

Local Autologous Tissues for Expander Coverage in 1st Stage of Delayed-Immediate Breast Reconstruction: Economy-Directed Protocol Modification

RAMA A. ALI, M.D.; TAREK MAHBOUB, M.D. and OMAR A. ELSHARKAWY, M.D.

The Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Cairo University

ABSTRACT

Background: Increasing awareness of post-mastectomy reconstruction raises the demand of searching of many alternatives that can be applied to every patient who came for reconstruction. Completion of expander pocket in first-stage of delayed-immediate breast reconstruction was performed by many techniques.

Aim: We propose an algorithm for this step that can be applied in our low-income country.

Methods: Thirty-four patients fulfilling skin-sparing mastectomy criteria were enrolled in this study. Definite decision regarding postoperative radiotherapy was questionable. First stage of delayed-immediate reconstruction performed with insertion of expander at time of mastectomy. Regarding choice of completion of sub-muscular pocket of expander, the patients were divided into two groups according to the degree of ptosis: Group I (large ptotic breasts where in dermal flap was indicated), group II (small non ptotic breasts wherein total submuscular pocket indicated).

Results: Dermal flap was performed on patients with large ptotic breasts, whereas subpectoral pocket completion was performed on patients with small non-ptotic breasts using the serratus fascia. Two algorithms were proposed to guide the surgeon during the selection of timing and the second one in choosing the most suitable technique. Early post-operative complications were minor and managed conservatively.

Conclusion: Decisions regarding postmastectomy breast reconstruction are multifactorial. The factors not only include staging and perioperative adjuvant management but also include considerations regarding cost and availability of resources. Authors proposed an economically directed algorithm in the first stage of delayed-immediate reconstruction for selection of expander coverage.

Key Words: Breast – Reconstruction – Delayed-immediate – Dermofat flap – Serratus fascia – Economy, expander.

Disclosure: The authors have no financial conflicts of interests or relationships to disclose in the current study and the study did not receive any funding.

Ethical Considerations: Our study was performed in accordance to Helsinki Declaration, after approval of The Local Ethical Committee of Cairo University.

Correspondence to: Dr. Rama Ahmed Ali
E-Mail: ramaahmed163@gmail.com

Consent: Informed written consent was obtained from all patients before the surgical procedures. It includes details of surgical procedures, possible outcome, complications.

INTRODUCTION

Advanced approaches for breast reconstruction after early detection of breast cancer increased the patients' chances to elect skin-sparing mastectomy and immediate or delayed immediate breast reconstruction [1]. Selecting ADM in pocket completion around the implant resulted in a significant shift toward implant-based reconstruction. In the United States and Western countries, the use of implant-based breast reconstruction is favored over the use of autologous reconstruction [2]. Several techniques proposed to either place the implant in the subpectoral plane and complete the lower pole with ADM [3,4] or completely cover the implant with ADM in the pre-pectoral plane [5].

However, the high cost of ADM hindered its use in many centers. In Egypt and other developing countries, the limited availability and the spiking cost of ADM directed the reconstructive surgeons to favor the autologous reconstruction and inspired our team to explore economic methods to complete the pocket around the implant.

Numerous alternatives have been described for muscular pocket completion, including the use of serratus muscle to complete muscular pocket [6]. Using serratus muscle carries the drawback of expander animation deformity [7].

Dermal autografts have been previously described with various degrees of success for inferior pocket completion. However, the technique has a high complication rate e.g., seroma and infection, leading to implant extrusion [8,9,10].

Use of dermal flaps has been reported with a higher success rate in patients with ptotic breasts who are candidates for a breast reduction procedure. Different techniques have been described for dermal

flap elevation, with the Wise pattern technique or through a single horizontal incision with no vertical scar [11,12]. However, this is not possible in patients with small non ptotic breasts.

This study aimed to find alternative methods using autologous tissue to complete the pocket needed for expander in the first stage of the delayed-immediate breast reconstruction without the use of ADM in patients who are candidates for skin-sparing mastectomy. Furthermore, we attempted to describe an algorithm that can provide the most suitable and economical method of expander coverage in the first step of delayed-immediate setting in developing countries with limited resources.

