Subfascial Breast Augmentation: A Systematic Review and Meta-Analysis of Capsular Contracture

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Abstract

Background: Subfascial breast augmentation is a technique originally developed to reduce the risks of capsular contracture while decreasing the postoperative pain associated with subpectoral augmentation. It was pioneered in Brazil by Dr. Graf and others, and recently this technique has gained interest in the aesthetic world.

Objectives: The goal of this study was to provide a systematic analysis of subfascial breast augmentation to assess the combined reported rates of capsular contracture, animation deformity and complications.

Methods: The PubMed, Embase, and Web of Science databases were searched for the use of the subfascial plane for breast augmentation. We included studies that reported on capsular contracture and other outcomes following subfascial breast augmentation.

Results: Through the initial search, 26 articles were identified. Of which, 22 were included in the final study. A total of 3743 patients were identified across these studies with a total number of 38 cases of capsular contracture representing a rate of 1.01% of capsular contracture. Several articles reported on demographics, perioperative and long-term complications, and outcomes with regards to the aesthetic outcome from the surgeon’s perspective. Several infections were reported representing a rate of 0.1%. Animation deformity was not reported, although rippling was occasionally reported as was malrotation, axillary banding, sensory deficit, and asymmetry. Subfascial breast augmentation appears to have a low complication rate and an extremely low rate of capsular contracture at approximately 1%.

Conclusions: Subfascial breast augmentation may provide the benefits of low rates of capsular contracture while avoiding the discomfort and future animation deformity of subpectoral augmentation.

Level of Evidence: 4
the intact fascia can blunt the edges and reduce the visibility of the implant and it does not disrupt the pectoral muscle. It has been described as a composite breast augmentation in conjunction with fat grafting as well as a technique for thin patients who wish to camouflage the implant edge.

Classical efforts have been focused at blunting the step off in the superior pole through the use of the subpectoral pocket or with a dual plane approach. Patients may have excellent outcomes with this type of reconstruction, but there may be less pain and spasm with subfascial implant placement. Several studies have sought to elucidate advantages and have suggested subfascial implantation may have some benefits compared to submuscular. Furthermore, several large case series have reported long-term outcomes and very low rates of capsular contracture. There have been reported cases of capsular contracture and methods to correct capsular contracture in patients with subfascial augmentation.

Given these reports, the goal of this study was to examine the literature on subfascial augmentation to determine outcomes with regards to capsular contracture, animation deformity, and complications. Study participants included in the literature are largely undefined; however, a comparison of outcomes is still warranted. A systematic review of the literature has not yet been performed on this subject. As such, rates of capsular contracture among those patients that have received subfascial breast augmentation will be investigated in relation to subglandular and submuscular augmentation.

**METHODS**

The primary endpoint of this review was to study the effect of subfascial breast augmentation on capsular contracture and other complications, including revisions, hematoma, seroma, infection, animation, ripples, malrotation, and asymmetry. Secondary analysis was conducted to determine the effect of subfascial breast augmentation on aesthetic outcome. The patient follow-up period and demographics were also evaluated.

**Study Selection**

On April 9, 2017, we conducted a search of published articles in PubMed, Embase, and Web of Science databases. The search was done with no restrictions and for specific search terms: “subfascial, retrofascial, breast augmentation, mammaplasty.” After excluding duplicates, the authors (L.O. and D.G.) screened the titles and abstracts of all the articles. Studies evaluating subfascial breast augmentation and capsular contracture were considered candidate studies and the full text of each of these articles was assessed for further evaluation based on the inclusion and exclusion criteria established prior to the literature search.
In cases of disagreement between the two screeners, another author (O.S.) assessed the full text and resolved the dispute. If there was further disagreement, the senior author was consulted. The reference list of each study was manually screened for additional pertinent articles (Figure 1).

To be included in the meta-analysis, a published study had to measure capsular contracture in patients who have undergone primary breast augmentation in the subfascial plane only. Studies between the years 2000 and 2017 were included given that modern developments of the technique have largely occurred in the 21st century.

