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Breast

The "Butterfly" Wrap: A Simplified Technique for Consistent Prosthesis Coverage in Prepectoral Breast Reconstruction

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Background: Here, we describe our simple, systematic, reproducible, and effective method for prosthesis coverage in prepectoral breast reconstruction.
Methods: Our Butterfly Wrap is a simple technique, which provides prosthesis coverage with a single sheet of acellular dermal matrix (ADM) in a reproducible and elegant manner. The wrap design creates an anatomic tear-shaped pocket to guide expansion and encourage lower pole fullness, without ADM folding or bunching for optimal incorporation and minimal overlap. Further, it minimizes waste, allowing for smaller sheets of ADM to be used per breast, and can easily be performed in minimal time on the back table while the mastectomies are being performed, as a means of minimizing cost.
Results: Our technique can be applied to effectively cover all shapes and sizes of expanders and implants, both teardrop and round. As a result, the surgeon need only focus on the critical nuances of prosthesis-based prepectoral breast reconstruction, without the anxiety of how to wrap the prosthesis and what size of ADM to use.
Conclusions: The Butterfly Wrap is a simple, systematic, reproducible, and effective method for prosthesis coverage in prepectoral reconstruction. *(Plast Reconstr Surg Glob Open 2018;6:e2007; doi: 10.1097/GOX.0000000000002007; Published online 16 November 2018.)*

INTRODUCTION

In recent years, prepectoral expander and prosthesis placement has gained ground as a viable option for immediate breast reconstruction after mastectomy. Prepectoral reconstruction enables preservation of the pectoralis major muscle, reduces postoperative pain, eliminates risk for postoperative animation deformity, and results in high patient satisfaction.[1–4]

In concert with this technique, acellular dermal matrices (ADM) are now routinely used to provide prosthesis coverage and support during prepectoral reconstruction. The use of ADM in this manner has proved a useful adjunct: First, the ADM offers improved aesthetics by providing a scaffold for prosthesis positioning and soft-tissue support, allowing the surgeon to control the breast pocket, and offer a reliable option for both setting and supporting the inframammary fold during expansion.[2] Second, the ADM offers an additional layer of coverage between the prosthesis and mastectomy flap incision and distributes tension away from the healing mastectomy skin flaps as they recover and heal.

Research supports prepectoral reconstruction as a viable and safe alternative to subpectoral reconstruction, with comparable risk profiles and reduced capsular contracture rates.[2,3,5,6] Further, comparison of prepectoral and partial subpectoral technique demonstrate that prepectoral reconstruction can be safely performed in conjunction with postoperative radiotherapy and in obese patients with a body mass index <40.[7]

Various approaches to using an ADM in prepectoral reconstruction exist, including total 360 degree prosthesis wrapping, and anterior only coverage.[8] To date, the methods employed for ADM-assisted prosthesis coverage in these newer reconstructive procedures remains largely ad hoc, with surgeons developing their own techniques over time, or relying upon random trimming and suturing in an effort to minimize folding and overlap. Although this learning curve is useful in perfecting one's own wrapping technique, the randomness of the process may serve as a barrier to adoption of prepectoral reconstruction and also creates challenges in teaching the technique to inexperienced surgeons.

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Table 1. Estimated Coverage Needs for Common Prosthesis Base Widths

Prosthesis Base Width (cm)	Base Radius (cm)	Approximate Anterior Area (cm^2)	Approximate Anterior Circumference (cm)	Approximate Half-Circumference (cm)	Minimum ADM Size (cm)
11	5.5	47.5	17.3	8.6	12×20
12	6	56.5	18.8	9.4	16×20
13	6.5	66.4	20.4	10.2	16×20
14	7	77.0	22.0	11.0	16×20
15	7.5	88.4	23.6	11.8	20×20

Once the patients' breast footprint is known, a prosthesis may be selected. The prosthesis base width can be cross referenced to select the size of ADM required.

