin flap ischemia; OR: 7.042; 95% CI: 0.7109; P < 0.001),[40,41] and preoperative radiotherapy (major skin flap ischemia and capsular contraction; P < 0.002).[48]

In Lin et al's[16] study, the Wise pattern resulted in a significantly larger mean flap necrosis area (21.1 cm², SD 21.8) compared with the vertical pattern (1.9 cm², SD 3.7, P < 0.001). The Wise pattern group required more postoperative visits (6.3, SD 1.9) versus the vertical pattern group (5.0, SD 1.3, P = 0.03) and had a longer time to wound closure (12.6 wk, SD 4.8) compared with the vertical pattern group (5.0 wk, SD 1.1, P = 0.001).

Aesthetic Outcomes

BREAST-Q Score

Four studies[21,50,58,67] used the BREAST-Q questionnaire to assess patient satisfaction with reconstructed breasts. Median and interquartile range scores were reported in 1 study,[50] whereas the others used mean and SD.[21,58,67] Among these, 1 study used the vertical pattern[21] and 3 used the Wise pattern.[50,58,67]

A pooled subgroup meta-analysis of BREAST-Q scores from 3 studies (2 Wise and 1 vertical) revealed borderline significant differences in psychosocial well-being, with the Wise pattern scoring higher compared with the vertical pattern (MRAW: 82.01; 95% CI: 77.69–86.32 versus MRAW: 69.83; 95% CI: 76.91–87.24) (P = 0.05). The Wise pattern also scored higher in sexual well-being (MRAW: 84.51; 95% CI: 79.39–89.62 versus MRAW: 82.08; 95% CI: 46.51–93.16) (P < 0.01). No significant differences were found in breast satisfaction or physical well-being (Fig. 10).