Excluded from the meta-analysis were studies that included patients who underwent breast augmentation only partially in the subfascial plane, studies that focused on most appropriate implant type and not complications of subfascial breast augmentation, and studies that only included reoperations albeit in the subfascial plane.
Table 2. Reported Patient Follow-Up of Included Studies

| Study             | Follow-up period                                      | No. of patients who underwent subfascial BA |
|-------------------|-------------------------------------------------------|--------------------------------------------|
| Araco, 2007       | “Short follow-up period”                              | 511                                        |
| Aygit, 2013       | Ranging from 7 to 28 months (average, 21 months)      | 27                                         |
| Barbato, 2004     | 1 year on average                                     | 110                                        |
| Benito-Ruiz, 2003 | NR                                                    | 16                                         |
| Brown, 2012       | NR                                                    | 200                                        |
| Goes, 2003        | “Pleasing long-term results”                           | 241                                        |
| Graf, 2000        | NR                                                    | 8                                          |
| Graf, 2003        | NR                                                    | 263                                        |
| Graf, 2005        | NR                                                    | 415                                        |
| Hunstad, 2010     | Ranging from 2 to 24 months                           | 61                                         |
| Keramidas, 2006   | NR                                                    | 350                                        |
| Kerfant, 2017     | Ranging from 1 to 86 months (average, 22.5 months)    | 156                                        |
| Lin Jinde, 2010   | NR                                                    | 10                                         |
| Munhoz, 2006      | The minimum follow-up period was 3 months (average, 16 months; range, 4-45 months) | 42                                         |
| Pereira, 2009     | Ranging from 6 months to 3 years                     | 18                                         |
| Said, 2016        | 2- to 4-month follow-up period                       | 25                                         |
| Serra-Renom, 2005 | 1 day, 1 week, 1 month, 3 months, 1 year             | 45                                         |
| Siclovan, 2008    | NR                                                    | 45                                         |
| Stoff-Khalili, 2004 | 2.9 years on average (69 of 75 followed up)   | 75                                         |
| Tijerina, 2009    | NR                                                    | 1000                                       |
| Ventura, 2005     | NR                                                    | 100                                        |
| Yang, 2013        | Ranging from 2 to 26 months                           | 25                                         |

BA, breast augmentation. NR, not reported.

Data Collection

Data from each study were extracted into a form with the following parameters: publication citation, number of patients, number of capsular contracture, baker class, number of hematomas, infections, revisions, seromas, ripples, scarring, sensory deficits, malrotations, asymmetries demographic information, and patient satisfaction criteria.

Meta-Analysis

After collecting 22 studies with reported capsular contracture rates, the studies were subjected to a meta-analysis to determine the overall rates of capsular contracture and the weighted effects of each study. Several methods were utilized toward this end and Microsoft Excel was used for calculation of the effects, statistical analysis of the studies as well as the visual display of the data in the form of forest plots with the reported outcomes. The overall heterogeneity was reported and a Q-test was applied as well as a calculation of which is an indicator of heterogeneity previously reported in the literature. Models under the assumptions of either fixed or random effects were also studied. The principle summary measure is a difference in pooled means. Risk of bias was not assessed for the observational studies included, since a majority of the STROBE checklist could not be evaluated from the publicly available text. The quality of this systematic review and
meta-analysis was assessed using the PRISMA checklist (Supplementary Appendix A).

RESULTS

Initial electronic database search resulted in 100 manuscripts. After further screening of title and abstract, 58 articles were subject to further screening. Following inclusion and exclusion analysis, a total of 22 articles representing data on 3743 patients was included in this review and meta-analysis.

Demographics

Unfortunately, very little was reported in the qualifying studies on the actual demographics of the patients receiving implants. Though many studies stated that these patients were similar to other patients seeking primary augmentation, there were few studies with reported age range, BMI, or other medical information about the augmented patients (Table 1). However, there were large numbers of patients in each of the study groups, with a total of 3743 patients reported across all included studies.