PATIENTS AND METHODS

Thirty-four patients who fulfilled the criteria of skin-sparing mastectomy were enrolled in this study from March 2017 – March 2020. Mastectomy was performed by a surgical oncologist followed by first stage delayed-immediate reconstruction by the plastic surgeon. Smooth, hard-base, rounded expanders with remote valves were used in all cases. The expander base varies between 12-14.5cm according to the measurement of the breast base. Patients with advanced stages (III, IV) and metastatic cases or recurrent cases after previous breast conserving surgeries were excluded. All patients gave the consent to share in the study and the institutional ethical committee approval was obtained.

Preoperative decision making:

Patients were assessed regarding the degree of ptosis that was defined according to the following measurements: Suprasternal notch to nipple distance and nipple to inframammary fold (IMF) distance. The patients were classified into two groups: Group I, patients with grades II and III ptosis; and group II, patients with no ptosis or grade I ptosis.

Group I: Dermofat flap group:

1- Planning and patient selection:

In this group (28 patients), muscular pocket completion was performed with the dermofat flap dissected from the inferior pole of the breast. It was further subdivided according to skin excision patterns (groups Ia and Ib). For patients whose suprasternal notch to nipple distance was ≤ 30 cm, the Wise pattern technique was designed with an inverted T scar (group Ia) (20 patients). If the distance was >30 cm, the final scar was transverse with no vertical element (group Ib) (8 patients) (Fig. 1-A,B). The dermofat flap was designed with

its base the same as the IMF length. The flap widths were 6cm medially and 8cm laterally. (Fig. 2).

2- Surgical procedure:

Intradermal infiltration of the dermal flap with adrenaline (1:500,000 concentration) was performed. Flap de-epithelialization is shown in Fig. (3-A). Subsequently, the thin flap with a thickness of one subdermal fat cell layer was dissected (about one cm thickness). (Fig. 3-B). Mastectomy was then performed by oncoplastic surgeon. Subpectoral pocket creation performed by the plastic surgeon (Fig. 3-C). tissue expander inserted into the dissected pocket and suturing of the de-epithelialized dermofat flap to inferior border of the muscle the inferior limit of dissection was the inframammary fold to preserve the foot print of the breast. (Fig. 4). Separate pocket for expanders' valve was dissected, all of them were located at least 6cm away from the IMF at anterior axillary line level.

Group II: Serratus fascia group:

1- Patient selection and planning:

In patients with no ptosis or grade I ptosis (six patients), muscular pocket completion with serratus fascia and inferomedial part of the pocket were completed with the rectus sheath.

2- Surgical procedure:

After subpectoral muscle pocket dissection, the serratus muscle fascia was dissected (Fig. 5-A). Using the serratus sheath for expander coverage preserved the integrity and action of the serratus muscle. The most medial part of the pocket was completed by the rectus sheath (Figs. 5-B,6) Two different designs were used according to the size of the pocket defect. Rectus fascia advancement was enough to complete small defects, whereas a turnover flap was needed in larger defects.

Intraoperative expansion by 10% filling of the expander volume followed by 10-20% of its volume weekly after complete wound healing. The process of expansion stopped during the period of radiotherapy session and resumed again after completion of radiotherapy.

The oncology team decided postoperative radiotherapy based on the final histopathological results. Patient was followed-up for 3 months post last radiotherapy session.

The outcome was postoperatively assessed by incidence of complications; mastectomy flap necrosis, seroma, hematoma, wound infection / dehiscence, and remote complications; capsular contracture.



Fig. (1): (A): The Wise pattern design in patients with suprasternal notch-nipple areola complex (SSN-NAC) ≤ 30 cm and (B): Transverse scar with no vertical element if the distance is >30 cm.

Fig. (2): Dermal flap planning with its base the same as the IMF length and 5-6cm width.