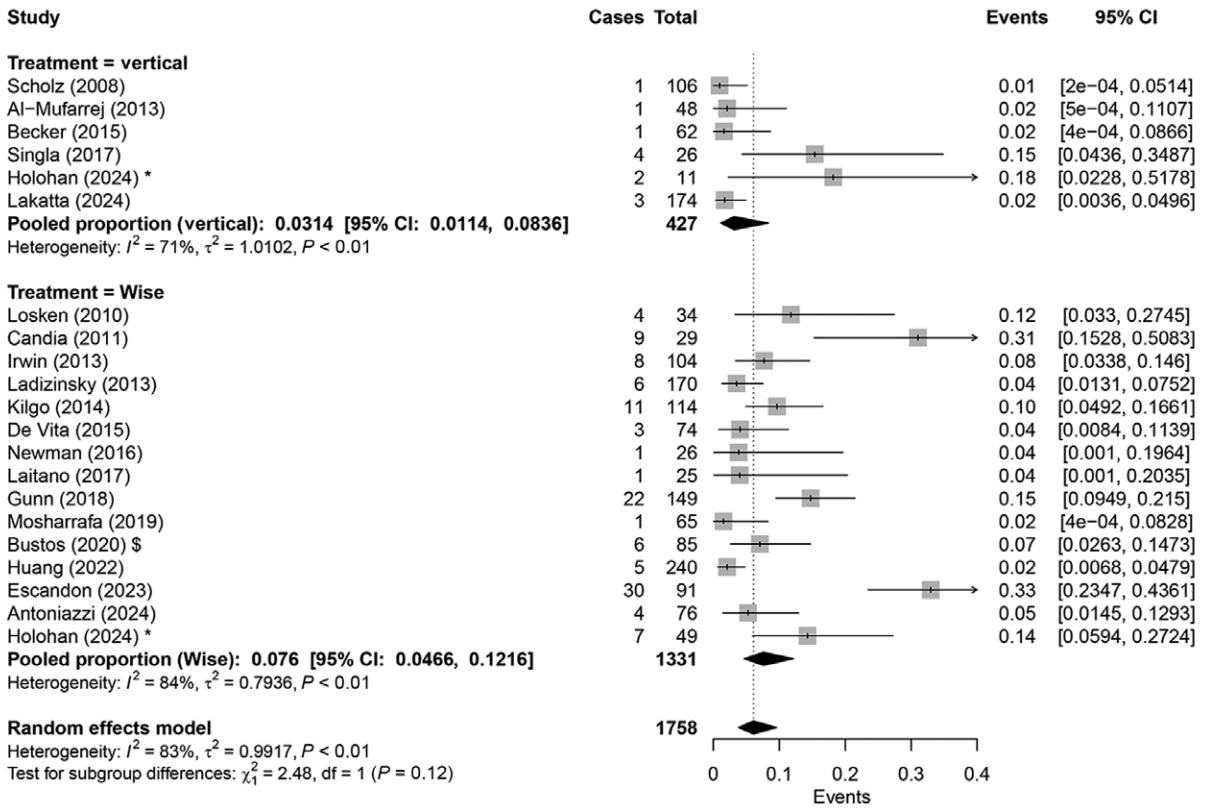

Fig. 7. Outcomes relating to cases of infection for vertical vs Wise group. *Comparative studies with 2 arms (vertical and Wise). $First-stage IBR only (direct to implant).

Questionnaires and Surveys

Eight studies[16,44,47,54,57,62,66,67] assessed aesthetic outcomes and patient satisfaction using Likert scale analysis, whereas 2 studies[41,63] used a visual analog scale. One study compared aesthetic outcomes between Wise and vertical patterns using the Likert scale.[16] The vertical group scored better in breast shape (2.3 ± 0.5 versus 1.7 ± 0.6, P = 0.01), upper pole fullness (2.9 ± 0.4 versus 2.3 ± 0.5, P = 0.01), scars (3.3 ± 0.9 versus 2.1 ± 0.8), and symmetry (2.4 ± 0.8 versus 2.1 ± 0.8, P = 0.03). However, surgeons' assessments indicated better symmetry for the Wise pattern (1.4 ± 0.6 versus 2.0 ± 0.8, P = 0.02).

Four studies using the vertical incision technique reported aesthetic scores out of 5: 3.6 (3.3–4.0),[47] 3.57,[44] 3.86 (SD 0.86),[62] and 4.20 (SD 0.83),[62] with 1 study reporting 3.53 (3.62–3.44).[66] One study reported a cumulative mean score of 21.1 for the Wise pattern, averaging 4.24 across 5 domains (breast size, shape, symmetry, texture, and scars).[57] Four other studies used various questionnaires and stratified groups, reporting satisfaction percentages across different domains.[16,41,54,63,67]

Publication Bias

Funnel plots revealed potential publication bias, with the Egger test (P < 0.0001) and the Begg test (P = 0.0015) suggesting asymmetry. Although most studies were within the funnel boundaries, the plots were not symmetrical, indicating small-study effects likely due to limited studies and small sample sizes (Fig. 11).

DISCUSSION

Our study demonstrated that the Wise mastopexy pattern is associated with a significant increase in overall mastectomy flap necrosis compared with the vertical incision technique, likely due to the larger sample size encompassing both major and minor necrosis cases. No significant difference was found between Wise and vertical techniques in other complication domains. However, it is important to acknowledge the possibility of heterogeneity between the patient demographics in the Wise and vertical groups. Variations in patient risk factors across studies may have influenced the outcomes. This aligns with Lin et al,[16] who reported fewer complications with the Lejour technique compared with the Wise pattern (P < 0.001). The incidence of mastectomy flap necrosis for the Wise pattern ranged from 7.2% (Bayesian zero-inflated model) to 17.2%, compared with 1.6% (Bayesian zero-inflated model) to 7.8% for the vertical pattern. Current literature indicates a broad range of skin flap necrosis (10%–52%) for SSM with Wise pattern, which may stem from varying inclusion criteria and necrosis definitions.[8,15]

Several patient factors were linked to increased complications in SSM/SRM with IBR using a mastopexy