Follow-Up Time

Ten of the included studies did not report a follow-up length; however, several described pleasing long-term results or outcomes. Table 2 summarizes the reported follow-up length for each of these studies.

Capsular Contracture

The pooled rate of capsular contracture was 1.01% among all 3743 subfascial augmentations included in this meta-analysis. In each study, the standard error and variability were calculated as well as a weighting for each study (Figure 2). Note studies without capsular contracture hold low weight in the models because of the nature of the mathematical formula used to calculate the weight. The meta-analysis was first conducted by weighting the reported contracture rate for each study and then by modeling the outcomes using a fixed-effects model and a random-effects model with 21 degrees of freedom. The weighted rate of capsular contracture was determined to be 0.69%. A Q-test was applied and a calculated Q-score was found to be 22.4% (α = 0.05) which, when compared to the chi-squared table value of 32.6, was lower and thus suggests that the studies are homogenous in nature. The calculated $I^2$ value for heterogeneity was extremely low at 6.29% which is also indicative of a low level of heterogeneity across all included studies. Given low heterogeneity, the fixed-effects model was found to be appropriate for statistical analysis and discussion. Furthermore, a random-effects model was not used, given that a single outcome was investigated and the data were relatively homogenous.

Outcomes

Among complications, hematoma was reported with a pooled rate of 0.72% overall (Table 3). Rippling was
| Study            | Capsular contracture (%) | Baker class | Hematoma | Ripples | Revisions | Animation | Infection | Hypertrophic scarring | Sensory deficits | Malrotation/ misplacement | Axillary fibrous banding | Asymmetry | Seroma |
|------------------|--------------------------|-------------|----------|---------|-----------|-----------|-----------|-----------------------|-----------------|---------------------------|------------------------|-----------|--------|
| Araco, 2007      | 0                        | 0           | 1        | NR      | NR        | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | NR     |
| Aygit, 2013      | 14.81                    | 2           | 1        | 0       | 0         | NR        | NR        | 2                     | NR              | 0                         | NR                     | 1 (patient did not request reoperation) | NR        | NR     |
| Barbato, 2004    | 3.64                     | NR          | 0        | NR      | NR        | NR        | 0         | 2                     | 2               | NR                        | NR                     | 2 (areola asymmetry)    | NR        | NR     |
| Benito-Ruiz, 2003| 0                        | NR          | 0        | NR      | NR        | NR        | NR        | 0                     | NR              | Subcutaneous banding at the axilla was noted in 6 patients but disappeared within 3 months of surgery | NR        | NR     |
| Brown, 2012      | 0.5                      | NR          | 10       | 7       | 8         | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | NR     |
| Goes, 2003       | 0                        | NR          | 0        | NR      | NR        | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | NR     |
| Graf, 2000       | 0                        | 0           | NR       | NR      | NR        | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | NR     |
| Graf, 2003       | 2.28                     | 2           | 3        | NR      | NR        | 0         | 0         | NR                    | NR              | 8                         | NR                     | NR        | NR     |
| Graf, 2005       | 217                      | 2           | 5        | NR      | NR        | NR        | NR        | 2                     | NR              | 4                         | NR                     | 3         | 4      |
| Hunstad, 2010    | 0                        | 0           | 0        | 2       | Patient 9.5 Physician 9.6 (both 10) | 4         | 0         | 0                     | Patient 9.0 Physician 9.6 | 9.7/10 (10 being none) | NR                     | Patient: 9.1 Physician: 9.5 (both 10) | NR        | NR     |
| Keramidas, 2006  | 0                        | NR          | 1        | NR      | NR        | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | NR     |
| Kerfant, 2017    | 3.85                     | 4 class 2; 2 class 3 | 2       | NR      | Reoperation rate was 9.64% | 0         | 2         | NR                    | NR              | 1                         | NR                     | 0         | NR     |
| Lin Jinde, 2010  | 0                        | 0           | 0        | NR      | NR        | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | NR     |
| Munhoz, 2006     | 0                        | 0           | 0        | 2       | NR        | 0         | 2         | 0                     | NR              | 5                         | 1                      | 2         |        |
| Pereira, 2009    | 0                        | 0           | 0        | NR      | NR        | 0         | 0         | 1                     | NR              | NR                        | NR                     | NR        | 0      |
| Said, 2016       | 0                        | 0           | 0        | NR      | NR        | NR        | NR        | NR                    | NR              | 0                         | NR                     | 0         | 0      |
| Serra-Renom, 2005| 0                        | 0           | NR       | 0       | 0         | NR        | 0         | NR                    | 0               | NR                        | NR                     | NR        | NR     |
| Siclaven, 2008   | 0                        | 0           | NR       | NR      | NR        | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | NR     |
| Stoff-Khalili, 2004 | 1.33                   | 3           | 0        | 1       | 1         | 0         | 0         | NR                    | 3               | NR                        | NR                     | 0         | 0      |
| Tijerina, 2009   | 0.4                      | 3 and 4     | 1        | 0       | NR        | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | NR     |
| Ventura, 2005    | 2                        | 2           | 0        | NR      | NR        | NR        | NR        | NR                    | NR              | NR                        | NR                     | NR        | 1      |
| Yang, 2013       | 8                        | NR          | 1        | 1       | NR        | NR        | 0         | NR                    | NR              | NR                        | NR                     | NR        | NR     |

