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LETTER

Update on the Split-Muscle Technique for Breast Augmentation: Prevention and Correction of Animation Distortion and Double-Bubble Deformity

Richard A. Baxter

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The subpectoral technique [1] and systematic analysis of soft tissue characteristics [2] have resulted in a more predictable approach to breast implant surgery, yet certain problems receive scant attention. Among these problems are animation distortions and shape issues such as "double-bubble" deformity.

In 2004, I reported the split-muscle technique as an option that balances factors such as the need for coverage in thin or athletic women who want to avoid breast distortion with physical activity [3]. Use of the split-muscle technique in a large series also has been reported by Khan [4], with good outcomes and no significant animation problems. Conversely, a recent survey by Spear et al. [5] found an overall incidence of 77.5% for some degree of distortion with subpectoral augmentation, rated as moderate or severe by 15% of patients. Considering that more than 350,000 augmentation cases occur annually in the United States [6], most of which are subpectoral, this becomes a significant issue.

Another problem, the "double-bubble" deformity, may be related. Although this contour defect generally corresponds to the original inframammary fold, particularly in cases with a short preoperative distance from the areolar margin to the inframammary fold, I have routinely observed termination of the pectoralis muscle into the anterior capsule at the level of the external groove, which defines the abnormality. This may be coincidental where the preoperative inframammary fold is high, but the double-bubble contour occasionally develops when the areolar margin-to-fold distance is normal. This can easily be ascertained by asking the patient to flex and then observing upward pull at the level of the external groove, a phenomenon called "windowshading" (Fig. 1a, b). When the patient is at rest, this external indentation is manifest externally as the "double bubble" and corresponds to the edge of the muscle where it transitions into the capsule.

The aforementioned problems occur because the portion of the muscle originating from the rib cage typically is attached at or cephalad to the inframammary fold. Therefore, it must be divided in most cases, allowing its retraction superiorly (Fig. 2a, b). By definition then, the divided edge of the muscle settles somewhere between the nipple–areolar complex and the inframammary fold, where it fuses with the anterior capsule as it develops. Contraction of the muscle unavoidably exerts pull on the capsule (Fig. 3), tethered only at its medial transition to the sternal attachment. For this reason, conversion to the split-muscle plane can be a useful option in cases of double-bubble deformities with animation.

One of the primary indications for subpectoral placement is upper pole coverage, afforded by the portion of the pectoralis major originating from the sternum. The costal portion provides central coverage, in which a subfascial or subglandular plane very often is adequate because of breast tissue, even when upper pole muscle coverage is desirable.

For primary augmentation using the split-muscle technique, the prepectoral fascia is elevated using electrocautery under direct vision up to a line from the axilla to the point at which the pectoralis transitions from the sternum to the rib cage. The muscle fibers then are separated along this line to elevate the superior portion of the muscle while leaving the inferior portion undisturbed (Fig. 4). Implant dimensions determine how far toward the insertion the muscle should be split. If an observable tendency exists for the superior portion of the muscle to retract, a few sutures

