CAPSULAR CONTRACTURE AFTER BREAST AUGMENTATION:

A SYSTEMATIC REVIEW AND META-ANALYSIS

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Introduction

- Augmentation mammaplasty ranks as one of the most frequently performed aesthetic surgical procedures
- Capsular contracture, thought to be an inflammatory response in which a fibrotic capsule forms around the implant, is one of the most common long-term complications and indications of reoperation
- This meta-analysis reviews the literature comparing capsular • contracture incidence rates between implant surface types, plane of placement, implant filler material

Purpose

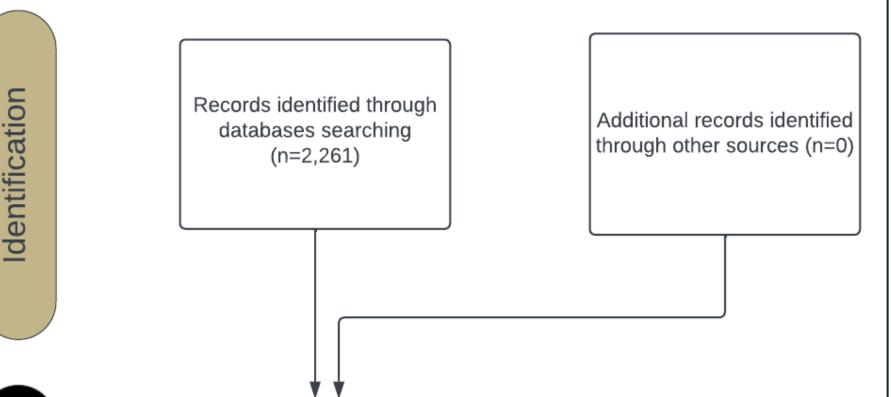
Smoo		th Textured				Odds Ratio	Odds Ratio
Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl
Asplund 1996	8	52	5	58	5.8%	1.93 [0.59, 6.31]	
Burkhardt 1994	18	45	1	45	2.7%	29.33 [3.70, 232.44]	
Burkhardt 1995	12	52	7	52	6.8%	1.93 [0.69, 5.37]	+
Calobrace 2018	260	3168	72	1954	13.0%	2.34 [1.79, 3.05]	+
Coleman 1991	28	48	4	52	5.9%	16.80 [5.21, 54.15]	
Ersek 1991	34	330	1	70	2.8%	7.93 [1.07, 58.90]	
Filiciani 2022	5	214	4	292	5.1%	1.72 [0.46, 6.49]	- !-
Hakelius 1992	11	25	0	25	1.5%	40.45 [2.22, 737.97]	
Henriksen 2005	5	286	34	4213	7.4%	2.19 [0.85, 5.64]	↓
Lista 2020	7	212	5	314	6.0%	2.11 [0.66, 6.74]	+
Malata 1997	13	22	3	27	4.4%	11.56 [2.66, 50.29]	
Poeppl 2007	20	34	10	14	5.0%	0.57 [0.15, 2.19]	
Pollock 1993	13	98	2	99	4.3%	7.42 [1.63, 33.81]	
Spear 2014	53	268	32	187	11.3%	1.19 [0.74, 1.94]	
Stevens 2013	215	3158	51	1951	12.7%	2.72 [1.99, 3.71]	-
Tarpila 1997	8	21	6	21	5.3%	1.54 [0.42, 5.61]	
Total (95% CI)		8033		9374	100.0%	2.80 [1.92, 4.08]	•
Total events	710		237				
Heterogeneity: Tau ² =	-		-		= 0.0002	2); $I^2 = 65\%$	0.001 0.1 1 10 1
Test for overall effect	z = 5.30	S(P < 0)	.00001)				Favors Smooth Favors Textured

Results

- To comprehensively collect and analyze findings from existing research to better understand the potential causes of capsular contracture following breast augmentation
- To identify specific risks associated with different surgical techniques and materials and empower surgeons and patients to make informed decisions regarding breast augmentation procedures

Methods

- A systematic review and meta-analysis were performed as per the PRISMA guidelines (Prospero CRD42024529482)
- Online databases PubMed MEDLINE, EMBASE (OvidSP), and Cochrane libraries were included in the search - Included studies reported incidence of, and clearly defined capsular contracture as Baker grade III or IV
- Study groups were compared and stratified by surface texture of the implant (smooth versus textured surface), plane of implant placement (subpectoral versus prepectoral) and filler material (saline versus silicone)
- Odds ratios (OR) were calculated for capsular contracture for each of these groups



