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SPECIAL TOPIC
Breast

Prepectoral Site Conversion for Animation Deformity

Glyn E. Jones, MD*
Victor A. King, MD†
Aran Yoo, MD‡

Background: A signifcant disadvantage of subpectoral breast reconstruction procedures is animation deformity during pectoralis major contraction. In this study, we discuss one surgeon's experience with elective subpectoral to prepectoral implant site conversion as a definitive solution to animation deformity.
Methods: Authors performed a retrospective review of pre-pectoral and sub-pectoral breast reconstructions performed by a single surgeon. Implants placed in the prepectoral plane were supported with total anterior AlloDerm coverage.
Results: One hundred forty-two breasts in 90 patients who had underwent elective subpectoral to prepectoral implant site conversion. Postoperative resolution of animation deformity was 100%. Overall, complications are minimal with rates at 4.2% for infection, 2.1% for seroma, and 0.7% for hematoma, dehiscence, partial thickness necrosis, and explantation. One patient requested reoperation for reduction in implant volume. Baker grades II–IV capsular contractures are 0% at 43 months.
Conclusion: Breast implant site conversion from the subpectoral to the prepectoral plane is a safe and definitive solution for animation deformity. *(Plast Reconstr Surg Glob Open 2019;7:e2301; doi: 10.1097/GOX.0000000000002301; Published online 29 July 2019.)*

INTRODUCTION

Subpectoral implant placement has been the gold standard for implant-based breast reconstruction for over 5 decades. In recent years, considerable attention has been focused on performing immediate and delayed reconstruction in the prepectoral space to eliminate many of the complications associated with subpectoral implant positioning. These subpectoral complications include animation deformity, tightness, functional limitations on the shoulder, and problems with implanted distortion.[1–8] Attempts to correct some of these esthetic issues with fat grafting have met with mixed and often disappointing results, whereas their impact on functional problems has been negligible.

The recent interest in prepectoral reconstruction, both single and 2-stage approaches, has seen a dramatic improvement in both the esthetic and functional outcomes of implant-based reconstruction when coupled with the use of acellular dermal matrices (ADM). Numerous articles attest to the enhanced esthetic outcomes in terms of cleavage formation, and complete elimination of animation deformity, improved long-term comfort and reduced postoperative pain.[9]

The senior author migrated to a single-stage prepectoral direct-to-implant approach for breast reconstruction over 5 years ago. The dramatic improvement in esthetic outcome, with particular reference to reduction in animation deformity, improved cleavage formation and postoperative comfort with enhanced shoulder range of motion, triggered an interest in the concept of prepectoral conversion as a means of dealing definitively with the problem of animation deformity in the subpectoral patient population. Having performed two stage, and later single-stage, subpectoral reconstruction for many years, it had been the senior author's experience that animation deformity is an almost universal problem that causes patients embarrassment and often discomfort on a daily basis. Attempts at ameliorating these problems with fat grafting met with very mixed results and never completely eliminated animation deformity. More so, fat grafting had no impact whatsoever on patient comfort and physical function. The senior author follows all implant patients annually and began specifically asking patients if they were bothered by their animation deformities or experienced discomfort and

*From the *Department of Plastic and Reconstructive Surgery, University of Illinois College of Medicine, Peoria, Ill.; †Department of Plastic and Reconstructive Surgery, Brown University Warren Alpert Medical School at Rhode Island Hospital, Providence, R.I.; and ‡Department of Plastic and Reconstructive Surgery, Louisiana State University School of Medicine, New Orleans, La.*
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limited range of motion with subpectoral implants, particularly during exercise. Given the surprisingly large number of patients who expressed an interest in alleviating these symptoms, the decision was made to offer prepectoral site conversion to those patients with subpectoral reconstructions in whom animation deformity, implant distortion, and tightness were significant complaints. This article reports our experience with this patient population over a 3-year period.

