Aesth Plast Surg (2019) 43:890–898
https://doi.org/10.1007/s00266-019-01404-7

ORIGINAL ARTICLE BREAST SURGERY

Complications Following Subpectoral Versus Prepectoral Breast Augmentation: A Meta-analysis

Shangshan Li[1] · Dali Mu[1] · Chunjun Liu[1] · Minqiang Xin[1] · Su Fu[1] · Boyang Xu[1] · Zifei Li[1] · Jun Qi[1] · Jie Luan[1]

Received: 30 January 2019 / Accepted: 12 May 2019 / Published online: 28 May 2019

Abstract
Background Subpectoral and prepectoral planes have commonly been used in implant-based breast augmentation. The effect of implant plane on complication rate was still unclear. This meta-analysis demonstrated current evidence with regard to comparison of complication rates between subpectoral and prepectoral breast augmentation.
Methods Pubmed, EMBASE and Cochrane library were searched to December 2018. The results of selected studies were meta-analyzed to obtain a pooled odds ratio of the effect of subpectoral versus prepectoral breast augmentation on rates of complications.
Results There were significantly lower rates of capsular contracture and hematoma but higher rates of implant displacement and animation deformity in the subpectoral group compared with the prepectoral group. There was no significant difference with regard to rates of reoperation, seroma, rippling, infection and implant rupture between these two groups.
Conclusions Subpectoral and subglandular breast augmentations both have their merits and demerits with regard to complications. The pros and cons of each procedure should be fully explained to patients and selection of implant plane should be considered more comprehensively.
Level of Evidence III This journal requires that authors assign a level of evidence to each article. For a full description of these Evidence-Based Medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Subpectoral · Prepectoral · Breast augmentation · Complication

Introduction

Breast augmentation has been one of the most popular cosmetic surgeries for years. Selection of the implant plane is one of the key strategies of decision making for breast augmentation [1]. The subpectoral plane and prepectoral plane have both been commonly used in breast augmentation.

Various studies indicated that submuscular breast augmentation had a decreasing rate of capsular contracture [2–4] compared with prepectoral breast augmentation. However, some studies stated that the submuscular procedure could induce higher rates of implant malposition, animation deformity and increasing postoperative pain [5–7] due to contraction of the muscle. Currently, more attention was paid to capsular contracture, but other complications related to submuscular procedures were not emphasized as much as capsular contracture.

The objective of this study was to meta-analyze previous historical studies to explore the role of implant plane on the rate of complications to provide objective evidence that might be helpful for plane selection.

✉ Jie Luan
luanjieplastic@126.com

1 Department of Aesthetic and Reconstructive Breast Surgery, Plastic Surgery Hospital, Chinese Academy of Medical Sciences, Peking Union Medical College, 33 Badachu Road, Shijingshan District, Beijing 100144, China

Patients and Methods

Literature Searches and Study Selection

The Pubmed, EMBASE and Cochrane library were searched to December 2018 using the key words "breast augmentation," "augmentation mammaplasty" and "complication." Publication language was limited to English.

Selection Criteria

References that met the following criteria were included: (1) cosmetic breast augmentation; (2) comparison of subpectoral and prepectoral breast augmentation with regard to complication rate; (3) human clinical study. References that met the following criteria were excluded: (1) breast reconstruction with implants; (2) case reports, letters, comments, reviews; (3) the former publication of the same institution that had repeated data. Firstly, all identified titles and abstracts were evaluated to meet the aim of the study. Secondly, all potentially relevant references were retrieved for full text.

Data Abstraction and Quality Assessment

Data abstraction was conducted using a standardized form including first author, publication country and year, study design, quality assessment, sample size, patients' mean age and body mass index (BMI), follow-up, implant type and rates of complications including reoperation rate, capsular contracture, seroma, implant displacement, rippling, infection, implant rupture, hematoma and animation deformity. The Methodological Index [8] was used to assess non-randomized studies, and the quality was categorized into high (score greater than or equal to 16) and low (score lower than 16).

Statistical Analysis

Odds ratios (OR) and 95% confidence intervals (CI) were calculated, and a p value < 0.05 was judged as statistically significant. Statistical heterogeneity was tested using Chi-square and inconsistency (I^2) statistics and an I^2 value of greater than or equal to 50% represented substantial heterogeneity. A random effect model was used if I^2 was greater than or equal to 50%, and a fixed effect model was used if I^2 was lower than 50%. Meta-regression was performed using types of implant surface, implant shape and methodological quality as covariates to investigate the effect of characteristics on complication rates. The significance level of all the analyses was 0.05. Analyses were conducted in Review Manager version 5.3 from Cochrane Collaboration and STATA 15.0 from Stata Corporation.

Results

Study Selection

The process of selecting eligible studies is listed in Fig. 1.

Characteristics of the included studies are summarized in Table 1. A total sample size of 18,109 (13,211 in the subpectoral group and 4898 in the prepectoral group) was enrolled in this study. According to the type of complication, four studies described the reoperation rates, 11 studies described rates of capsular contracture, three studies described seroma rates, three studies described rates of implant displacement, two studies described rippling rates, five studies described infection rates, three studies described rates of implant rupture, three studies described hematoma rates and two studies described rates of animation deformity.