R. A. Baxter (✉)
6100 219th Street SW, Suite 290, Mountlake Terrace, WA 98043, USA
e-mail: drbaxter@drbaxter.com

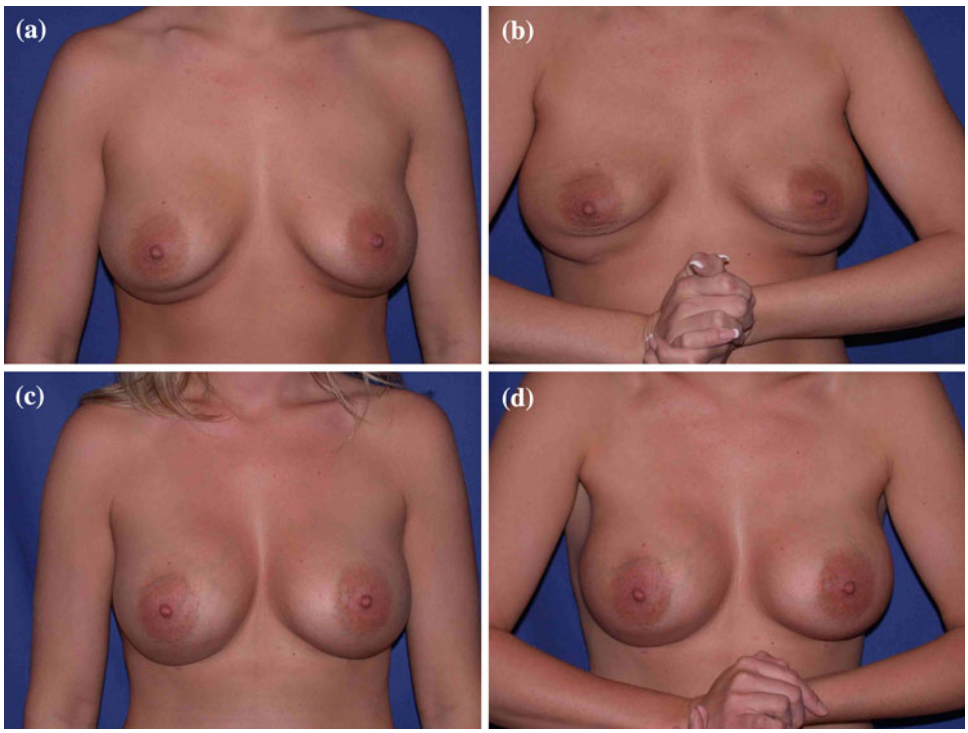

Fig. 1 Subpectoral breast augmentation with combination double-bubble contour deformity (**a**) and windowshading animation (**b**). Correction by conversion to the split-muscle plane shows elimination of the double-bubble contour (**c**) and animation with active flexion (**d**)

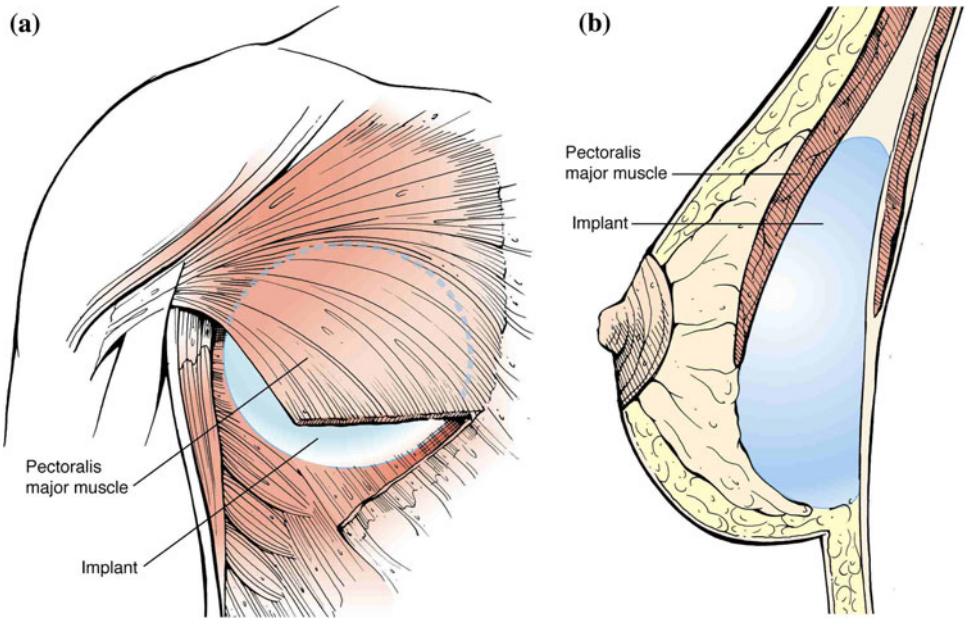

Fig. 2 Traditional subpectoral implant placement requires division of the pectoral origin from its costal attachment, allowing it to retract superiorly for optimal implant positioning

from the split edge to the undersurface of the breast tissue (elevated pectoral fascia) may be used. This prevents bowstringing of the muscle back to the chest wall and loss of coverage. Postoperative flexion poses demonstrate minimal distortion (Fig. 5c).