MATERIALS AND METHODS

A retrospective review of 90 patients, 142 breasts, was performed from April 5, 2015, to May 20, 2018, after Institutional Review Board approval. Data collected from electronic health records included baseline patient demographics, patient risk factors, surgery characteristics, and postoperation complications. All patients underwent breast implant site change from the subpectoral to the prepectoral plane performed by a single plastic surgeon. This procedure was performed primarily as a corrective procedure for symptomatic animation deformity. No exclusion criteria in terms of skin flap thickness, body mass index (BMI), prior smoking history, or diabetes were used for the surgery after patient consent was completed. Thin skin flap thickness was not considered problematic because the flaps have been vascular-delayed by the prior mastectomy, and the use of ADM and cohesive gel implants further reduced any tendency to show significant rippling as is borne out in the data. Radiated patients were included unless their skin was thin, tight, and telangiectatic. Health Insurance Portability and Accountability Act procedures were followed to deidentify patient information during data collection. Descriptive statistics for patient characteristics and surgical outcomes were generated by summating and averaging each variable across the total number of breasts.

OPERATIVE PROCEDURE

An incision is made through the original mastectomy scar, and the previously placed subpectoral implant is removed. With the upper mastectomy flap everted using digital pressure from the outside, the juncture of the caudal border of the pectoralis major muscle with the native previously placed ADM is identified. This junction is incised with electrocautery until the superficial aspect of the pectoralis major is identified and the prepectoral plane is identified. The muscle border is grasped with tissue forceps and with gentle downward traction on the pectoral muscle, the plane between the superficial aspect of the pectoralis major muscle and the overlying upper mastectomy flap is developed (Fig. 1). Dissection is carried upward across a broad front separating the mastectomy skin from the underlying muscle until the upper aspect of the new breast pocket has been defined. This corresponds to the uppermost limits of the preoperative skin markings. Medial dissection is carried down to the level deemed appropriate to achieve an attractive natural cleavage for the patient. Laterally, the dissection is carried out toward the anterior axillary fold. This broad-based dissection allows

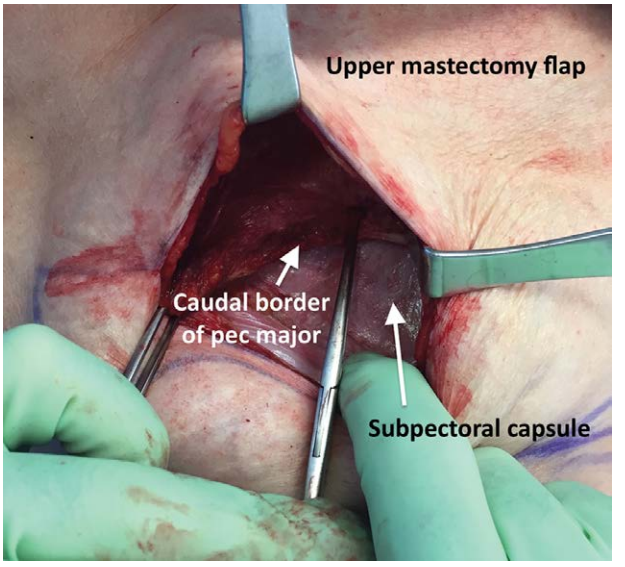

Fig. 1. The pectoralis major muscle returned to the chest wall, creating a prepectoral pocket for implant placement.

Fig. 2. Shaping of the ADM to control pocket shape and dimensions.

the muscle to be returned to the chest wall without tension. The pectoralis major muscle is then sutured to rib periosteum with four or five 3-0 Vicryl sutures (Ethicon, Somerville, N.J.). With the pocket thus prepared, it is lavaged first with 50% povidone iodine solution followed by a triple antibiotic solution. A sheet of 16×20 cm thick ADM (Alloderm; Allergan Corp Dublin) is then trimmed