Table 2. Template for Butterfly Wrap Design for Anatomic Teardrop-shaped Implants or Tissue Expanders: Based on Prosthesis Base Width

Prosthesis Base Width (cm)	Base Radius (cm)	X Distance (cm)	Y Length (cm)	Superior Pole Triangle (Height × Width)	Inferior Pole Triangle (Height × Width)
11	5.5	7	5.5	5.5×5 cm	2×2 cm
12	6	8	6	6×5 cm	2×2 cm
13	6.5	9	6.5	6.5×5 cm	2×2 cm
14	7	10	7	7×5 cm	2×2 cm
15	7.5	11	7.5	7.5×5 cm	2×2 cm

Once the selected prosthesis base width is known, Table 2 acts as a reference to the size triangles to be removed from the ADM sheet to allow 3D teardrop single layer coverage to be created.

OPERATIVE TECHNIQUE

The "Butterfly" Wrap is a simple and reliable method of total prosthesis coverage with a single sheet of ADM—via a templated cutting design, the surgeon is guided where to cut and fenestrate the ADM to consistently wrap the anatomic expander or implant without bunching, wrinkling or overlap, and with windows for tabs should the surgeon wish to use them. The principle relies on the prosthesis geometry and involves cutting triangles superiorly, inferiorly, and laterally at pretemplated positions to create a conforming wrap. First, using the dimensions of the planned prosthesis to be used, Table 1 allows determination of the minimum size of ADM required for adequate anterior prosthesis coverage. Second, Table 2 allows determination of X and Y values and superior and inferior triangle sizes to be removed to create a "hand-in-glove" fit for an anatomic teardrop prosthesis or tissue expander. Once these dimensions are determined, they are transposed onto the ADM along-side planned fenestrations (as needed); Figure 1 shows the basic template.

Step-by-step Butterfly Wrap Technique for Tissue Expander or Anatomic Implant Coverage:

1. *Butterfly Wrap Preparation*: A single sheet of ADM (FlexHD pliable, MTF Biologics, Edison, N.J.) is prepared on the Operating room back table (Fig. 2A). The size of the ADM is determined by the geometry of the prosthesis selected and can be accurately estimated by using Table 1. Table 2 is then used to extrapolate X and Y values based on the prosthesis dimensions. These X and Y dimensions are then transposed onto the planned "internal surface" of ADM, along with planned superior and inferior triangles (Fig. 2B). Please note that in our case, we have selected FlexHD pliable as our ADM due to it's lack of polarity, such that the distinction between an "internal/epidermal" side and an "external/dermal" side is not important.[9,10] Likewise, this lack of polarity is useful for step 5 below when the lateral triangles are flipped 180 degrees secured on the posterior surface of the prosthesis.
2. *Cut ADM*: Cuts are then made along the solid black lines in accordance with the transposed cutting guide (Fig. 2C). If using fenestrations, be sure to cut the fenestration lines first for speed and simplicity; the Butterfly Wrap fenestrations are designed vertically to accommodate subtle discrepancies in the size of ADM sheet, or moderate differences in the width of prosthesis. Similar to the concept of meshed grafts, by creating small, 1 cm, nonoverlapping fenestrations, you can effectively increase the width of your ADM for better coverage of wider prostheses.[11]
3. *Suture Anterior Wrap:* First align point A-to-A, then B-to-B etc; this will close the defects created by removal of the 4 triangles, and subsequently create a natural anatomic/tear-drop shape to the ADM sheet that will nicely conform to the prosthesis. Closure can be achieved with a running suture to save time (Fig. 2D). By suturing on the "internal" side of your wrap, you also effectively bury suture knots so they are not prominent on the anterior surface of the prosthesis/ADM construct, and thus do not have the potential to cause irritation to the overlying mastectomy skin flaps after inset. We prefer to use 3.0 PDS sutures; however, any surgeons preferred suture may be used as well. Note, if using an expander with tabs, this design leaves windows to access these tabs as well.
4. *Anterior Wrapping*: Situate the prosthesis within the wrap, with the anterior surface of the prosthesis facing the ADM. If using an anatomic expander, we fully inflate the expander with air to ensure that our ADM support is of the appropriate size and will not serve as a potential limitation to soft-tissue expansion by being too tight (Fig. 3).