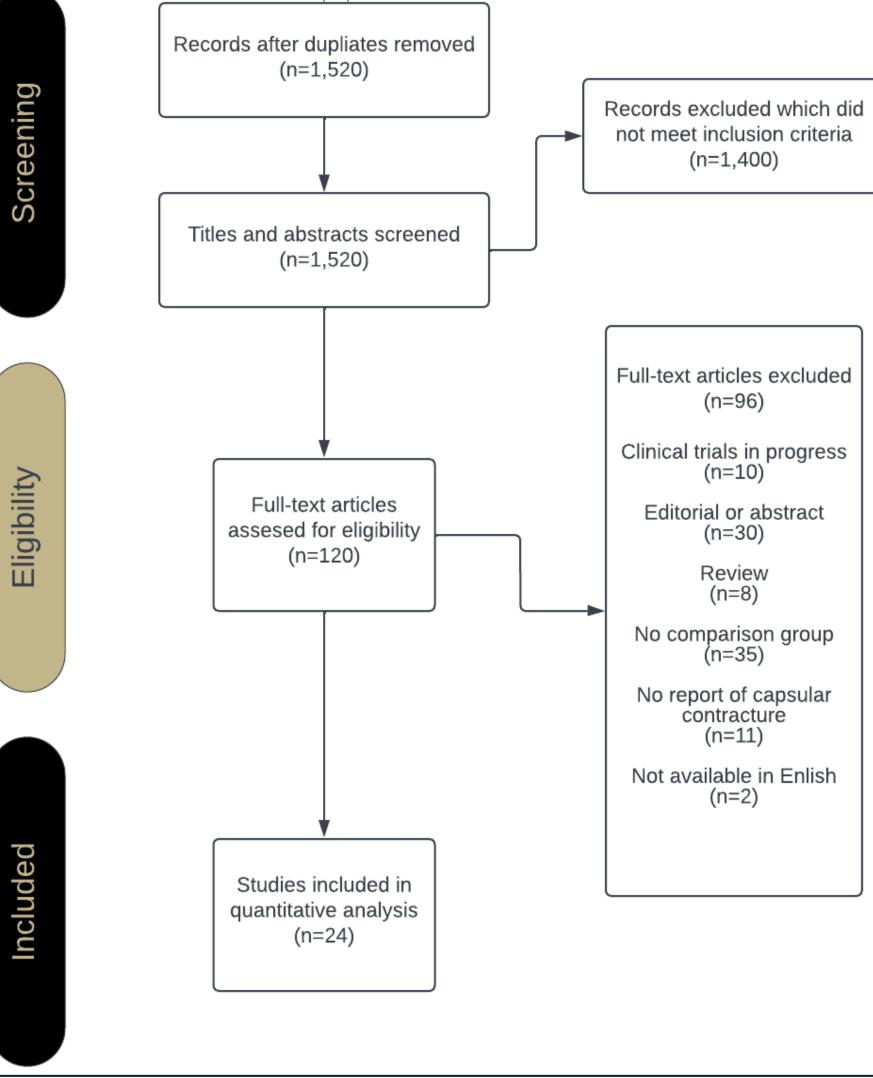
Favors Smooth Favors Textured

Т								
L	Subpectoral		Prepectoral			Odds Ratio	Odds Ratio	
L	Study or Subgroup	Events	Total	Events	Total	Weight	M-H, Random, 95% Cl	M-H, Random, 95% Cl
l	Benito-Ruiz 2017	3	113	10	260	5.3%	0.68 [0.18, 2.53]	
l	Calobrace 2018	100	2856	231	2266	16.4%	0.32 [0.25, 0.41]	-
l	Henriksen 2005	21	3133	18	1351	11.4%	0.50 [0.27, 0.94]	
L	Khan 2013	0	110	6	751	1.4%	0.52 [0.03, 9.28]	
L	Pereira 2009	0	17	1	36	1.1%	0.68 [0.03, 17.46]	
l	Puckett 1987	8	96	39	96	9.1%	0.13 [0.06, 0.30]	
L	Shi 2015	5	178	3	70	4.5%	0.65 [0.15, 2.78]	
l	Spear 2014	50	317	36	135	13.4%	0.51 [0.32, 0.84]	
	Stevens 2013	80	2848	185	2261	16.1%	0.32 [0.25, 0.42]	-
1	Stutman 2012	25	356	22	261	11.9%	0.82 [0.45, 1.49]	
	Vazquez 1987	9	96	58	100	9.5%	0.07 [0.03, 0.17]	
	Total (95% CI)	:	10120		7587	100.0%	0.35 [0.25, 0.50]	•
L	Total events	301		609				
L	Heterogeneity: Tau ² =	0.19; Chi	$^{2} = 34.0$	02, df = 1	10 (P = 0)	0.0002);	$l^2 = 71\%$ 0.01	0,1 1 10
Test for overall effect: $Z = 5.70 (P < 0.00001)$							0.01	Favors Subpectoral Favors Prepectoral
Saline		Silic	one		Odds Ratio	Odds Ratio		
L	Study or Subgroup	Events	Tota	Events	s Tota	l Weigh	nt M-H, Random, 95% CI	M-H, Random, 95% CI
L	Cairns 1980	3	36	5 35	5 43	3 33.4	% 0.02 [0.01, 0.09]	_ _
	Henriksen 2005	1						
	Stutman 2012	33					· , ·	
	Total (95% CI)		493	•	2705	5 100.0		
	· ·	-				5 100.0	% 0.39 [0.02, 6.69]	
	Total events	37	,	82	2			