Fig. (3-A): Flap de-epithelialization.



Fig. (3-B): Dermofat flap dissection.

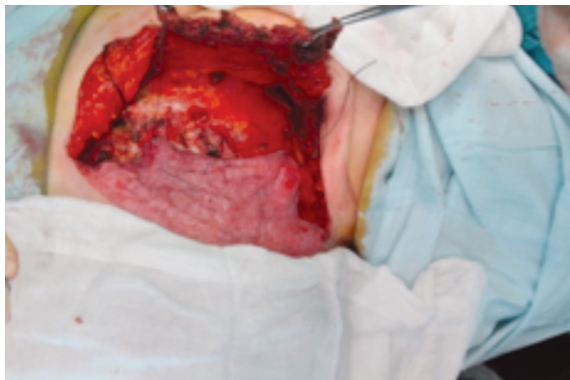


Fig. (3-C): Dissection of subpectoral pocket flap.



Fig. (4): Suturing of the dermofat flap (blue arrow) to the lower border of the pectoralis major muscle (green arrow).

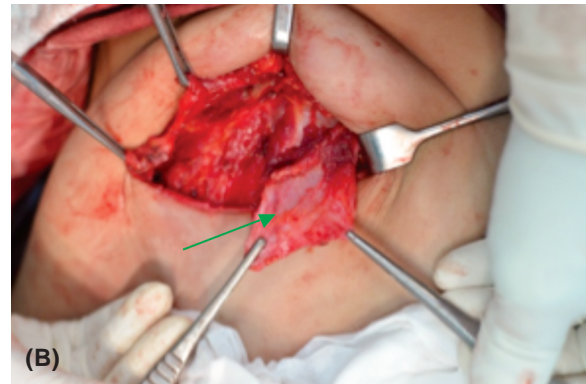
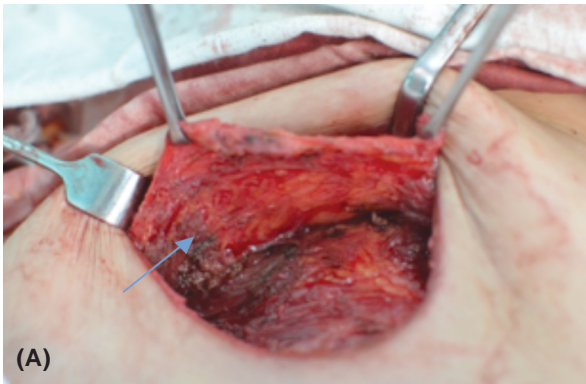


Fig. (5): Dissection of the (A): Serratus fascia (blue arrow) and (B): Rectus fascia (green arrow).

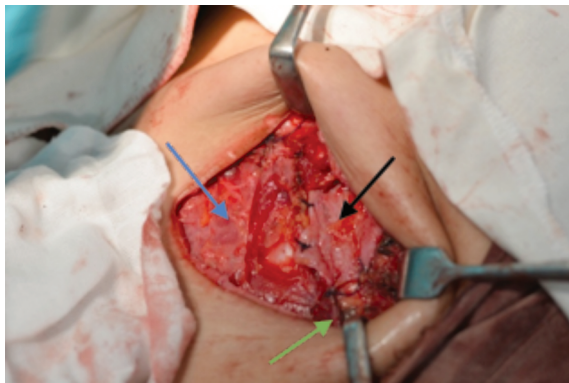


Fig. (6): Submuscular pocket completion (pectoralis major superiorly (blue arrow), serratus fascia inferolaterally (green arrow), and rectus sheath in most medial part of the pocket (black arrow).

RESULTS

This prospective study was performed on 34 patients who were candidates for skin-sparing mastectomy followed by the first stage of delayed-immediate reconstruction. Breast reconstruction timing selection was based on the probability of the need for postmastectomy radiotherapy (PMRT), which is summarized in Fig. (7).

Three pathways will lead to delayed-immediate reconstruction, which constitutes a major percent-

age of patients indicated for postmastectomy breast reconstruction (PMBR).