5. *Secure ADM Posteriorly around the Prosthesis:* Drape the ADM around the posterior side of the prosthesis and secure point D to D and E to E (Fig. 1). Please note, since this is the posterior surface of the prosthesis, total ADM coverage is not necessary and thus these points do not have to be in direct apposition upon closure; in larger prosthesis coverage they will likely be approximated with spanning sutures. Care should be made to avoid over tightening these points as this could distort the anterior wrap and potentially limit soft-tissue expansion. Like a belt and suspenders, the lateral triangles, which strategically during the wrap design remain attached to the anterior portion of the ADM, are then swung posteriorly and secured to the D and E portions of the ADM using interrupted 3-0 PDS suture. The fully excised superior triangle can then be used as a bridge between the right and left sides of the wrap as needed to provide additional posterior support.
6. *Prepare Prosthesis Pocket:* Once the ADM/prosthesis construct has been completed, the mastectomy pocket should be prepared for inset in routine fashion. Our preferred preparation technique includes thorough hemostasis, antibiotic irrigation, sterile glove change, and a minimal/no-touch technique for insertion to minimize contact of the ADM/prosthesis construct with the skin.[12] We routinely place one 15 French round drain, through a separate stab incision along the inferolateral chest wall, and position it along the entire outer circumference of the mastectomy pocket. As a result of the anterior fenestrations, and the incomplete posterior wrap, we have found no need to place a drain within the sub-ADM position.
7. *Inset ADM/Prosthesis Construct:* If using an expander, we typically deflate it partially within the wrap on the backtable before inset; this provides ample room within the mastectomy pocket to secure the construct with optimal visualization, and thus prevent inadvertent damage to the prosthesis during inset. Based on the anterior wrap design, the inferior mid-point of the ADM/prosthesis construct is easily identified by the superior triangle closure. This will guide the surgeon in positioning the prosthesis in the appropriate orientation. If using expanders, we utilize the expander tabs, however, the ADM can also be secured directly to the chest wall/pectoralis fascia using interrupted sutures, as is the case with direct-to-implant reconstruction. Superiorly, to minimize the potential for a rocker-deformity and to better camouflage the superior pole of the prosthesis, we routinely utilize a small 2 cm wide superiorly based pectoralis fascia flap, or a 2 cm wide partial thickness strip of the superior pectoralis muscle, and secure it to the anterior ADM superiorly using interrupted sutures.[13] For ease in placement, these sutures are often placed within the superior flap before prosthesis inset and tagged with a hemostat.
8. *Skin Redraping and Closure:* After the inset, the mastectomy flaps are redraped over the prosthesis. Any nonviable tissue should be removed, and incision edges freshened as needed. At this point, the tissue expanders may then be reinflated to optimum intraoperative fill at the surgeons' discretion. The skin is closed in the surgeon's standard fashion.

Alternative Butterfly Wrap Technique for Round Implant Coverage

The Butterfly Wrap technique can easily be adapted to cover round prosthesis, either for use in immediate or delayed breast reconstruction. We offer an adapted template to easily conform to round implants (Fig. 2), and

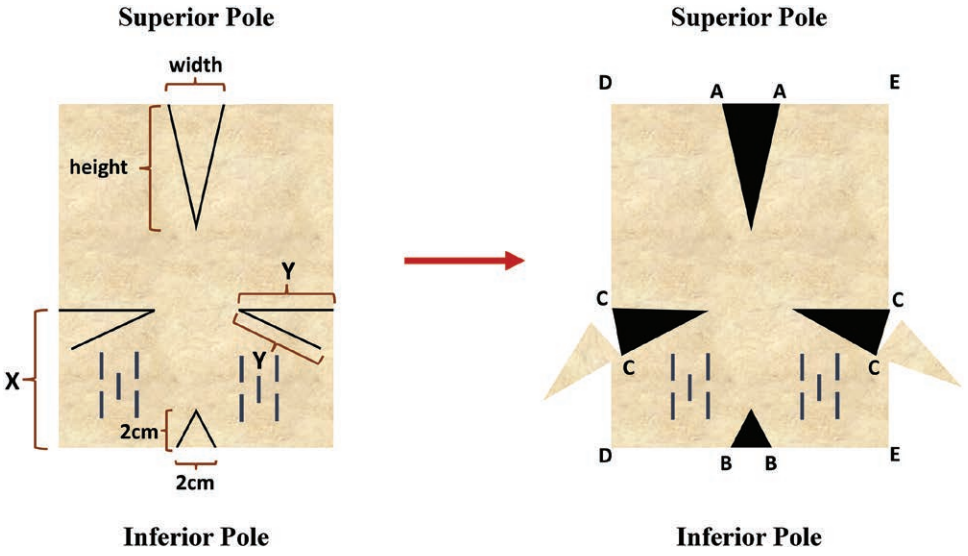

Fig. 1. Butterfly Wrap technique template for anatomic teardrop-shaped implants — Dark lines represent full-thickness cuts through ADM, including vertical fenestrations. X length and Y lengths are determined by prosthesis base width (see Table 2). Corresponding letters represent points to be sutured together. Superior triangle is kept and used for posterior prosthesis coverage.