at its upper medial and lateral corners to create a teardrop-shaped construct (Fig. 2). Commencing at 12 o'clock and using running 2-0 PDS sutures (Ethicon, Somerville, N.J.), the ADM is sutured onto the anterior aspect of the pectoralis major muscle at its cusp with the overlying mastectomy skin flap. Suturing is performed from 12 to 5 o'clock and 12 to 7 o'clock, respectively, leaving an inferior access window for implant insertion. This creates the anterior tenting approach with a gentle tapering contour to the upper and medial poles of the reconstruction.[10] The implant pocket is washed again with a 50% povidone iodine solution and triple antibiotic solution and follows the 14-point biofilm reduction protocol described by Deva et al.[11] Glove change is performed, and the implant is inserted under the ADM and on top of the pectoral muscle utilizing a Keller funnel. The anterior ADM sheet is then sutured to the chest wall along the curve of the inframammary crease using the remaining tails of 2-0 PDS sutures (Ethicon, Somerville, N.J.). The pocket is again washed before inserting a 10 French, fully fluted, hubless, round-channel drain, and the mastectomy flap is closed in layered fashion with 3-0 Monocryl (Ethicon, Somerville, N.J.).

RESULTS

In our study, 90 women underwent 142 breast reconstructions. Patient characteristics are presented in Table 1. Mean patient age was 55 years, and average BMI was 28. Average follow-up time was 77 weeks after the procedure. Patients (51.1%) had a history of smoking, and 8.9% were current smokers. A cohort of 14.8% of patients had preoperative radiation, but skin quality was relatively soft without telangiectatic changes.

Table 1. Patient Characteristics: 90 Patients (N Breasts = 142)

Variable	Average	Minimum	Maximum
Age	55	29	77
BMI	28	19	42
Days for drain removal	11	5	42
Follow-up weeks	77	9	184
	N (%)		
Current smoker	8 (8.9)		
Smoking history	46 (51.1)		
Preoperative radiation	21 (14.8)		
FX implant profile	114 (80.3)		
FF implant profile	6 (4.2)		
Other implant profile	22 (15.5)		

Table 2. Postoperative Complications (N Breasts = 142)

Complication	N (%)
Contour deformity	41 (28.9)
Fat grafting	26 (18.3)
Rippling	7 (4.9)
Infection requiring PO antibiotics	5 (3.5)
Minor seroma	2 (1.4)
Major seroma	1 (0.7)
Infection requiring IV antibiotics	1 (0.7)
Explantation	1 (0.7)
Necrosis requiring local wound care	1 (0.7)
Dehiscence	1 (0.7)
Hematoma	1 (0.7)
Change in implant size	1 (0.7)
Capsular contraction	0 (0.0)
Necrosis requiring debridement	0 (0.0)
Animation deformity	0 (0.0)
Red breast syndrome	0 (0.0)

Postoperative complications are presented in Table 2. Breasts (28.9%) had minor contour deformities in the form of implant edge visibility or small hollows. Fat grafting was performed in 18.3% of breasts for minor implant edge visibility, rippling, or hollowing, and the average volume of fat grafted was 130 cm^3. Minor rippling occurred in 4.9% of breasts and resolved with fat grafting. Localized cellulitis occurred in 3.5% of patients responding completely to oral antibiotic treatment. Minor seromas occurred in only 1.4% of breasts, requiring in-office aspiration, whereas 0.7% (one previously radiated breast) developed major seroma requiring replacement of a drain. The low number of seromas contrasts with our higher 5% seroma rate in immediate prepectoral direct-to-implant reconstructions and was not surprising given that the procedure was performed in the controlled environment of stable, well-vascularized mastectomy flaps. Technically, these skin flaps can be considered to have been vascular-delayed by the previous mastectomy and subsequent healing. Rates of necrosis requiring local wound care, hematoma, and wound dehiscence were 0.7% in 1 radiated breast which developed infection after reoperation for implant malrotation and seroma. This patient required intravenous (IV) antibiotics and eventual explantation. Rates of red breast syndrome and necrosis requiring debridement were 0%. One patient requested a smaller implant size subsequent to conversion. There have been no grade II–IV capsular contractures. Animation deformity resolved in all patients, and most patients reported improved range of shoulder motion (Figs. 3–5) (note the animation of her unoperated subpectoral right augmentation compared with the left prepectoral conversion) (**See Video 1, [online]**, which displays preoperative animation video and postoperative animation video at 1 year; **See Video 2, [online]**, which displays preoperative animation video and postoperative animation video at 1 year; and **See Video 3, [online]**, which displays preoperative animation video and postoperative animation video at 1 year). Overall breast esthetics were improved with distinctly better cleavage appearance due to improved medial placement of the implants when compared with the subpectoral position.