For a plane change in cases of established animation or double-bubble problems, preoperative markings are made with the pectoralis muscle flexed, which identifies where the capsular scar transitions into the muscle. After access capsulotomy and implant removal, the anterior capsule is dissected away in continuity with the muscle. The muscle is split, creating a muscle flap with the capsule on its posterior aspect (Fig. 6). It then is sutured to the posterior capsule, reestablishing the original anatomy. The inferior edge of the muscle's upper portion is reinforced with sutures to the deep aspect of the breast tissue. Suction drains are used routinely for plane-change procedures.

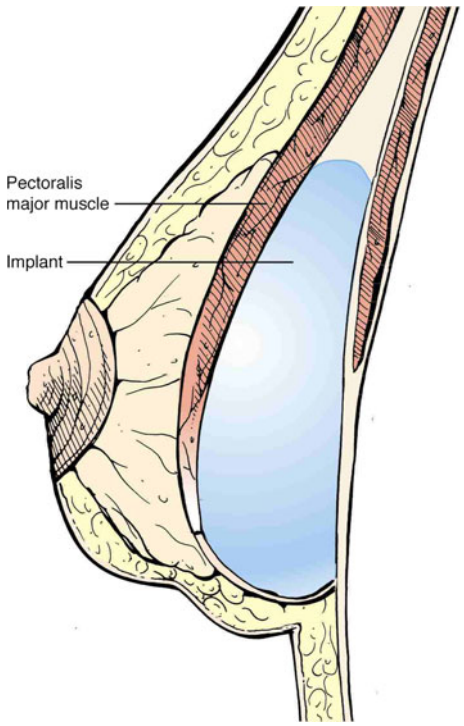

Fig. 3 Pectoral muscle contraction may exert pull on the capsule corresponding to the level of the external groove that defines the double-bubble contour deformity

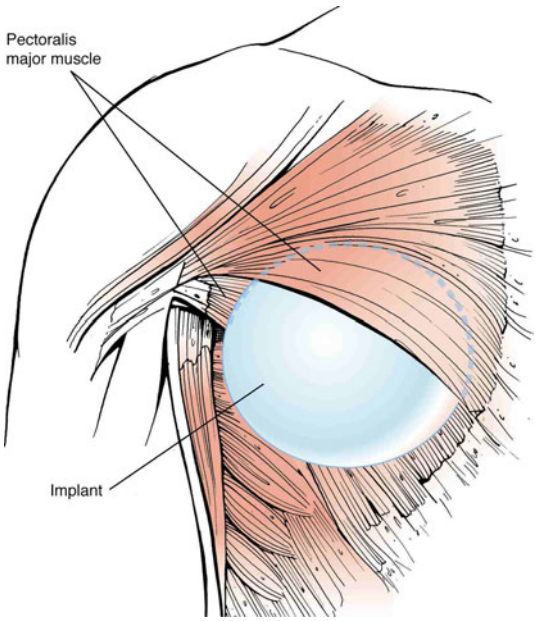

Fig. 4 The split-muscle technique preserves attachments of the pectoral muscle while providing upper pole implant coverage

Maxwell and Tornambe [7] provided a prescient discussion of animation problems, observing that visible distortion may be buffered by adequate breast tissue, in which case surgeons might consider subglandular or subfascial placement. As a solution, they recommended severing the medial pectoral nerve. Pelle-Cerevolo et al. [8] proposed a simpler approach that involves sectioning of the pectoralis major muscle at the retroareolar level in addition to disinsertion of the costal attachment. They speculated that the improvement may be related to denervation of the muscle's