NR, not reported.
reported in several studies with a pooled rate of 0.24%. The revision rate was similarly low at 0.4% as was the infection rate at 0.1%. There were low rates of hypertrophic scarring (0.18%), sensory deficit (0.24%), malrotation (0.29%), axillary banding (0.21%), asymmetry (0.13%), and seroma (0.10%). The relative complication rate was low for this surgery.

**DISCUSSION**

Overall, the systematic review and meta-analysis identified several key findings. Importantly, capsular contracture is a relatively low percentage with a pooled rate of 1.01% and a weighted rate of less than 1%. Our analysis of the heterogeneity allowed us to determine that there was not a significant variability in the studies to throw off the weighted estimate. In contrast, other meta-analysis studies have presented capsular contracture rates as high as 38% for subglandular smooth implants, 15% for submuscular smooth implants, 8.9% for subglandular textured implants, and 8.6% for submuscular textured implants.34 Retrospective studies from single practices with large numbers show the lowest rates of capsular contracture for submuscular textured implants at 2.6%,35 and 7.6%.36 These findings suggest that subfascial augmentation has a lower rate of capsular contracture compared with subglandular and perhaps submuscular augmentation.

The authors suppose several factors may contribute to these findings. Notably, subfascial augmentation does not violate the ducts, so this may be a reason why the capsular contraction rates are lower than subglandular augmentation. Others have suggested that cold dissection or blunt dissection may decrease the risk of contracture but this has never been validated. Importantly, the mechanism of animation deformity is that the implant moves as it is under the muscle, and the hope is that subfascial augmentation avoids this outcome. This has yet to be explicitly validated; however, animation deformity is not reported in these studies.

The quality of this review, as with any systematic review, is limited by the studies that were included for analysis. Limitations of our study include the use of solely observational and retrospective studies (Level 4 evidence). The absence of comparative studies, cohort studies, and randomized controlled trials is an inherent selection bias based on physician preference for candidate patients. In addition, there is an intrinsic risk of bias across many of the included articles primarily stemming from variable length of follow-up and selection of which complications to report. The lack of articles reporting individual patient data, and heterogeneity in outcome measures reporting and scoring further complicate objective conclusions. Standardization of these reporting measures would allow for better analysis of outcomes following treatment.

Unfortunately, the studies presented here lacked key demographic and follow up data. There is simply not enough information on when the patients were followed up to reasonably confirm long-term results. While these results are promising, more studies are needed to adequately power a large cohort. Alternatively, a study comparing interventions with good sample size may help answer that question.