Comparison of Reoperation Rates

Four trials were pooled to compare the reoperation rates between subpectoral group and prepectoral groups. Low heterogeneity was observed in this study pool with a I^2 value of 0% ($\chi^2 = 1.81$), and a fixed effect model was adopted in this meta-analysis. The result showed no significant difference between these two groups (13.8% in subpectoral group versus 9.6% in prepectoral group; OR 0.98; 95% CI 0.72–1.35, $p = 0.92$) (Fig. 2).

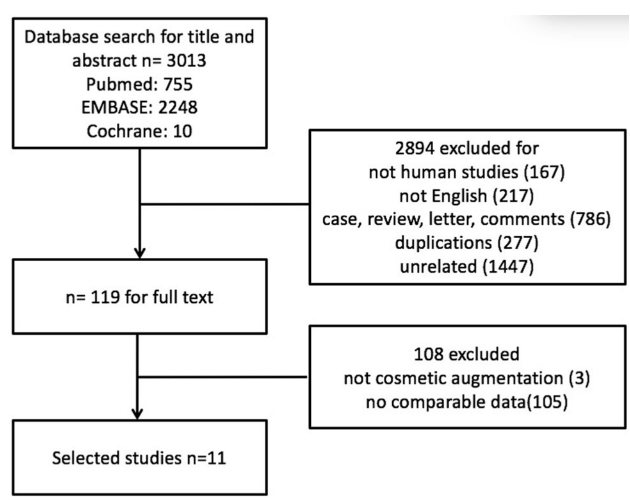

Fig. 1 Diagram of study selection

Table 1 Characteristics of the selected studies

Reference	Country	Study design	Methodologic quality	Sample size	Implant types	Mean age (years)	Mean BMI	Follow-up
Calobrace [9]	USA	Prospective	High	5122	Sientra round smooth, textured	36	20.8	10 years
McGuire [2]	USA	Prospective	High	10,075	Natrelle 410 form-stable	36	20.9	4.1 years
Ruiz [5]	Spain	Retrospective	Low	373	Allergan 410 form-stable	31–31.7	20.85–22.15	5 years
Li [6]	China	Retrospective	Low	124	Round textured silicon gel	31.21–38.10	19.17–20.19	31.66–32.5 months
Spear [3]	USA	Prospective	High	455	Natrelle round	34	20.7	10 years
Khan [7]	UK	Retrospective	Low	2026	Round textured silicon gel	30.0–33.0	N/A	> 3 years
Stutman [10]	USA	Retrospective	Low	619	Mentor	N/A	N/A	1.4 years
Pereira [11]	Brazil	Prospective	Low	53	Texturized silicone implant	23.2–26.1	N/A	3 years
Seify [12]	USA	Retrospective	Low	44	Mentor smooth	32	N/A	34 months
Vazquez [13]	USA	Retrospective	Low	196	Surgitex, Dow Corning, Heyer-Schulte	31.9	N/A	17.4–38.1 months
Puckett [14]	USA	Prospective	High	192	Round	30–33	N/A	27 months

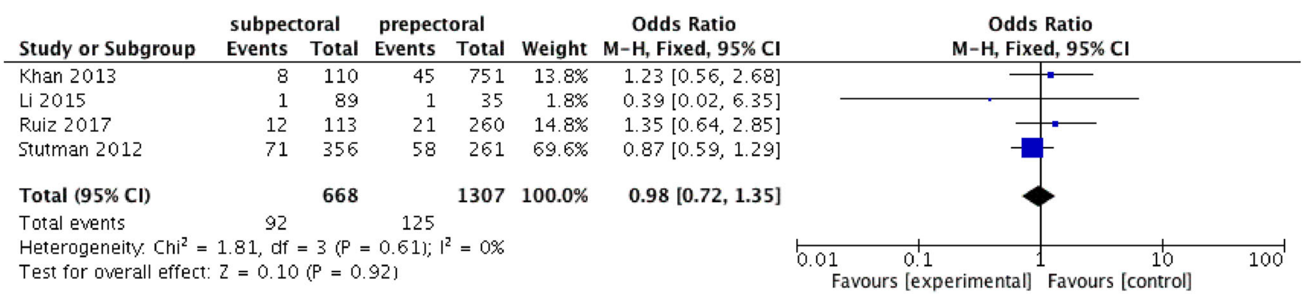

Fig. 2 Forest plot demonstrating the odds ratio of reoperation rates in subpectoral group versus prepectoral group with fixed effects model meta-analysis (Mantel–Haenszel)

Comparison of Capsular Contracture Rates

Eleven trials were combined to compare the capsular contracture rates between the subpectoral group and prepectoral group. A high heterogeneity was observed in this study pool with a I^2 value of 91% ($\chi^2 = 108.88$), and a random effect model was adopted in this meta-analysis. The result showed significantly higher rates of capsular contracture in the prepectoral group compared with the subpectoral group (1.7% in subpectoral group versus 9.6% in prepectoral group; OR 0.26; 95% CI 0.13–0.55, $p < 0.00001$) (Fig. 3). Meanwhile, meta-regression revealed the following: types of implant surface ($\tau^2 = 0.23$, $I^2 = 59.32\%$, adjusted $R^2 = -26.67\%$, $p = 0.391$), methodological quality ($\tau^2 = 0.20$, $I^2 = 54.69\%$, adjusted $R^2 = -11.83\%$, $p = 0.446$) and shape of implant ($\tau^2 = 0.23$, $I^2 = 58.30\%$, adjusted $R^2 = -24.08\%$, $p = 0.791$). These results of meta-regression showed that these characteristics had no influence on the results of the analyses.