The first pathway is patient with a questionable need for PMRT. The second pathway is patient with clear PMRT indication and candidate for skin-sparing mastectomy. The third pathway is a patient in whom time is needed before deciding ideal reconstruction method. Particularly, time is needed* for the following patient situations: Patients with concomitant uncontrolled medical illness, those who need psychological preparation, those who did not recover from the consequences of neoadjuvant chemotherapy, those who are undecided regarding the optimum procedure and whether to perform contralateral breast symmetrization, those who need time to decide, and those who wait for the final histopathology report, which will determine the need for adjuvant chemoradiation.

In all patients' tissue expanders were inserted into the subpectoral plane. Lower pole expander coverage selection was established either by the dermofat flap or the serratus fascia based on the breast measurements of the patient according to the algorithm shown in Fig. (8). Moreover, the final closure was based on these measurements by either no vertical scar or inverted T scar.

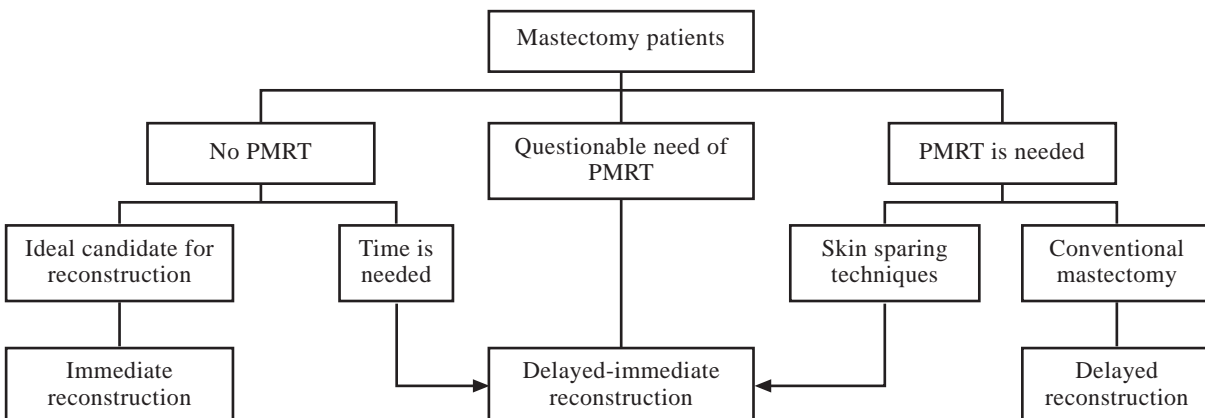


Fig. (7): Algorithm of the postmastectomy reconstruction timing.

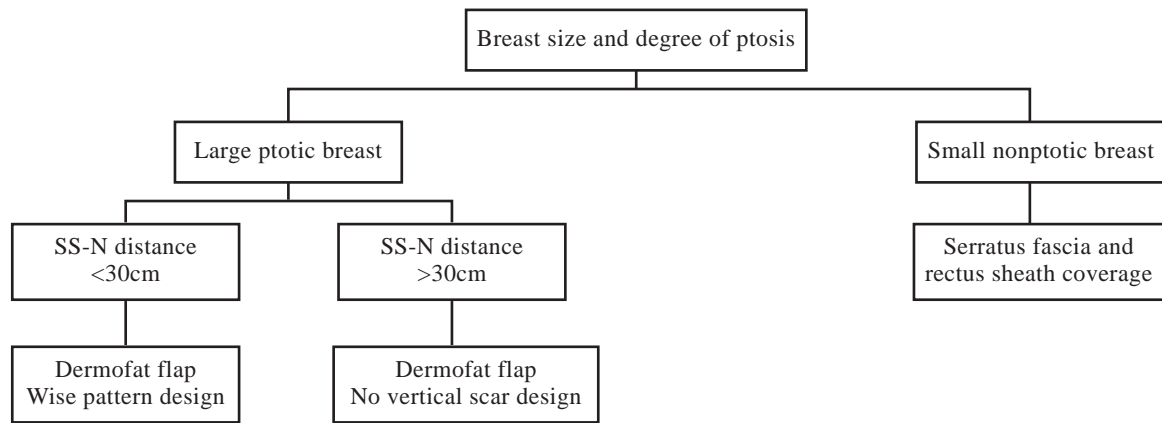


Fig. (8): Algorithm for the selection of subpectoral pocket completion method according to breast size and degree of ptosis.