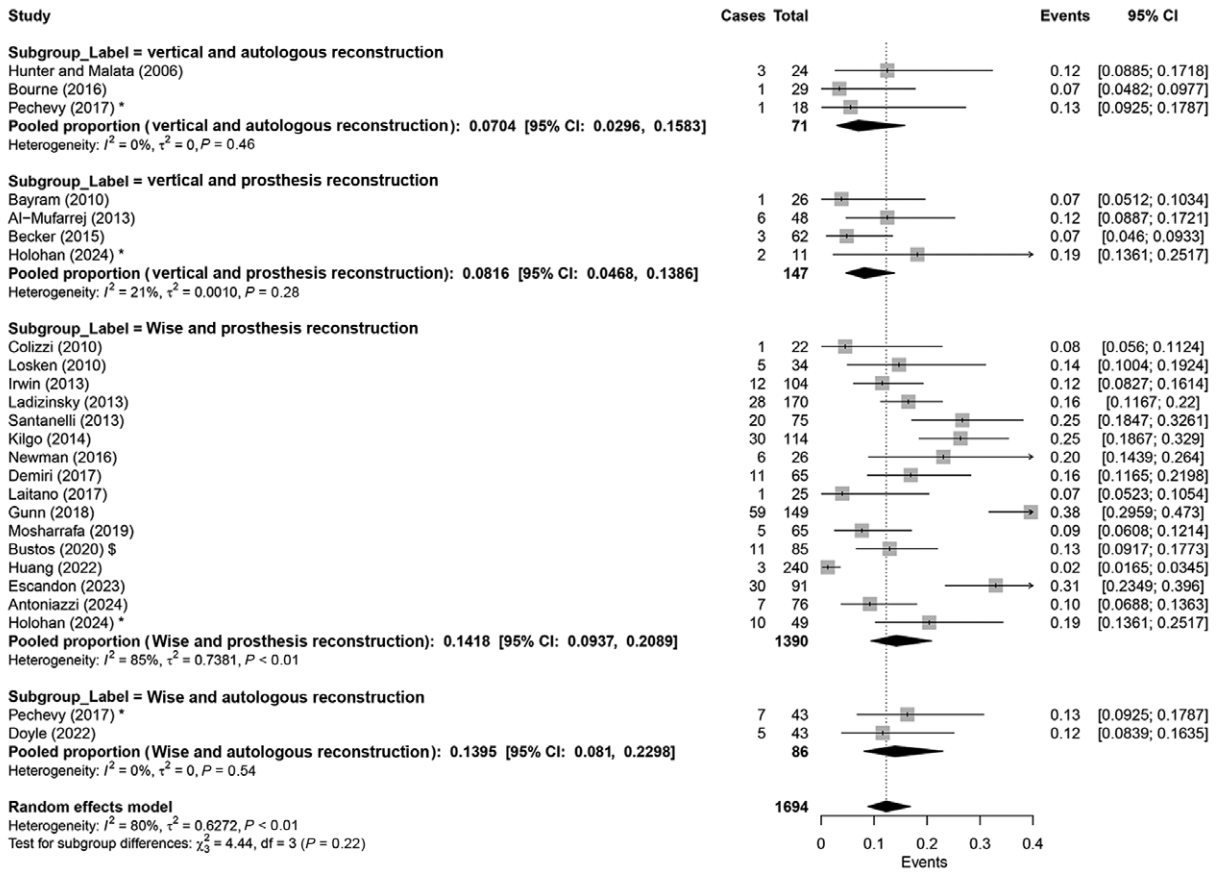

Fig. 8. Outcomes relating to flap ischemic rate for prosthesis vs autologous in vertical vs Wise group. *Comparative studies with 2 arms (vertical and Wise). $First-stage IBR only (direct to implant).

pattern. Key risk factors identified include smoking, diabetes, high-grade ptosis, large breast size, axillary clearance, high body mass index, increased mastectomy breast weight, neoadjuvant chemotherapy, and radiotherapy. Additionally, the use of autoderm, permanent implants, and high implant volume were associated with higher complication rates. Direct-to-implant placement in Wise SSM also showed increased complication risks compared with a 2-stage tissue expander approach. Pechevy et al[17] reported that the vertical scar technique resulted in a lower incidence of complications and necrosis, although patient demographics may contribute to these findings.