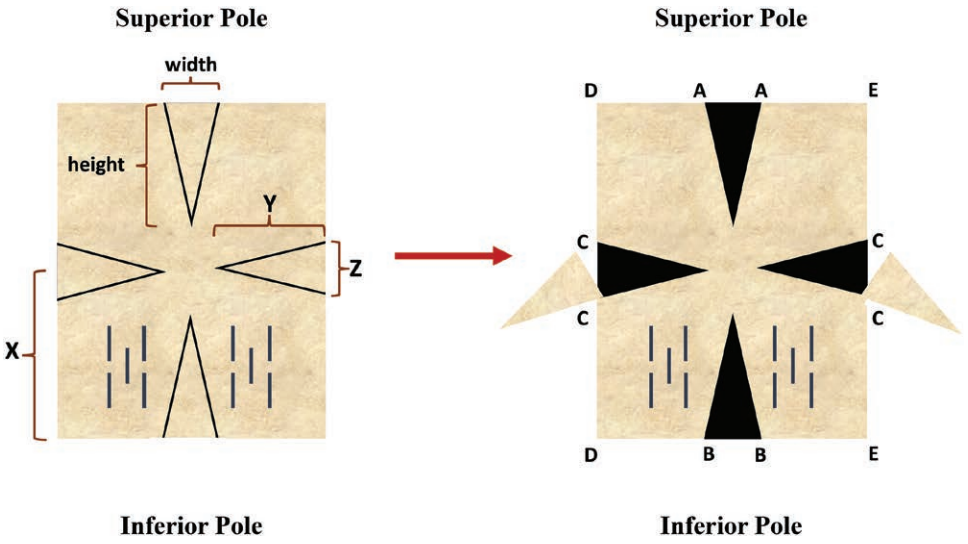

Fig. 2. Butterfly Wrap technique template for round implants — Dark lines represent full-thickness cuts through ADM, including vertical fenestrations. X length is found at the midpoint height of the ADM, and Y and Z lengths are determined by prosthesis base width (see Table 3). Corresponding letters represent points to be sutured together. Superior triangle is kept and used for posterior prosthesis coverage.