Heterogeneity: Tau² = 5.72; Chi² = 28.77, df = 2 (P < 0.00001); I² = 93% Test for overall effect: Z = 0.64 (P = 0.52)

0.001

- 16 studies (17,407 cases) were analyzed to compare **smooth versus** textured breast implants
- Textured implants were associated with significantly lower rates of capsular contracture when compared to smooth implants, with an odds ratio (OR) of 2.80 (95% confidence interval [CI]: 1.92, 4.08)
- 11 studies (17,707) cases compared the outcomes of **subpectoral versus** prepectoral implant placement
- Subpectoral placement was found to be significantly more effective in reducing capsular contracture rates than prepectoral placement, as evidenced by an OR of 0.35 (95% CI: 0.25, 0.50)
- 3 studies (4,198 cases) compared saline versus silicone filled implants and • revealed no statistically significant difference in capsular contracture rates between the two types of implants, with an OR of 0.39 (95% CI: 0.02, 6.69)



Conclusions

- Lower rates of capsular contracture with textured implants may be explained through the mechanism by which greater surface area of textured implants results in upregulation of adhesion-related genes in breast-derived fibroblasts, thus reducing excessive motion of the implant that may provoke the overproduction of collagen and ultimately lead to contracture (46-49)
- Lower rates of capsular contracture seen with subpectoral placement may be explained through the preservation of the blood supply of the pectoralis major, as well as providing cushioning and flexibility for the implant in the submuscular pocket (52)
- The pectoralis major muscle provides greater coverage than the superficial fascia used in prepectoral placement; thus, restricting implant movement and improving adhesion (10)
- Submuscular placement has anatomic advantages which include avoiding of breast parenchyma and minimization of contact between implant and bacteria in breast ducts (53,54)

References

- 10. Kraenzlin F, Darrach H, Khavanin N, et al. Tissue Expander-Based Breast Reconstruction in the Prepectoral Versus Subpectoral Plane: An Analysis of Short-Term Outcomes. Ann Plast Surg. 2021;86(1):19-23. doi:10.1097/SAP.00000000002415
- 46. Valencia-Lazcano AA, Alonso-Rasgado T, Bayat A. Physico-chemical characteristics of coated silicone textured versus smooth breast implants differentially influence breast-derived fibroblast morphology and behaviour. J Mech Behav Biomed Mater. 2014;40:140-155. doi:10.1016/j.jmbbm.2014.08.018
- 47. Hwang K, Sim HB, Huan F, Kim DJ. Myofibroblasts and capsular tissue tension in breast capsular contracture. Aesthetic Plast Surg. 2010;34(6):716-721 doi:10.1007/s00266-010-9532-8
- 48. Baker JL, Chandler ML, LeVier RR. Occurrence and activity of myofibroblasts in human capsular tissue surrounding mammary implants. Plast Reconstr Surg 1981;68(6):905-912. doi:10.1097/00006534-198112000-00010
- 49. Rubino C, Mazzarello V, Farace F, et al. Ultrastructural anatomy of contracted capsules around textured implants in augmented breasts. Ann Plast Surg. 2001;46(2):95
- 52. Blount AL, Martin MD, Lineberry KD, Kettaneh N, Alfonso DR. Capsular contracture rate in a low-risk population after primary augmentation mammaplasty. Aesthetic Surg J. 2013;33(4):516-521. doi:10.1177/1090820X13484465
- 53. Deva AK, Adams WP, Vickery K. The role of bacterial biofilms in device-associated infection. Plast Reconstr Surg. 2013;132(5):1319-1328 doi:10.1097/PRS.0b013e3182a3c105
- 54. Adams J, William P, Eric J. C, et al. Macrotextured breast implants with defined steps to minimize bacterial contamination around the device: experience in 42,000 implants. Plast Reconstr Surg. 2017;140(3):427-431



^{0.1} Favors Saline Favors Silicone