DISCUSSION

Animation deformity is a common complication of subpectoral breast reconstruction. Spear et al.[8] noted that it is not widely reported or studied in the literature. This finding may reflect the fact that most plastic surgeons examine patients in repose during follow-up; unless the patient actively animates during examination, the condition may be completely overlooked. In an effort to characterize breast animation deformities and their clinical significance after subpectoral breast augmentation, Spear et al.[8] clinically evaluated 40 patient photographs. They found 77.5% of the patients evaluated had mild-to-severe breast animation deformity. In a follow-up questionnaire regarding the

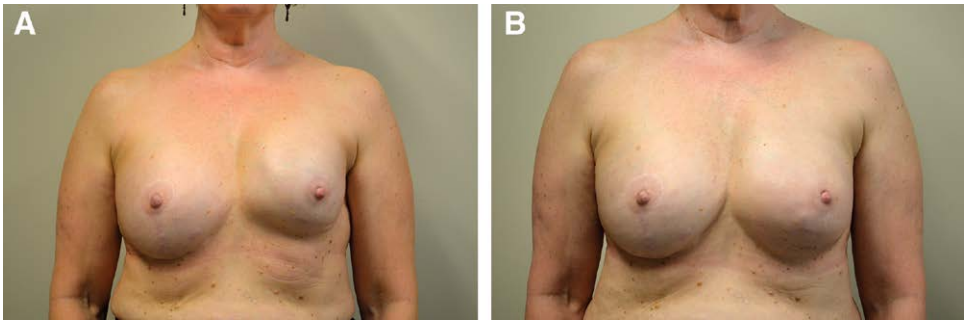

Fig. 3. A, Sixty-year-old woman with prior radiated left subpectoral breast reconstruction with animation and asymmetry secondary to radiation fibrosis. B, Postoperative view of the patient following left prepectoral conversion with ADM insertion and implant upsizing.

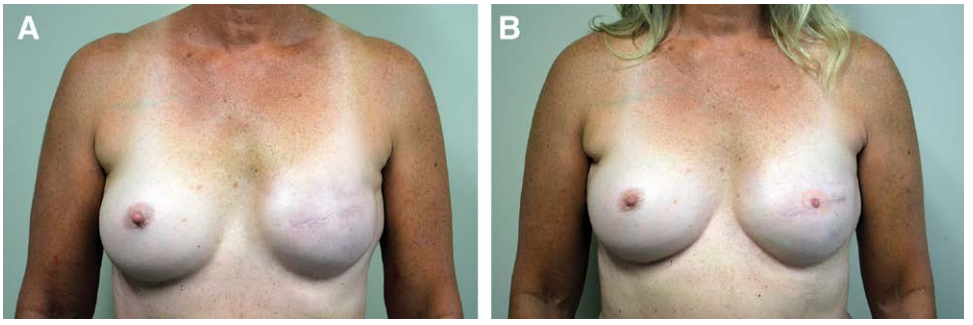

Fig. 4. A, Fifty-five–year-old woman with radiated left subpectoral 2 stage expander implant reconstruction with animation and asymmetry secondary to radiation fibrosis and stable right subpectoral breast augmentation. B, Postoperative view of the patient following left prepectoral conversion with ADM insertion and implant upsizing.