The mean age of patients was 36.56 ± 6.097 years old. Mean body mass index (BMI) was $27.85 \pm 4.77 \text{ kg/m}^2$. The mean distance between suprasternal notch and nipple was $29.23 \pm 5.06 \text{ cm}$. Smooth, hard-base and rounded tissue expanders used in all patients. The mean expander volume was $392.35 \pm 40.66 \text{ mL}$. (Table 1).

Table (1): Demographic data of the patients and expanders used in the study.

Parameters	Total patients (n=34)
Age	36.56 ± 6.097
BMI	27.85 ± 4.77
SSN: NAC	29.23 ± 5.06
Expander volume (mL)	392.35 ± 40.66
IO expander fill (mL)	49.70 ± 10.72
IO expander fill (%)	12.53 ± 1.66
Final expander fill (mL)	416.91 ± 52.10
Final expander fill (%)	107 ± 9.35

Patients were divided into 2 groups according to breast measurements: Dermofat group (Wise pattern in 20 patients and No vertical scar in 8 patients) and Serratus fascia group Fig. (9). According to breast measurements, especially the breast base, larger expanders were used in the dermofat flap with no vertical scar group since they had larger breast dimensions.

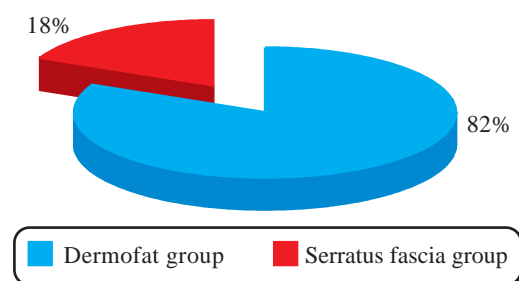


Fig. (9): The distribution of patients among the two groups.

No statistically significant difference in terms of age between the groups was noted. BMI was significantly lower in the serratus fascia group. For patients with an SSN to nipple distance of $>30 \text{ cm}$, dermofat flap with no vertical scar was performed, whereas for those with a distance of $<30 \text{ cm}$, dermofat flap with an inverted T final scar was performed. In the third patient subgroup with small breast and with no ptosis, expander pocket was completed by serratus fascia. (Table 2).

Table (2): The operative and clinical characters of the patients.

	Dermal flap no vertical scar group (n=8)	Dermal flap Wise pattern group (n=20)	Serratus fascia group (n=6)
Age	36 ± 6.86	37.1 ± 7.003	35.5 ± 7.71
BMI	33.37 ± 2.66	27.45 ± 3.50	21.83 ± 0.98
SSN: NAC	36.62 ± 1.40	28.6 ± 0.99	21.5 ± 1.51
Expander volume (mL)	428.12 ± 45.19	393.75 ± 25.48	337.85 ± 15.49
IO expander fill (mL)	60 ± 11.64	49.25 ± 7.48	37.5 ± 2.7
IO expander fill (%)	13.77 ± 1.76	12.47 ± 1.38	11.06 ± 1.23
Final expander fill (mL)	475 ± 38.54	412.75 ± 35.74	353.33 ± 25.81
Final expander fill (%)	111.25 ± 10.83	106.15 ± 8.47	104.16 ± 10.20

Abbreviation: IO expander fill; intraoperative expander fill.