**CONCLUSION**

Several studies have proposed a low rate of capsular contracture in subfascial augmentation. This coupled with the benefits of decreased pain, no animation deformity, superior anatomic pocket and blending of the implant junction, subfascial augmentation may prove a superior method in a certain subset of patients. It should be considered in thin or athletic patients. Furthermore, additional comparative, single surgeon studies are needed with appropriate reporting and follow-up to confirm these findings.

**Supplementary Material**

This article contains supplementary material located online at [www.asjopenforum.com](http://www.asjopenforum.com).

**Disclosures**

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**REFERENCES**

1. Graf RM, Bernardes A, Rippel R, Araujo LR, Damasio RC, Auerswald A. Subfascial breast implant: a new procedure. *Plast Reconstr Surg.* 2003;111(2):904-908.
2. Graf R, Bernardes A, Auerswald A, Damasio R. Subfascial endoscopic transaxillary augmentation mammoplasty. *Rev Brasil Cir Plást.* 2001;14(2):45-54.
3. Benito-Ruiz J. Transaxillary subfascial breast augmentation. *Aesthet Surg J.* 2003;23(6):480-483.
4. Stoff-Khalili MA, Scholze R, Morgan WR, Metcalf JD. Subfascial periareolar augmentation mammoplasty. *Plast Reconstr Surg.* 2004;114(5):1280-8; discussion 1289.
5. Graf R. Advantages of subfascial implantation. *Aesthetic Plast Surg.* 2005;29(5):384-384.
6. Brown T. Subfascial breast augmentation: is there any advantage over the submammary plane? *Aesthetic Plast Surg.* 2012;36(3):566-569.
7. Góes JCS. Breast implant stability in the subfascial plane and the new shaped silicone gel breast implants. *Aesthetic Plast Surg.* 2010;34(1):23-28.
8. Siclovan HR, Jomah JA. Advantages and outcomes in subfascial breast augmentation: a two-year review of experience. *Aesthetic Plast Surg*. 2008;32(3):426-431.

9. Ventura OD, Marcello GA. Anatomic and physiologic advantages of totally subfascial breast implants. *Aesthetic Plast Surg*. 2005;29(5):379-83; discussion 384.

10. Lee JH, Lee PK, Oh DY, Rhie JW, Ahn ST. Subpectoral-subfascial breast augmentation for thin-skinned patients. *Aesthetic Plast Surg*. 2012;36(1):115-121.

11. Kerfant N, Henry AS, Hu W, Marchac A, Auclair E. Subfascial primary breast augmentation with fat grafting: A review of 156 cases. *Plast Reconstr Surg*. 2017;139(5):1080e-1085e.

12. Tebbetts JB. Achieving a predictable 24-hour return to normal activities after breast augmentation: part II. Patient preparation, refined surgical techniques, and instrumentation. *Plast Reconstr Surg*. 2006;118(7 Suppl):1155-27S; discussion 128S.

13. Yang YQ, Guo NQ, Sun JM, Chen HB, Ma H, Li Q. [Comparison study of clinical effect and complications between subfascial and submammary breast augmentation]. Zhonghua Zheng Xing Wai Ke Za Zhi. 2013;29(1):12-14.

14. Pereira LH, Sterodimas A. Transaxillary breast augmentation: a prospective comparison of subglandular, subfascial, and submuscular implant insertion. *Aesthetic Plast Surg*. 2009;33(5):752-759.

15. Serra-Renom J, Garrido MF, Yoon T. Augmentation mammaplasty with anatomic soft, cohesive silicone implant using the transaxillary approach at a subfascial level with endoscopic assistance. *Plast Reconstr Surg*. 2005;116(2):640-645.

16. Góes JC, Landecker A. Optimizing outcomes in breast augmentation: seven years of experience with the subfascial plane. *Aesthetic Plast Surg*. 2003;27(3):178-184.