Comparison of Seroma Rates

Three trials were combined to compare seroma rates between the submuscular group and prepectoral group. A low heterogeneity was observed in this study pool with a I^2 value of 0% ($\chi^2 = 0.10$), and a fixed effect model was adopted in this meta-analysis. The result showed no significant difference between these two groups (0.08% in subpectoral group versus 0.2% in prepectoral group; OR 1.06; 95% CI 0.22–5.06, $p = 0.94$) (Fig. 4).

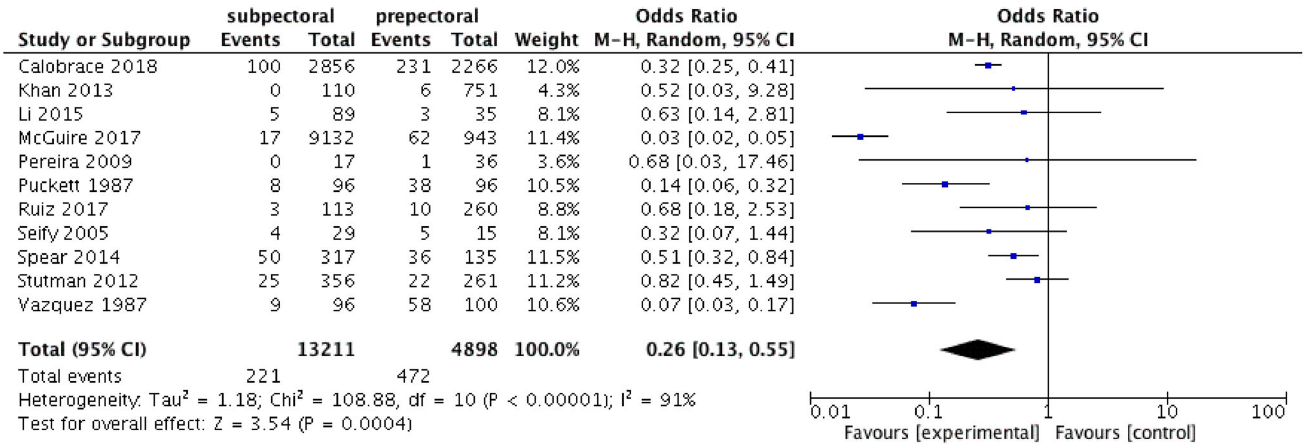

Fig. 3 Forest plot demonstrating the odds ratio of capsular contracture rates in subpectoral group versus prepectoral group with random effects model meta-analysis (Mantel–Haenszel)

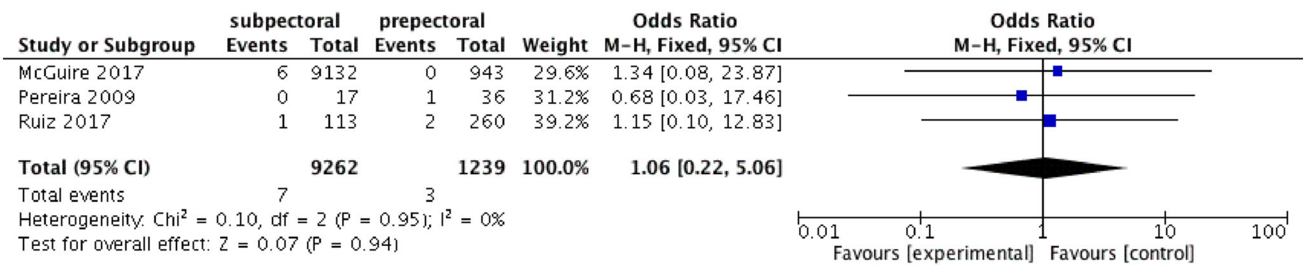

Fig. 4 Forest plot demonstrating the odds ratio of seroma rates in subpectoral group versus prepectoral group with fixed effects model meta-analysis (Mantel–Haenszel)

Comparison of Rates of Implant Displacement

Three trials were combined to compare implant displacement rates between the subpectoral group and prepectoral group. A low heterogeneity was observed in this study pool with a I^2 value of 0% ($\chi^2 = 0.66$), and a fixed effect model was adopted in this meta-analysis. The result showed significantly higher rates of implant displacement in the subpectoral group compared with the prepectoral group (4.5% in subpectoral group versus 0.6% in prepectoral group; OR 4.90; 95% CI 1.43–16.77, $p = 0.01$) (Fig. 5).