The primary outcome measure of this study is postoperative complications. Direct comparison between the three methods used for expander pocket completion is presented in Table (3). No major early complications requiring reoperation or expander removal were observed. Wound dehiscence developed in four patients and was managed conservatively with repeated dressing. No cases developed hematoma or mastectomy flap necrosis. Capsular contraction occurred in four cases prior to radiotherapy; however, this occurrence did not preclude the expansion process.

Table (3): Summary of complications in each group.

Complications	Total complications	Dermal flap no vertical scar group	Dermal flap Wise pattern group	Serratus fascia group
Seroma	2	0	2	0
Capsular contracture (preradiotherapy)	4	0	3	1
Capsular contracture (postradiotherapy)	7	1	5	1
Wound dehiscence	4	0	3	1

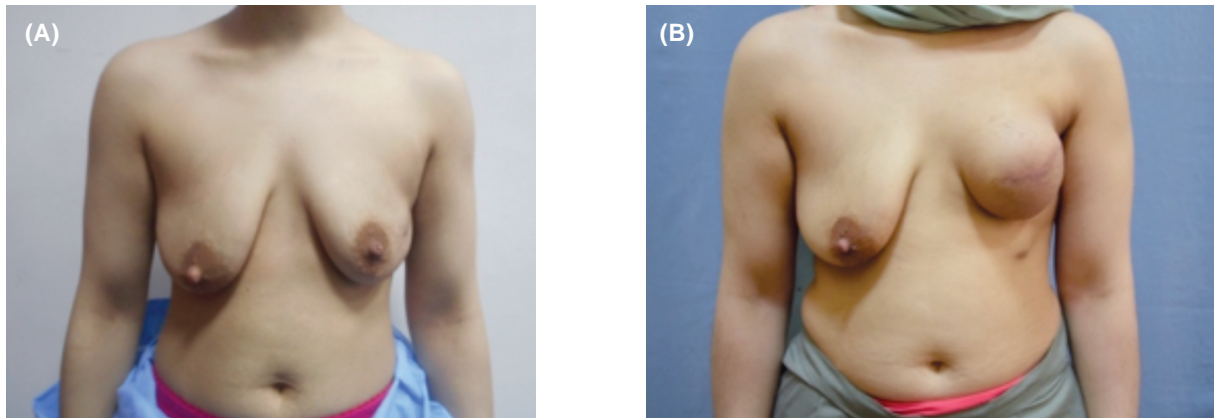


Fig. (10): (A) Patient with grade II ptosis with total submuscular coverage. A; pre operative, (B) After completion of expansion.

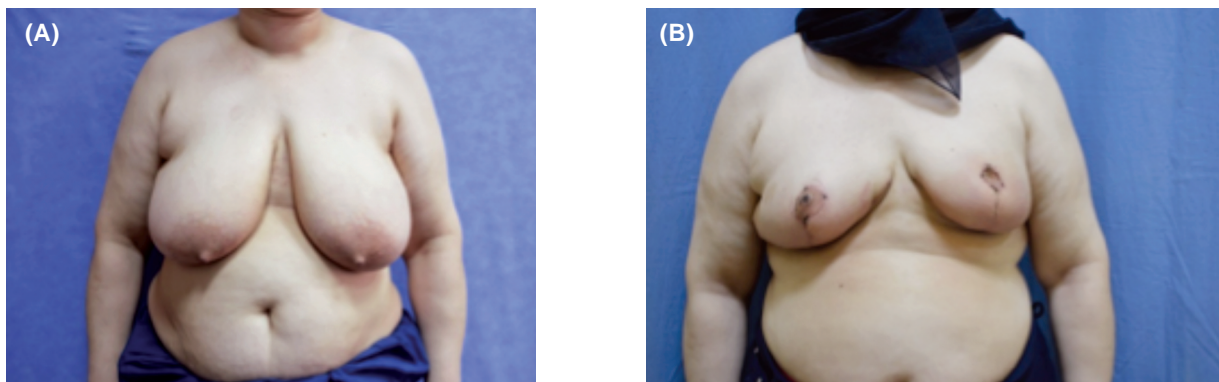


Fig. (11): Patient with grade III ptosis. (A): Pre operative. (B): Left breast mastectomy and expander with dermal flap coverage and areola reconstruction, and concomitant right breast symmetrization.