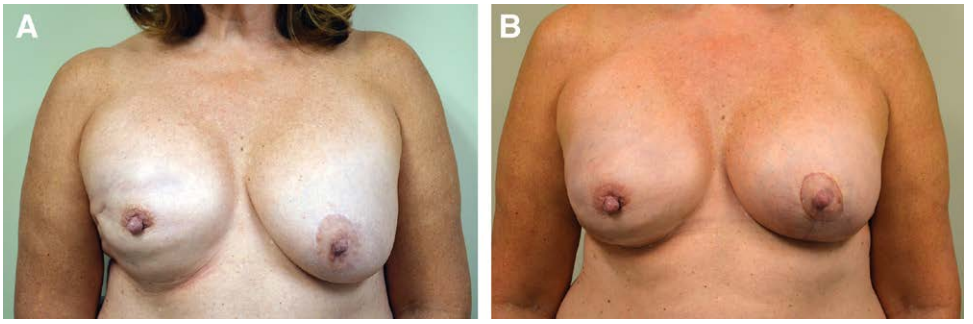

Fig. 5. A, Fifty-seven–yr-old woman following right 2 stage subpectoral expander implant reconstruction 10 years previously with right mastopexy augmentation. She complained of asymmetry and animation with daily discomfort. B, Postoperative view of the patient following right prepectoral conversion with ADM insertion and implant upsizing and revisionary left mastopexy–augmentation.

same topic, the same authors found a self-reported rate of animation deformity of 53% out of 69 respondents. The same questionnaire attempted to determine the clinical significance of breast animation deformity. They found lifting weights and exercising as the activities most commonly affected in this cohort of patients at 24% and 19%, respectively. A few additional studies explored the negative impact of subpectoral implant placement on pectoralis muscle thickness and power.[1–8,12,13] Roxo et al.[13] demonstrated a 49.8% reduction in pectoralis muscle thickness 12 months after subpectoral breast augmentation, whereas de Haan et al.[4] found a 20% reduction in adduction power after subpectoral breast reconstruction.

In a similar study to that of Spear et al.,[8] Becker and Fregosi[3] evaluated the significance of breast animation deformities after subpectoral breast reconstruction. All 25 respondents reported visible deformity upon contraction of pectoral muscles, with 20 (80%) confirming movement of the breast with muscle contraction bothering them. Furthermore, 9 patients affected by their animation deformity rated their displeasure as 6+ or higher on a 10-point scale. Two patients reported pain with contraction, whereas 6 patients (25%) report it impacting personal relation-

ships. It affected daily life in 12 patients (50%). Finally, 10 patients responded in the affirmative to the question of whether or not animation deformity negatively impacting them emotionally or psychologically. In another study, Nigro and Blanchet[14] found similar rates of self-reported animation deformity in breast reconstruction patients (75%). According to these studies, animation deformity is a more significant issue in breast reconstruction patients. Breast reconstruction patients are more likely to have thinner breast flaps that unfortunately makes implant movements less discreet.[14]

With our experience being similar to the report by Becker and Fregosi,[3] we have sought a definitive method for correction of breast animation deformity in patients reporting a clinically significant impact from the complication in their daily lives. Fat grafting proved to be an unsatisfactory solution in our hands, and we did not attempt Botox injection because the concept seemed flawed in terms of both its temporary nature, cost, and the side effect of weakening an already compromised pectoralis major muscle.[15–17] Other methods to reduce animation deformity include pectoralis muscle splitting that may lead to more patient morbidity,[18,19] implant size change, capsulotomy, or capsulorrhaphy.[20] To reduce the impact of these problems on patients' daily lives, the senior author began converting symptomatic subpectoral implant reconstructions to the prepectoral position. This procedure has few complications and solved the problem of animation deformity in all patients. The "tenting technique" of ADM suturing used on immediate prepectoral direct-to-implant reconstructions was used to accurately control the newly established prepectoral pocket.[10]

A few authors have also published their experience with this solution. Hammond et al.[21] described the outcomes of the procedure performed on 19 breasts. The average follow-up time for this study was 13.8 months. All patients had 100% resolution of their breast animation deformity. However, complications included 21.2% capsular contracture, 5.3% seroma, a high rate of 31.6% reoperations, and no rippling/contour deformities or infection. Our follow-up time is now 43 months and with lower rates of significant complications than reported by Hammond et al.[21] The differences in capsular contracture rates are particularly striking. Hammond et al.[21] reported a rate of 21% compared with ours of 0%. The major difference between these studies and our own is the use of anterior ADM coverage in all of our cases, and implants were inserted using the biofilm reduction protocol by Deva et al.[11]including the use of a Keller funnel. These techniques were employed to prevent complications like capsular contracture.[10,11,22,23] Our capsular contracture (grades II–IV) rate after a follow-up period of 3.5 years is 0%. In our series, the reoperation rate was only 1%.