Comparison of Rippling Rates

Two trials were combined to compare rippling rates between the subpectoral group and prepectoral group. A low heterogeneity was observed in this study pool with a I^2 value of 0% ($\chi^2 = 0.14$), and a fixed effect model was adopted in this meta-analysis. The result showed no significant difference between these two groups (6.8% in subpectoral group versus 3.5% in prepectoral group; OR 1.39; 95% CI 0.76–2.52, $p = 0.28$) (Fig. 6).

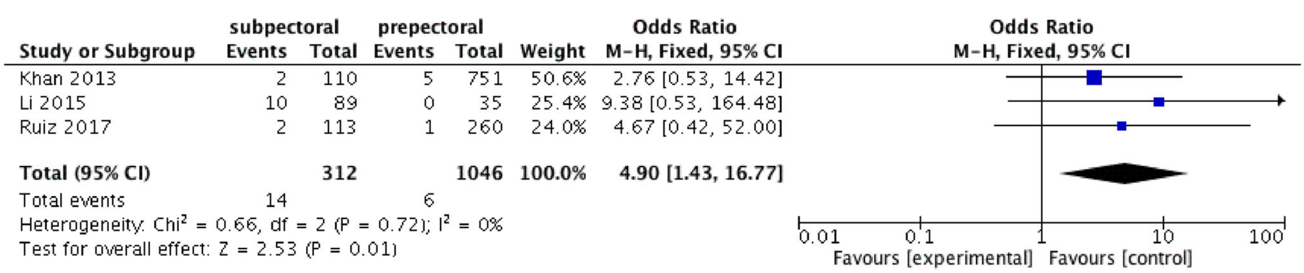

Fig. 5 Forest plot demonstrating the odds ratio of implant displacement rates in subpectoral group versus prepectoral group with fixed effects model meta-analysis (Mantel–Haenszel)

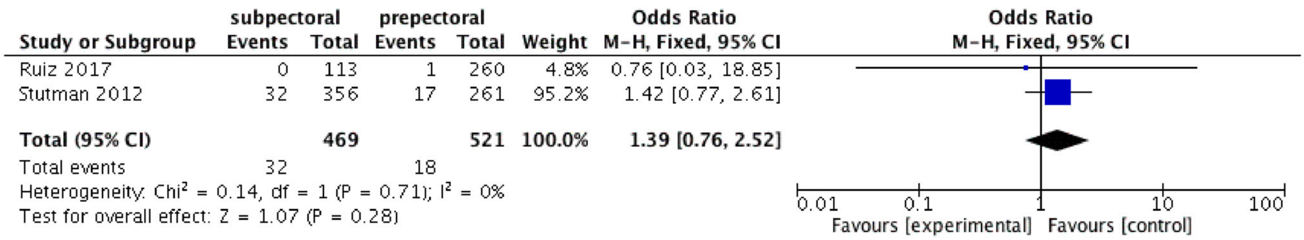

Fig. 6 Forest plot demonstrating the odds ratio of rippling rates in subpectoral group versus prepectoral group with fixed effects model meta-analysis (Mantel–Haenszel)

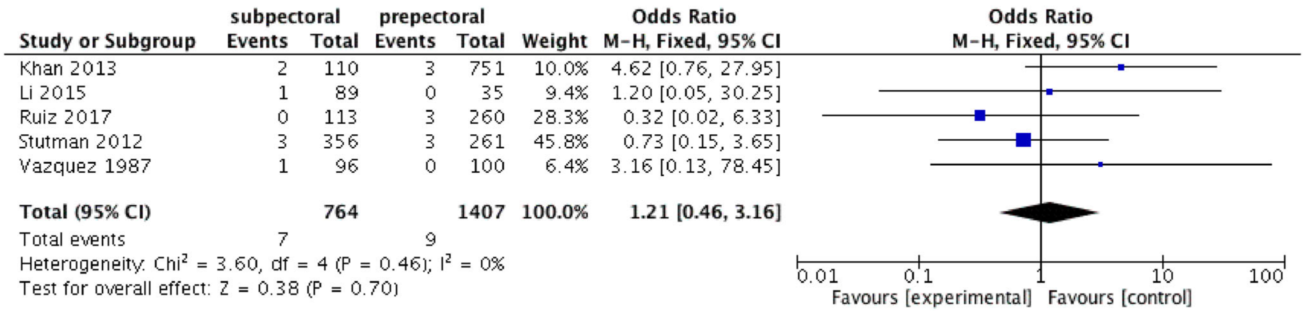

Fig. 7 Forest plot demonstrating the odds ratio of infection rates in subpectoral group versus prepectoral group with fixed effects model meta-analysis (Mantel–Haenszel)

Comparison of Infection Rates

Five trials were combined to compare infection rates between the subpectoral group and prepectoral group. Low heterogeneity was observed in this study pool with a I^2 value of 0% ($\chi^2 = 3.60$), and a fixed effect model was adopted in this meta-analysis. The result showed no significant difference between these two groups (0.9% in subpectoral group versus 0.6% in prepectoral group; OR 1.21; 95% CI 0.46–3.16, $p = 0.70$) (Fig. 7).