We identified only 4 studies[21,50,58,67] reporting breast aesthetic outcomes using BREAST-Q scores. Breast aesthetic outcomes assessed using the BREAST-Q questionnaire suggest that the Wise mastopexy pattern performs better in the psychosocial and sexual well-being domains compared with the vertical pattern. As more studies adopt standardized reporting tools such as BREAST-Q, the reliability and comparability of these outcomes are expected to improve.

LIMITATIONS

Most studies in this review were of low quality and showed substantial bias due to the absence of a control group, which is significant for confounding factors. High heterogeneity in meta-analysis results, particularly for the Wise group ($I^2 > 50\%$), is attributed to single-arm studies, varying patient characteristics, and variation in surgical incision approaches.

There is a lack of standardized reporting, with some studies failing to specify skin necrosis severity and using unclear terminology that conflates skin flap necrosis with wound dehiscence. Data extraction was conducted with objective agreement by the authors to mitigate these issues.

CONCLUSIONS

This review represents the largest comparison of the Wise pattern versus vertical mastopexy patterns for SSM/SRM followed by IBR. Bayesian meta-analysis revealed a significantly higher rate of mastectomy skin flap necrosis in the Wise pattern compared with the vertical pattern. Subgroup analysis indicated a notably higher flap ischemia rate for the Wise pattern with immediate prosthesis reconstruction compared with the Wise pattern with autologous reconstruction and the vertical pattern with either reconstruction type. Future studies should focus on higher quality evidence, such as randomized controlled trials, and explore additional risk factors for complications.