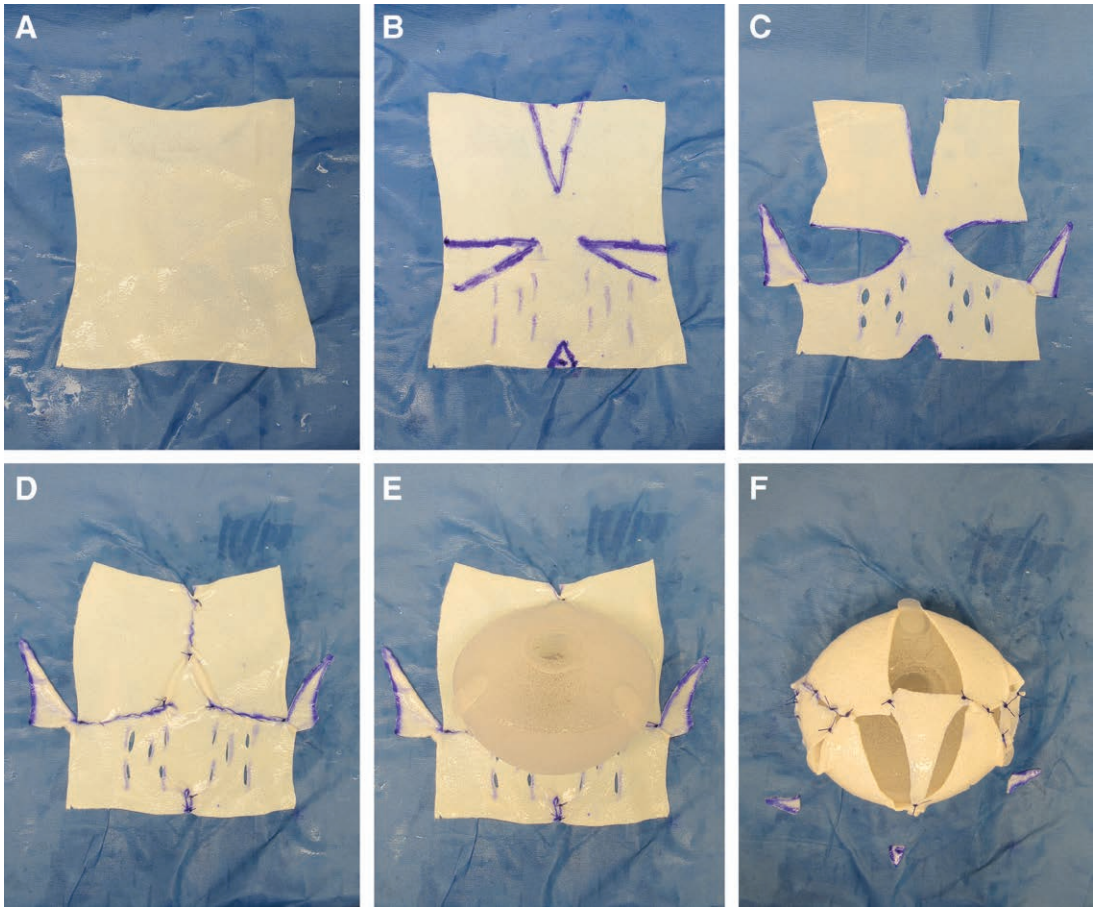

Fig. 3. Stages of Butterfly Wrap A, ADM sheet positioned on back table. B, Markings transposed from template. C, Full-thickness cuts made along solid black lines. D, Anterior conforming wrap created by suturing superior, inferior, and lateral triangles together. E, Inflated — expander or prosthesis placed onto wrap. F, ADM wraps to cover posterior surface of prosthesis with lateral triangles swung around and superior triangle kept and used for posterior coverage. Note minimal ADM waste triangles under completed wrap.

Table 3. Template for Butterfly Wrap Design for Round Implants: Based on Prosthesis Base Width

Prosthesis Base Width (cm)	Base Radius (cm)	X distance (cm) (Midpoint of 16 × 20 cm ADM)	Y Length (cm)	Z Length (cm)	Superior and Inferior Pole Triangles (Height × Width)
11	5.5	10	5.5	5	5.5×5 cm
12	6	10	6	5	6×5 cm
13	6.5	10	6.5	5	6.5×5 cm
14	7	10	7	5	7×5 cm
15	7.5	10	7.5	5	7.5×5 cm

Once the selected prosthesis base width is known Table 3 acts as a reference to the size triangles to be removed from the ADM sheet to allow creation of 3D single layer coverage for a round implant.