Comparison of Implant Rupture Rates

Three trials were combined to compare implant rupture rates between the subpectoral group and prepectoral group. Low heterogeneity was observed in this study pool with a I^2 value of 3% ($\chi^2 = 2.06$), and a fixed effect model was adopted in this meta-analysis. The result showed no significant difference between these two groups (1.8% in subpectoral group versus 1.0% in prepectoral group; OR 1.67; 95% CI 0.61–4.55, $p = 0.32$) (Fig. 8).

Comparison of Hematoma Rates

Three trials were combined to compare the reoperation rates between the subpectoral group and prepectoral group. Low heterogeneity was observed in this study pool with a I^2 value of 0% ($\chi^2 = 1.66$), and a fixed effect model was adopted in this meta-analysis. The result showed that hematoma rates were significantly higher in the prepectoral group than in subpectoral group (0.9% in subpectoral group versus 2.9% in prepectoral group; OR 0.35; 95% CI 0.13–0.89, $p = 0.03$) (Fig. 9).

Comparison of Animation Deformity Rates

Three trials were combined to compare the animation deformity rates between subpectoral group and prepectoral group. Low heterogeneity was observed in this study pool with a I^2 value of 0% ($\chi^2 = 0.04$), and a fixed effect model was adopted in this meta-analysis. The result showed higher rates of animation deformity in the submuscular group than in the prepectoral group (3.8% in subpectoral group versus 0% in prepectoral group; OR 14.47; 95% CI 1.70–123.07, $p = 0.01$) (Fig. 10).

Discussion

Breast augmentation is one of the most popular and widely studied cosmetic surgeries. Selection of implant plane is one of the key strategies that should be cautiously considered. Various studies stated that rates of capsular contracture were higher in prepectoral breast augmentation compared with the subpectoral procedure [2–4]. However, other studies stated that the risks including implant malposition were higher in the submuscular procedures [5–7] which might be induced by contraction of the muscle.

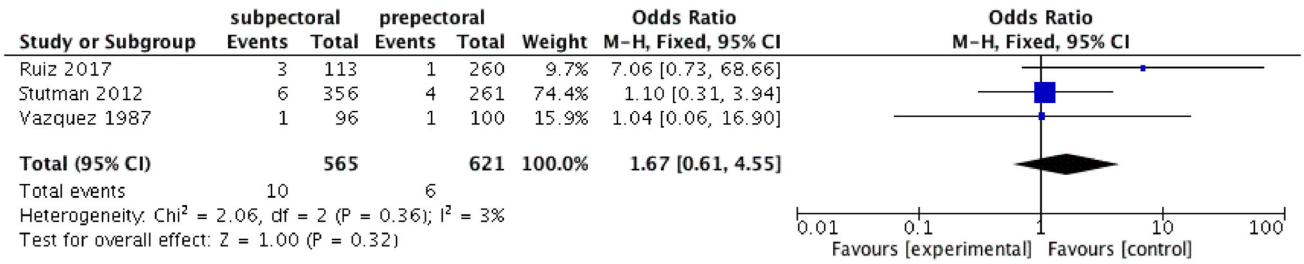

Fig. 8 Forest plot demonstrating the odds ratio of implant rupture rates in subpectoral group versus prepectoral group with fixed effects model meta-analysis (Mantel–Haenszel)

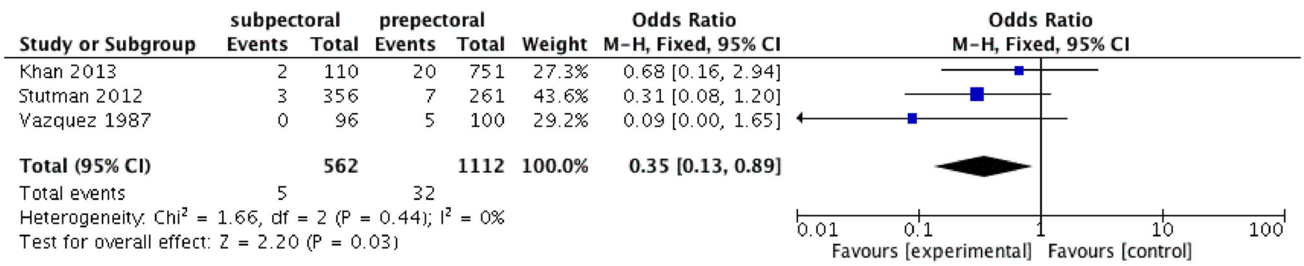

Fig. 9 Forest plot demonstrating the odds ratio of hematoma rates in subpectoral group versus prepectoral group with fixed effects model meta-analysis (Mantel–Haenszel)