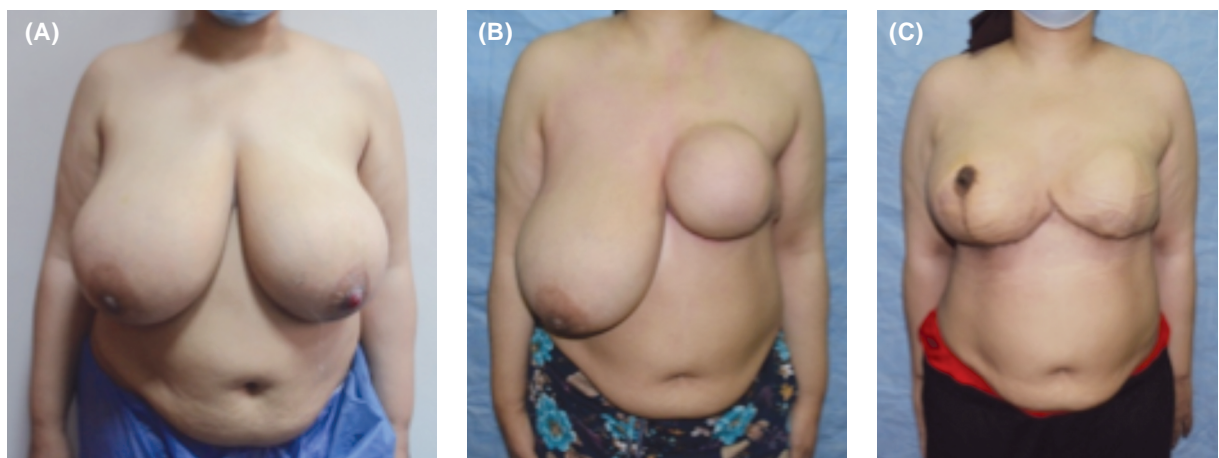


Fig. (12): Patient with grade III ptosis (A): Pre-operative, (B): After mastectomy and dermal flap coverage of expander, (C): After replacement of expander by implant and right breast symmetrization.

DISCUSSION

This study addressed the issue of economical alternatives in breast reconstruction. The timing and method of breast reconstruction vary according to several factors. One of the factors with an effective impact on the timing is the need for postmastectomy radiotherapy.

Delayed-immediate breast reconstruction, which was first described by Kronowitz et al., 2004, is indicated in patients with questionable need for postoperative radiotherapy. This technique carries advantage of preserving the 3-D breast envelope by inserting tissue expander into the subpectoral pocket after skin-sparing mastectomy. The released pectoralis muscle was sutured to breast skin to achieve adequate expander coverage and minimize risk of exposure in case of mastectomy flap necrosis [13]. To refine the technique, Kronowitz et al., recommended the use of serratus muscle with pectoralis muscle to add further protection and minimize the risk of expander exposure laterally [14]. Coverage of the major upper part of the expander was achieved by the pectoralis major, whereas lower part coverage can be achieved by several alternatives.

Breuing and Warren in 2005 reported first use of ADM that was sutured to the inferior border of the pectoralis muscle and chest wall to create a sling. The sling augments the inferior aspect of the subpectoral pocket and provides coverage and support to the expander [15]. Therefore, ADM use protects the lower pole of the expander and lowers operative time and complication rate. However, the high cost of it is a major obstacle faced by reconstructive surgeons in developing countries.

In search of more economical alternatives, several authors have attempted use of autologous tissues for muscular pocket completion. The serratus muscle is one of the alternatives [6]; however, it carries the drawback of differential expansion with medial and superior displacement of expanders that occurs as a consequence of its contraction in relation to the pectoralis major.

Bordoni et al., described pocket completion using the serratus fascia instead of the muscle itself. They concluded that using the fascia for pocket completion has more superior results and lower complication rates [7].