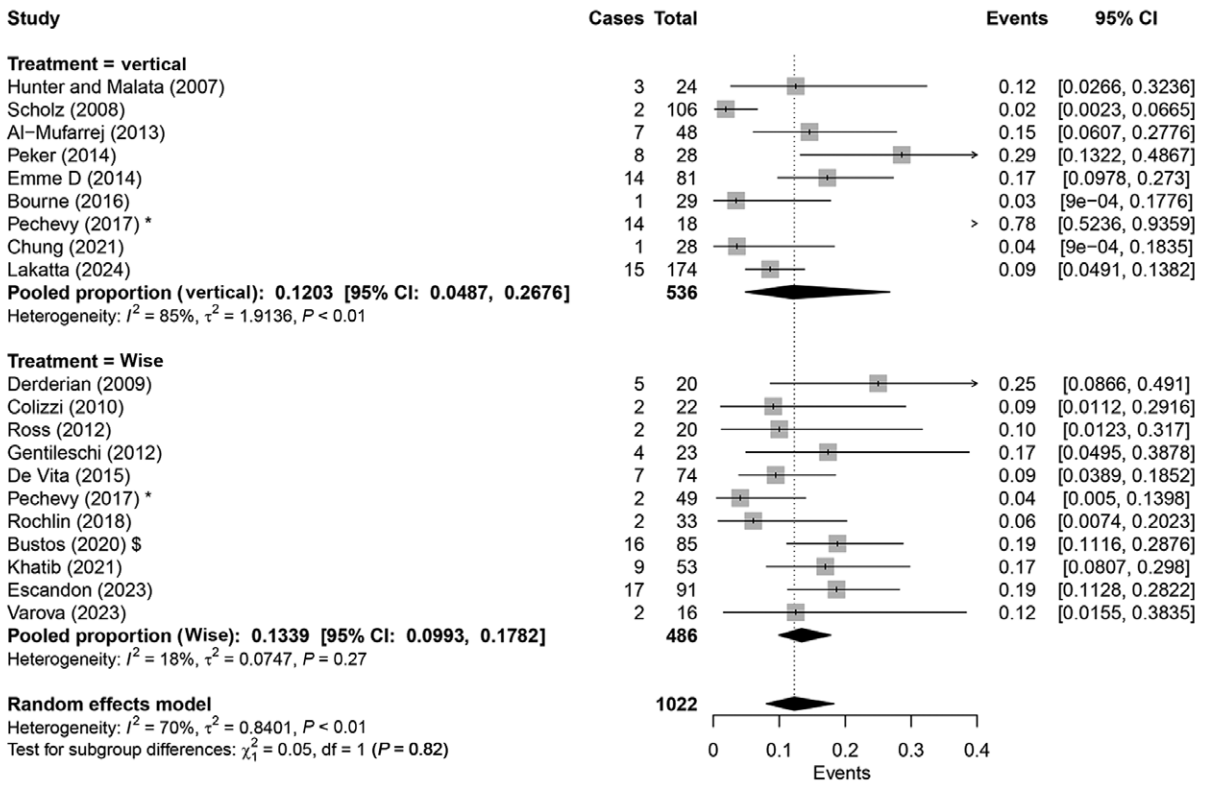

Fig. 9. Outcomes relating to cases of wound-related complications for vertical vs Wise group. *Comparative studies with 2 arms (vertical and Wise). $First-stage IBR only (direct to implant).

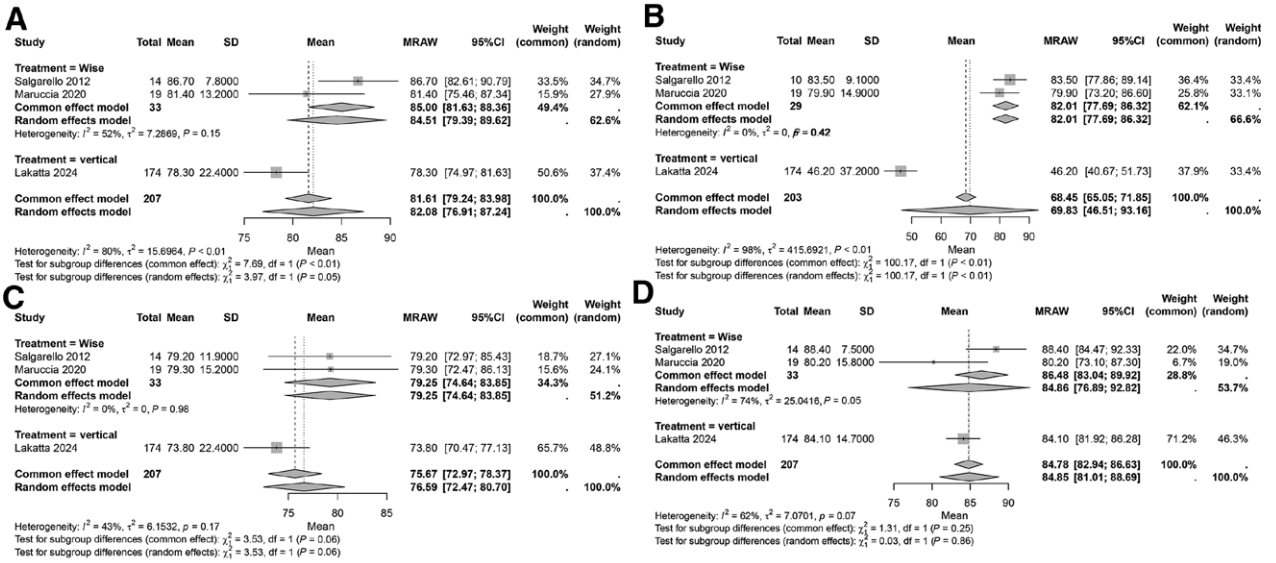

Fig. 10. BREAST-Q outcomes by domain: (A) BREAST-Q psychosocial domain. B, BREAST-Q sexual well-being domain. C, BREAST-Q satisfaction with breast domain. D, BREAST-Q physical well-being domain.