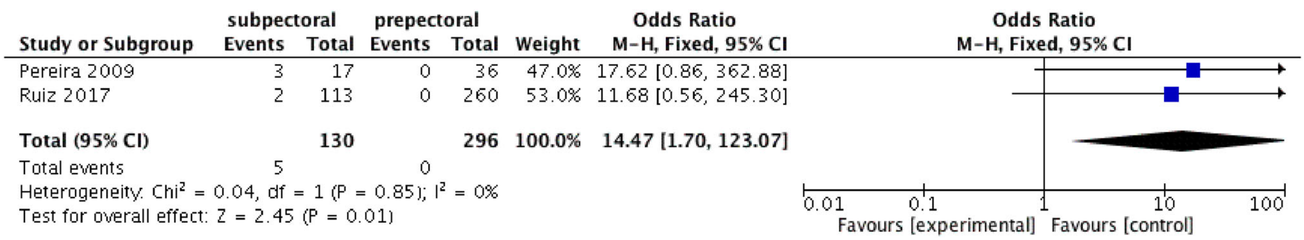

Fig. 10 Forest plot demonstrating the odds ratio of animation deformity rates in subpectoral group versus prepectoral group with fixed effects model meta-analysis (Mantel–Haenszel)

Animation deformity is another complication caused by muscle contracture. A study stated that only 22.5% had no distortion after primary dual-plane breast augmentation [15], and the proper method to prevent this kind of complication was a prepectoral procedure [16, 17]. There were few previous studies that meta-analyzed complication rates between subpectoral and prepectoral breast augmentation.

In this study, there was a significantly higher rate of capsular contracture in prepectoral breast augmentation that was in accordance with previous studies. Subpectoral breast augmentation could decrease contact with glandular tissues that might reduce the risk of capsular contracture [18, 19]. The etiology of capsular contracture was multifactorial and various factors affected the rates of capsular contracture including infection, type of incision and implant. Povidone-iodine, textured implants, non-periareolar incisions could be preventive factors for capsular contracture according to previous meta-analyses [20–22]. Because high heterogeneity was shown, to investigate the effect of these factors on the complication rates, meta-regression was done using types of implant surfaces and shapes of implants (round or anatomical) as covariates. The results showed that these characteristics had no influence on the results of the analyses.

There was a significantly higher rate of implant displacement following submuscular breast augmentation than prepectoral breast augmentation. The pooled rate of animation deformity was also significantly higher in the submuscular group. These kinds of complications might be caused by contraction of the pectoralis major muscle [15, 23, 24].

There was a significantly higher rate of hematoma following prepectoral augmentation than in the submuscular group which might be due to a relatively tight junction that might result in more vascular damage when being dissected in this layer than the submuscular layer in our view.

However, further studies should be conducted to verify this result because only three studies were included in this analysis.

One study stated that duration hours of pain were significantly higher in the subpectoral group (66.92 h in subpectoral group versus 47.54 h in prepectoral group, $p < 0.05$) and so was duration of indwelling drains (2.98 days in subpectoral group versus 1.46 days in prepectoral group, $p < 0.05$) [6], indicating that the trauma was larger in the subpectoral group which might decrease patient satisfaction.

For the reason for reoperation, capsular contracture accounted for 18.8%, whereas malposition or asymmetry that might be related to muscle contraction accounted for 15.6% according to a previous study [25]. In this meta-analysis, the merged rates of capsular contracture, implant displacement and animation deformity were 1.7%, 4.5% and 3.8%, respectively, in the submuscular group and 9.6%, 0.57% and 0% in the prepectoral group, respectively. In other words, there was a significantly higher rate of capsular contracture and significantly lower rates of implant displacement and animation deformity in the prepectoral group than in the submuscular group. It was difficult to state which procedure was more superior than the other through these results.

With regard to other complication rates including reoperation, seroma, rippling, infection and implant rupture, there was no significant difference between submuscular breast augmentation and prepectoral breast augmentation. Rippling was associated with thin breast tissue coverage [26, 27]. However, in this meta-analysis, there was no significant difference of rippling between these two groups. It could be explained by the fact that appropriate selection of patients for the prepectoral procedure might decrease the rates of rippling. However, there were only two rippling-related comparative studies and further studies should be conducted to verify this conclusion.

The prepectoral procedure was thought to be suitable for patients with a pinch test larger than 2 cm, or in some studies, patients with a pinch test larger than 1.5 cm could also be candidates for prepectoral breast augmentation [5]. In cases with thin soft-tissue coverage, fat injection could be an adjunctive procedure [28]. Acellular dermal matrix (ADM) was commonly used in prepectoral breast reconstruction or revisional breast augmentation to prevent capsular contracture [29–32]. Although there were few previous studies that used ADM in primary breast augmentation, the effect of ADM in increasing soft tissue coverage and reducing the rate of capsular contracture might be helpful for prepectoral breast augmentation.

Subfascial breast augmentation was thought to provide supplementary soft-tissue coverage and prevent muscular dynamics and implant displacement, which might make the best of subglandular and submuscular plane [33]. However, in this meta-analysis, we found only two comparative studies including specific subfascial augmentation that we merged subfascial group and subglandular group into prepectoral group. Further comparative studies should be conducted to verify the pros and cons of subfascial breast augmentation.

Four of the 11 studies revealed high quality according to the Methodological Index including 12 indices, indicating there was still less related studies with high quality. Our results of meta-regression using MI as a covariate showed that MI did not have an influence on rates of capsular contracture.