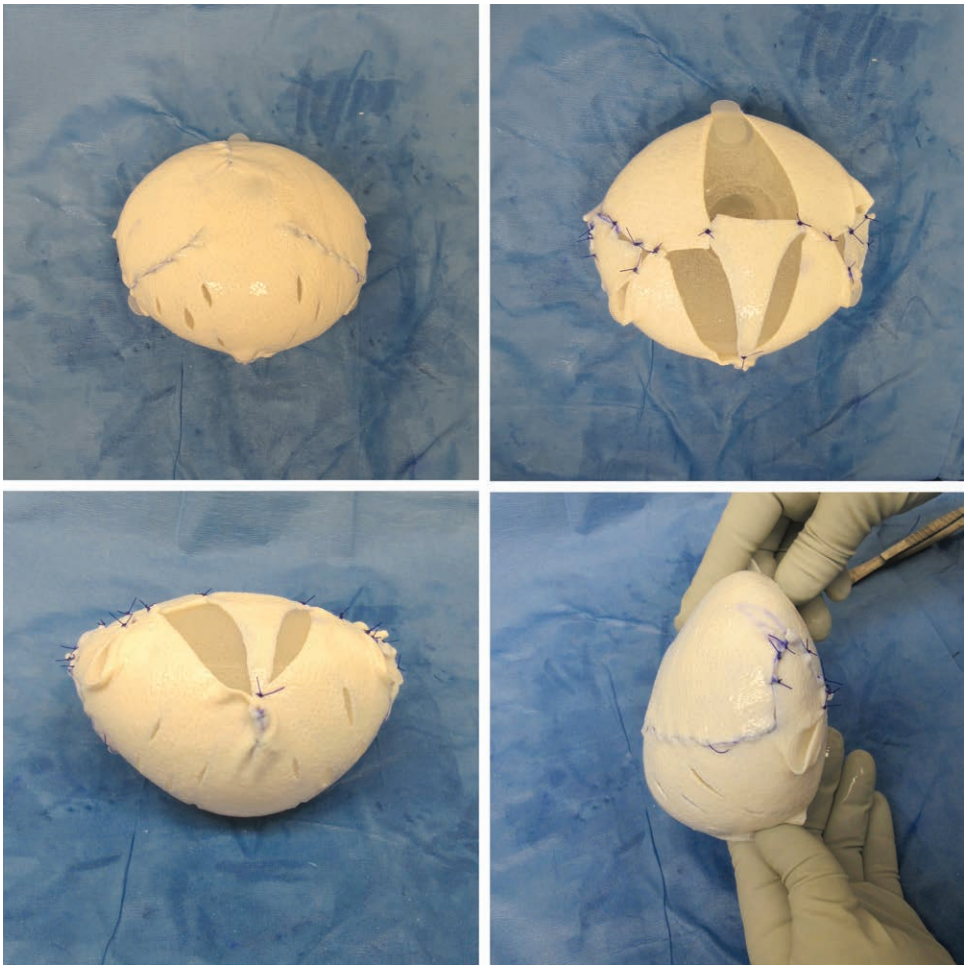

Fig. 4. Complete Butterfly Wrap—Note conforming anatomic wrap without ADM overlap. Wrap leaves space for expander tabs if used.

Table 3 offers determination of the X and Y values and superior and inferior triangle sizes to be removed to create a "hand-in-glove" conforming wrap should a round implant be used. In all other respects, the technique remains the same.

DISCUSSION

Prepectoral breast reconstruction has been shown to be a safe, straightforward and successful method of breast reconstruction. With increasing trends in bundled payments for reconstruction and hospital concerns with charge, efforts to minimize waste and cost, while maximizing efficiency, are gaining attention. Augmenting prepectoral reconstruction using ADM can be expensive, given the additional cost of the ADM, traditional 360-degree prosthetic wrap techniques requiring the largest ADM sizes, and recent use of multiple sheets per breast to provide coverage. By design, the Butterfly Wrap technique minimizes waste from each individual ADM sheet, thus allowing for the smallest size ADM to be selected for a given prosthesis, and subsequently reducing costs associated with the overall procedure. Further, it is time efficient as the wrap can be fashioned on the back-table while the surgical oncologist

is completing the mastectomy, which will save further cost through a reduction in overall operative time.

In addition to potential cost savings, the Butterfly Wrap technique provides a single layer of ADM coverage that conforms perfectly around the prosthesis without overlap (Figure 4); this eliminates folds or bunching of the ADM, leading to optimal incorporation and reduced risk of seroma, prolonged inflammation, scarring, and/or granuloma formation.[9,10] In addition, should you choose to use them, the vertical fenestrations within this technique allow for incremental increases in ADM width to optimize prosthesis coverage and conformability, and also act as sites for potential fluid egress, which has been shown to reduce the risk of postoperative seroma in ADM-assisted reconstruction.[1,14]

Finally, the Butterfly Wrap also provides an easy, reliable, and reproducible technique for providing prosthesis coverage in prepectoral breast reconstruction. We believe this technique is particularly ideal for surgeons starting out in prepectoral reconstruction who are looking for a stress-free method of prosthesis wrapping, and for educating surgeons in these newer techniques.

CONCLUSIONS

The Butterfly Wrap technique provides a simple, consistent and reproducible technique for total prosthesis ADM coverage in prepectoral breast reconstruction. We believe this technique is ideal for early career surgeons and has both time and cost-saving advantages and can be applied to either expander or direct-to-implant breast reconstruction cases. In addition, by eliminating the potential anxiety over how to wrap the prosthesis and what size ADM to use, the surgeon can focus on the critical nuances of prepectoral breast reconstruction with the confidence in knowing that prosthesis will be reliably covered.

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