17. Hunstad JP, Webb LS. Subfascial breast augmentation: a comprehensive experience. *Aesthetic Plast Surg*. 2010;34(3):365-373.

18. Keramidas EG. Personal experience following 350 subfascial breast augmentations. *Plast Reconstr Surg*. 2006;118(5):1276-7; author reply 1277.

19. Tijerina VN, Saenz RA, García-Guerrero J. Experience of 1000 cases on subfascial breast augmentation. *Aesthetic Plast Surg*. 2010;34(1):16-22.

20. Elizondo V, Elizondo RA. Capsular contracture in subfascial breast augmentation: recommendations and treatment. *Eur J Plast Surg*. 2012;35(7):527-532.

21. Sevcik EN, Szymanski JM, Jallerat Q, Feinberg AW. Patterning on topography for generation of cell culture substrates with independent nanoscale control of chemical and topographical extracellular matrix cues. *Curr Protoc Cell Biol*. 2017;75:10.23.1-10.23.25.

22. Bax L, Yu LM, Ikeda N, Tsuruta H, Moons KG. Development and validation of MIX: comprehensive free software for meta-analysis of causal research data. *BMC Med Res Methodol*. 2006;6:50.

23. Borenstein M, Hedges L, Higgins J, Rothstein H. Comprehensive Meta-Analysis Version 2. Englewood, NJ: Bloostat; 2005.

24. Borenstein M, Hedges LV, Higgins JPT, Rothstein HR. *Introduction to Meta-Analysis*. Chichester: John Wiley & Sons Ltd; 2009.

25. Eddy DM. *FAST*PRO: Software for Meta-Analysis by the Confidence Profile Method. *Statistical Modeling and Decision Science*. Cambridge MA: Academic Press; 1992.

26. Egger M, Smith GD, Altman D. *Systematic Reviews in Health Care: Meta-Analysis in Context*. Hoboken NJ: John Wiley & Sons; 2001:512.

27. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. *BMJ*. 2003;327(7414):557-560.

28. Lipsey MW, Wilson D. *Practical Meta-Analysis*. Thousand Oaks, CA: Sage Publications; 2000.

29. Neyeloff JL, Fuchs SC, Moreira LB. Meta-analyses and Forest plots using a microsoft excel spreadsheet: step-by-step guide focusing on descriptive data analysis. *BMC Res Notes*. 2012;5:52.

30. Rosenberg M. In: *MetaWin: Statistical Software for Meta-Analysis Version 2*. Sunderland, MA: Sinauer Associates; 2000.

31. Schriger DL, Altman DG, Vetter T, Heafner T, Moher D. Forest plots in reports of systematic reviews: a cross-sectional study reviewing current practice. *Int J Epidemiol*. 2010;39(2):421-429.

32. Stroup DF, Berlin JA, Morton SC, et al. Meta-analysis of observational studies in epidemiology: a proposal for reporting. *Meta-analysis Of Observational Studies in Epidemiology (MOOSE) group*. *JAMA*. 2000;283(15):2008-2012.

33. Wallace BC, Schmid CH, Lau J, Trikalinos TA. Meta-Analyst: software for meta-analysis of binary, continuous and diagnostic data. *BMC Med Res Methodol*. 2009;9:80.

34. Barnsley GP, Sigurdsson LJ, Barnsley SE. Textured surface breast implants in the prevention of capsular contracture among breast augmentation patients: a meta-analysis of randomized controlled trials. *Plast Reconstr Surg*. 2006;117(7):2182-2190.

35. Stevens WG, Pacella SJ, Gear AJ, et al. Clinical experience with a fourth-generation textured silicone gel breast implant: a review of 1012 Mentor MemoryGel breast implants. *Aesthet Surg J*. 2008;28(6):642-647.

36. Stevens WG, Nahabedian MY, Calobrace MB, et al. Risk factor analysis for capsular contracture: a 5-year Sientra study analysis using round, smooth, and textured implants for breast augmentation. *Plast Reconstr Surg*. 2013;132(5):1115-1123.