To the best of our knowledge, this is the first meta-analysis regarding the relationship between implant plane and complication rates. However, there are some limitations in this meta-analysis. First, there is a lack of comparative studies, especially univariate studies excluding other factors except implant plane. The effect of incision type, use of povidone-iodine, implant type could have an effect on complication rates. For example, one study stated that although there was no significant difference in total reoperation rates between prepectoral and submuscular procedures, the reoperation rate of the transaxillary submuscular procedure was significantly higher than the transaxillary subfascial procedure (13% vs. 6.2%, $p < 0.05$) [5]. Although the results of meta-regression stated these factors had no influence on the rates of capsular contracture in this meta-analysis, other complications could not be assessed via meta-regression due to inadequate published studies. Further univariate studies should be conducted to verify this conclusion. Second, there were only prospective and retrospective studies without any randomized controlled trials (RCT) published and recruited for this meta-analysis. Although the results of meta-regression showed no influence of methodological quality on the rates of complications, more RCTs with high quality should be performed for further accurate meta-analysis. Thirdly, there were four common planes including submuscular, dual-plane, subfascial and subglandular plane in breast augmentation. However, there were few comparative studies that make comparisons of these four planes. Thus, we merged subfascial and subglandular groups into prepectoral groups, which might influence the accuracy of the results. Moreover, only research in English was selected in this analysis which could not be enough to represent the whole published data.

Conclusions

The results of our meta-analysis demonstrated significantly lower rates of capsular contracture and hematoma but higher rates of implant displacement and animation deformity in the subpectoral group compared with the prepectoral group. There was no significant difference with regard to reoperation, seroma, rippling, infection or implant rupture. There were both merits and demerits in both techniques. The complications, especially the different rates of capsular contracture, hematoma, implant displacement and animation deformity, should be fully explained, and the selection of implant plane should be considered more comprehensively. However, a lack of research of high quality might influence the results. Meanwhile, further univariate studies with comparison of the submuscular, dual, subfascial and subglandular planes are required to verify this conclusion.

Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose. No funding was aided for this study.

Ethical Approval All analyses were based on previous published studies thus ethical approval is unnecessary.

Informed Consent This study was based on previous published studies that informed consent was unnecessary.

References

1. Tebbetts JB, Adams WP (2005) Five critical decisions in breast augmentation using five measurements in 5 minutes: the high five decision support process. Plast Reconstr Surg 116:2005–2016
2. McGuire P, Reisman NR, Murphy DK (2017) Risk factor analysis for capsular contracture, malposition, and late seroma in subjects receiving natrelle 410 form-stable silicone breast implants. Plast Reconstr Surg 139:1–9. https://doi.org/10.1097/PRS.0000000000002837
3. Spear SL, Murphy DK, Allergan Silicone Breast Implant U.S. Core Clinical Study Group (2014) Natrelle round silicone breast implants: core study results at 10 years. Plast Reconstr Surg 133:1354–1361. https://doi.org/10.1097/PRS.0000000000000021
4. Stevens WG, Nahabedian MY, Calobrace MB et al (2013) Risk factor analysis for capsular contracture: a 5-year Sientra study analysis using round, smooth, and textured implants for breast augmentation. Plast Reconstr Surg 132:1115–1123. https://doi.org/10.1097/01.prs.0000435317.76381.68
5. Benito-Ruiz J, Manzano ML, Salvador-Miranda L (2017) Five-year outcomes of breast augmentation with form-stable implants: periareolar vs transaxillary. Aesthet Surg J 37:46–56. https://doi.org/10.1093/asj/sjw154
6. Shi H, Cao C, Li X et al (2015) A retrospective study of primary breast augmentation: recovery period, complications and patient satisfaction. Int J Clin Exp Med 8:18737–18743
7. Khan UD (2013) Muscle-splitting, subglandular, and partial submuscular augmentation mammoplasties: a 12-year retrospective analysis of 2026 primary cases. Aesthet Plast Surg 37:290–302. https://doi.org/10.1007/s00266-012-0026-8
8. Slim K, Nini E, Forestier D et al (2003) Methodological index for non-randomized studies (minors): development and validation of a new instrument. ANZ J Surg 73:712–716
9. Calobrace MB, Stevens WG, Capizzi PJ et al (2018) Risk factor analysis for capsular contracture: a 10-year sientra study using round, smooth, and textured implants for breast augmentation. Plast Reconstr Surg 141:20S–28S. https://doi.org/10.1097/PRS.0000000000004351
10. Stutman RL, Codner M, Mahoney A et al (2012) Comparison of breast augmentation incisions and common complications. Aesthet Plast Surg 36:1096–1104. https://doi.org/10.1007/s00266-012-9918-x
11. Pereira LH, Sterodimas A (2009) Transaxillary breast augmentation: a prospective comparison of subglandular, subfascial, and submuscular implant insertion. Aesthet Plast Surg 33:752–759. https://doi.org/10.1007/s00266-009-9389-x
12. Seify H, Sullivan K, Hester TR (2005) Preliminary (3 years) experience with smooth wall silicone gel implants for primary breast augmentation. Ann Plast Surg 54:231–235 **(discussion 235)**
13. Vazquez B, Given KS, Houston GC (1987) Breast augmentation: a review of subglandular and submuscular implantation. Aesthet Plast Surg 11:101–105
14. Puckett CL, Croll GH, Reichel CA et al (1987) A critical look at capsule contracture in subglandular versus subpectoral mammary augmentation. Aesthet Plast Surg 11:23–28
15. Spear SL, Schwartz J, Dayan JH et al (2009) Outcome assessment of breast distortion following submuscular breast augmentation. Aesthet Plast Surg 33:44–48. https://doi.org/10.1007/s00266-008-9275-y
16. Lentz RB, Piper ML, Gomez-Sanchez C et al (2017) Correction of breast animation deformity following prosthetic breast reconstruction. Plast Reconstr Surg 140:643e–644e. https://doi.org/10.1097/PRS.0000000000003739
17. Hammond DC, Schmitt WP, O'Connor EA (2015) Treatment of breast animation deformity in implant-based reconstruction with pocket change to the subcutaneous position. Plast Reconstr Surg 135:1540–1544. https://doi.org/10.1097/PRS.0000000000001277
18. Wiener TC (2008) Relationship of incision choice to capsular contracture. Aesthet Plast Surg 32:303–306. https://doi.org/10.1007/s00266-007-9061-2
19. Del Pozo JL, Tran NV, Petty PM et al (2009) Pilot study of association of bacteria on breast implants with capsular contracture. J Clin Microbiol 47:1333–1337. https://doi.org/10.1128/JCM.00096-09
20. Yalanis GC, Liu EW, Cheng HT (2015) Efficacy and safety of povidone-iodine irrigation in reducing the risk of capsular contracture in aesthetic breast augmentation: a systematic review and meta-analysis. Plast Reconstr Surg 136:687–698. https://doi.org/10.1097/PRS.0000000000001576
21. Li S, Chen L, Liu W et al (2018) Capsular contracture rate after breast augmentation with periareolar versus other two (inframammary and transaxillary) incisions: a meta-analysis. Aesthet Plast Surg 42:32–37. https://doi.org/10.1007/s00266-017-0965-1
22. Wong CH, Samuel M, Tan BK et al (2006) Capsular contracture in subglandular breast augmentation with textured versus smooth breast implants: a systematic review. Plast Reconstr Surg 118:1224–1236. https://doi.org/10.1097/01.prs.0000237013.50283.d2
23. Lesavoy MA, Trussler AP, Dickinson BP (2010) Difficulties with subpectoral augmentation mammaplasty and its correction: the role of subglandular site change in revision aesthetic breast surgery. Plast Reconstr Surg 125:363–371. https://doi.org/10.1097/PRS.0b013e3181c2a4b0