Our most common complication was minor contour deformity (usually slight edge visibility of the superomedial aspect of the implant at its juncture with the chest wall or hollowing) at a rate of 28.9%, with 18.3% of these patients receiving fat grafting during follow-up. Lesavoy et al.[24] also performed a similar procedure for the correction of animation deformity postsubpectoral breast augmentation. These authors also report 100% resolution of animation deformity, with complications including one hematoma secondary to an extensive capsulectomy and postoperative hypertension, 6-month reoperation of 2.8%, and 2 Baker grade II capsular contractures not requiring reoperation.

Gabriel et al.[20] published results of a smaller series of 57 patients and 102 breasts with a history of subpectoral breast reconstruction undergoing 2-stage tissue expander/implant reconstruction or direct-to-implant prepectoral site conversion procedures. Average BMI and follow-up time were 27.3 kg/m^2 and 16.7 months, respectively. In their patients, authors tacked acellular dermal matrix to the subcutaneous tissue of the breast flap for anterior coverage of the implant. Very few complications were reported: seroma in 2 breasts, skin necrosis in 3 breasts, and wound dehiscence in 1 breast. Some patients underwent autologous fat grafting for further soft-tissue coverage although the frequency of this was not reported.[20] These results further support the concept that prepectoral site conversion is an effective solution for animation deformity.

The etiology of animation deformity following subpectoral implant reconstruction is the unavoidable adhesion between the pectoralis major muscle, the overlying mastectomy skin flap, together with adhesion to the underlying implant capsule. Attempts at breaking this contiguity with subcutaneous fat grafting have been somewhat disappointing, and fat grafting completely fails to address the other associated issues of tightness, decreased range of shoulder girdle motion, and muscle weakness. Prepectoral conversion using the ADM anterior tenting technique provides a thoroughly effective solution to the problem of animation deformity. Our patients' subjective reports of increased comfort and shoulder range of motion have prompted us to commence a prospective evaluation of these physical parameters in our prepectoral conversion patients in the hope that we may be able to quantify their self-reported improvements in function and appearance postconversion.

The present study is limited by its retrospective nature. Second, animation deformity was objectively evaluated by a senior surgeon with extensive experience in breast reconstruction but subjectively by patients. Currently, there is no widely accepted scale for animation deformity. Hammond[22] cited that in his own experience with site conversion procedures, that most patients do have some degree of lingering animation deformity because the implant capsule adheres to the pectoralis muscle. Further study with objective methods to assess the esthetic and functional effects of animation deformity should be performed.

CONCLUSIONS

Animation deformity is a postoperative complication present in a significant number of patients undergoing subpectoral breast reconstruction. Unless specifically examined for, it is easily overlooked by surgeons. Increasing number of studies document that patients are frequently perturbed by the physical appearance and discomfort of the deformity. Attempts at breaking this contiguity with fat grafting have been disappointing. In particular, fat graft-

ing fails to address the other associated issues of tightness, decreased range of shoulder girdle motion and muscle weakness that our patients present with. We are currently undertaking a study to objectively quantify esthetic and functional improvement in these patients postconversion using Breast-Q and Disabilities of the Arm, Shoulder and Hand (DASH) questionnaires coupled with independent physical therapy evaluation. In our hands, conversion from the subpectoral to prepectoral plane is a safe and effective procedure to solve the issue of animation deformity, improving both cosmetic and reported functional outcomes in our patients with very low complication rates.

Victor A. King, MD
UICOMP Department of Plastic Surgery
Illinois Medical Center
1001 Main St., Suite 300
Peoria, IL 61606
E-mail: king313@sbcglobal.net

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