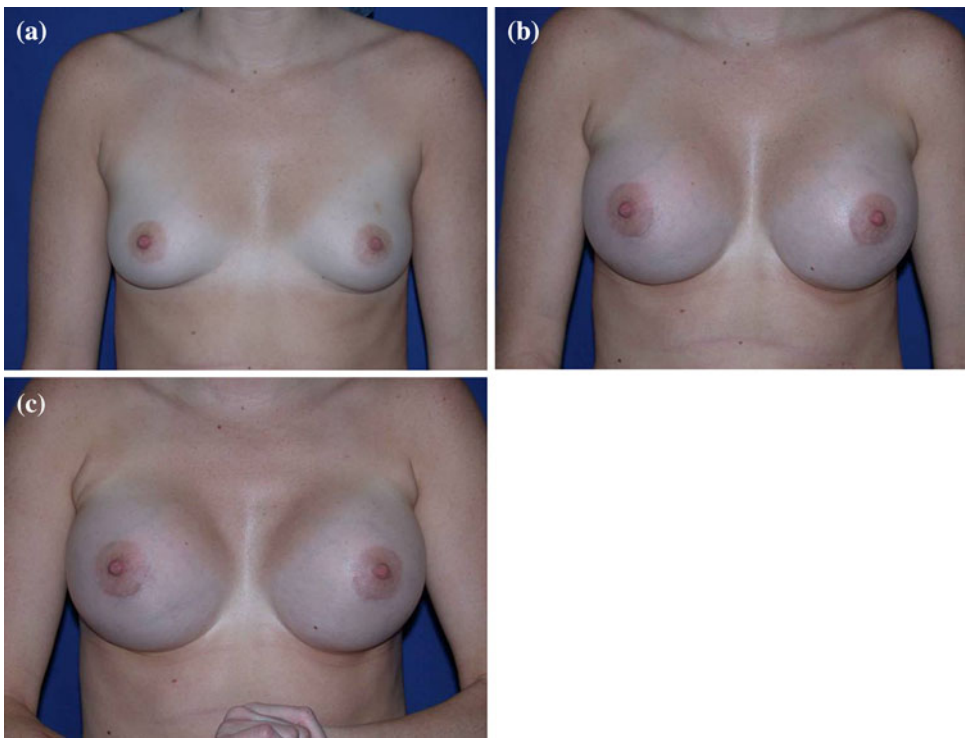

Fig. 5 **a**, **b** Primary augmentation with smooth round implants using the split-muscle technique. **c** Postoperative flexion shows no distortion

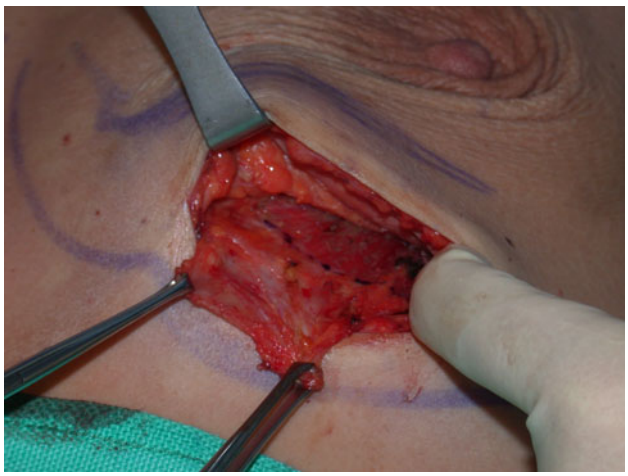

Fig. 6 Dissection of the anterior capsule in a case of established animation and double-bubble contour deformity showing the transition point of the muscle into the capsule

lower portion. For patients with adequate soft tissue coverage, conversion to the subglandular or subfascial plane will suffice [9], with reattachment of the pectoral origin. However, such a sufficiently robust soft tissue envelope often is lacking in athletic women and others predisposed to visible animation problems. The split-muscle technique may be considered where upper pole muscle coverage is desired but the potential for animation problems, double-bubble deformity, or both precludes traditional subpectoral placement.

Conflict of interest The author discloses that he serves as a consultant/speaker and receives consulting fees from Allergan.

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