24. Araco A, Gravante G, Araco F et al (2007) A retrospective analysis of 3,000 primary aesthetic breast augmentations: postoperative complications and associated factors. Aesthet Plast Surg 31:532–539. https://doi.org/10.1007/s00266-007-0162-8
25. Stevens WG, Calobrace MB, Alizadeh K et al (2018) Ten-year core study data for Sientra's Food and Drug Administration-approved round and shaped breast implants with cohesive silicone gel. Plast Reconstr Surg 141:7S–19S. https://doi.org/10.1097/PRS.0000000000004350
26. Adams WP Jr (2008) The process of breast augmentation: four sequential steps for optimizing outcomes for patients. Plast Reconstr Surg 122:1892–1900. https://doi.org/10.1097/PRS.0b013e31818d20ec
27. Handel N, Cordray T, Gutierrez J et al (2006) A long-term study of outcomes, complications, and patient satisfaction with breast implants. Plast Reconstr Surg 117:757–767. https://doi.org/10.1097/01.prs.0000201457.00772.1d **(discussion 768–772)**
28. Kerfant N, Henry AS, Hu W et al (2017) Subfascial primary breast augmentation with fat grafting: a review of 156 cases. Plast Reconstr Surg 139:1080e–1085e. https://doi.org/10.1097/PRS.0000000000003299
29. Vidya R, Iqbal FM (2017) A guide to prepectoral breast reconstruction: a new dimension to implant-based breast reconstruction. Clin Breast Cancer 17:266–271. https://doi.org/10.1016/j.clbc.2016.11.009
30. Highton L, Johnson R, Kirwan C et al (2017) Prepectoral implant-based breast reconstruction. Plastic and reconstructive surgery. Glob Open 5:e1488. https://doi.org/10.1097/GOX.0000000000001488
31. Pozner JN, White JB, Newman MI (2013) Use of porcine acellular dermal matrix in revisionary cosmetic breast augmentation. Aesthet Surg J 33:681–690. https://doi.org/10.1177/1090820X13491279
32. Maxwell GP, Gabriel A (2014) Acellular dermal matrix for reoperative breast augmentation. Plast Reconstr Surg 134:932–938. https://doi.org/10.1097/PRS.0000000000000777
33. Munhoz AM, Gemperli R, Sampaio Goes JC (2015) Transaxillary subfascial augmentation mammaplasty with anatomic form-stable silicone implants. Clin Plast Surg 42:565–584. https://doi.org/10.1016/j.cps.2015.06.016