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DISCLOSURES

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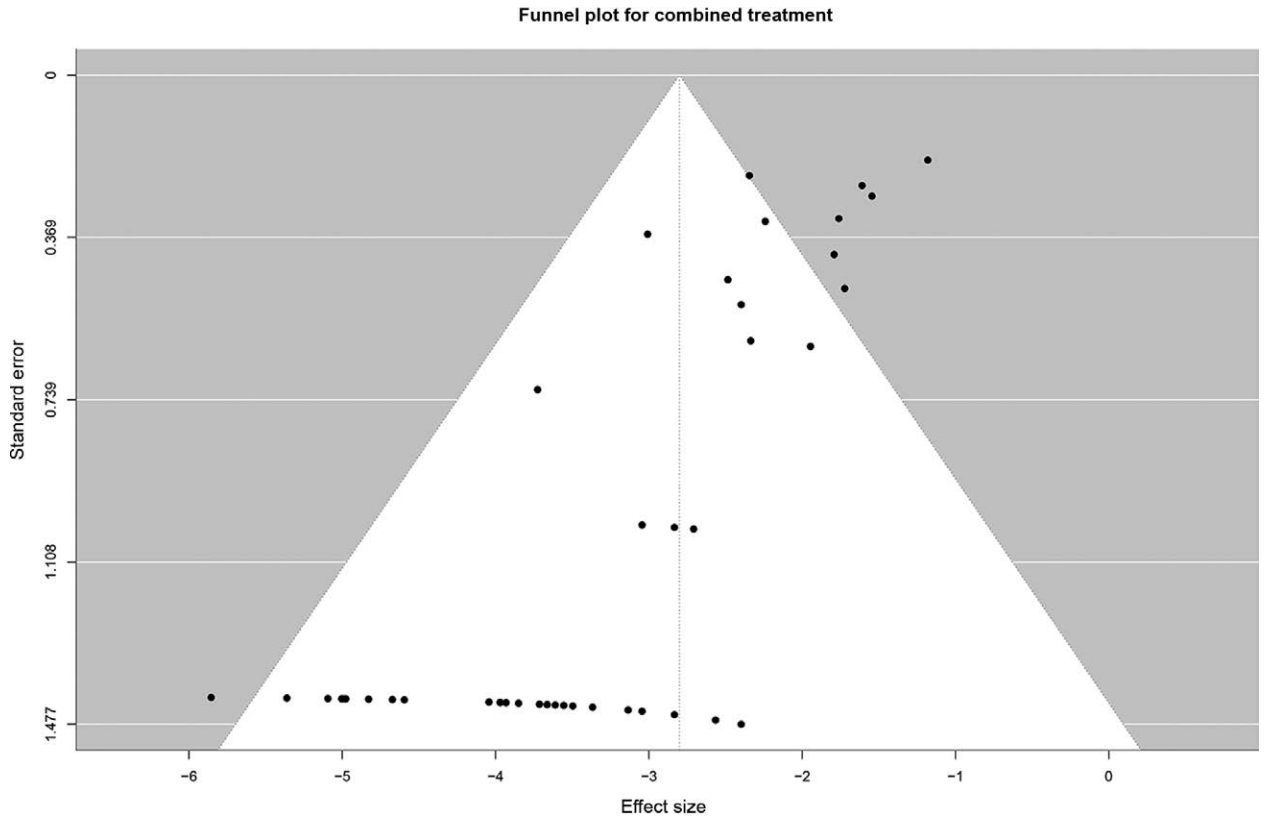

Fig. 11. Funnel plot for studies used in meta-analysis.

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ETHICAL APPROVAL

This review did not mandate ethical clearance, as it is categorized as a low-risk project. It solely involves the evaluation of previously published literature without involving human participants or personal data.

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