Dermal autograft harvested from anterior abdominal wall skin or contralateral breast can be used to complete the pocket; the outcome was comparable to the use of ADM with lower cost

[9,10]. The complication rate in the previously published series that use the autografts ranges from 13.9% to 59% [8].

In our initial trials, tensor fascia lata and dermal autografts were used as alternatives in a small number of patients. However, the result was not promising due to the high incidence of infection and fibrosis.

In the current study, dermofat flap was created from the lower pole of the breast in patients with grades II/III ptosis. This inferiorly based dermofat flap was sutured to the lower border of the pectoralis muscle to complete the pocket. However, this technique could not be used in patients with small-sized breasts or those with minimal to no breast ptosis. In those cases, serratus fascia was dissected to complete the inferolateral part of the pocket. As the fascia cannot achieve coverage of the inferomedial aspect of the expander, the anterior layer of rectus sheath was dissected and advanced or flipped over to complete the pocket.

In this series, we proposed two algorithms designed for management of our patients. The first algorithm; regarding the timing of PMBR that highlights the candidates for delayed-immediate breast reconstruction (Fig. 7). Three pathways will lead to delayed-immediate reconstruction, which constitutes a major percentage of patients indicated for PMBR.

The second algorithm described selection of the expander pocket completion method (Fig. 8). The patients were distributed into two groups: group I (28 patients), which included patients with large breasts with ptosis. The dermofat flap was designed and dissected from the lower pole of the breast. On the basis of the distance between the suprasternal notch to nipple, the skin excision pattern and final scar were determined. In 20 patients, the distance <30cm; therefore, the design and final closure were an inverted T. In eight patients, the distance was >30cm; therefore, an excess skin was created, and design and final closure were a transverse incision with no vertical scar.

Group II included six patients with nonptotic small breasts; therefore, the serratus fascia in combination with the anterior layer of the rectus sheath was used.

No major complications, including mastectomy flap necrosis and expander extrusion, were encountered in our series. In the dermo fat flap group, minor complications were encountered in 28% of

the cases. Seroma occurred in two patients (7%), who were managed conservatively via ultrasound-guided aspiration. Wound dehiscence developed in three patients (10.7%), who were managed conservatively, and all cases were able to complete expander expansion and exchange to the implant. A large study was completed by Danker et al., wherein 422 cases underwent immediate breast reconstruction using an inferiorly based dermal flap with Wise pattern for closure. They had similar low complication rates with an implant loss rate of 4% [11]. Carstensen used vascularized dermal flap to complete pocket in immediate breast reconstruction on fifteen patients with complication rate of 31%. Seroma occurred in 13% of cases and wound dehiscence in 13%, which were managed conservatively; hematoma occurred in one case (0.4%) [16]. Rivet et al., used dermal flap with no vertical scar technique; however, their results showed a markedly higher rate of expander extrusion at 20% either due to intractable infection (10.5%), symptomatic capsular contracture (8%), or spontaneous deflation of expander (2.5%) [12].

No major complications occurred in serratus fascia group. Wound dehiscence in one patient, and capsular contracture occurred in one patient. Compared with a study published by Saint-Cyr, who used the serratus fascia for pocket completion, seroma, infection, and partial mastectomy flap necrosis occurred in 6%, 3%, and 12% respectively [17].

In Conclusion, when compared with ADM, both the dermofat flap and serratus fascia provided good autologous alternatives for pectoral pocket completion as well as safe and easy techniques with no additional cost.

REFERENCES

- Colwell A.S. and Taylor E.M.: "Recent Advances in Implant-Based Breast Reconstruction," *Plast. and Reconstr. Surg.*, Vol. 145, p. 421e, 2020.
- Momoh A.O., Griffith K.A., Hawley S.T., Morrow M., Ward K.C., Hamilton A.S., Shumway D., Katz S.J. and Jaggi R.: "Postmastectomy Breast Reconstruction: Exploring Plastic Surgeon Practice Patterns and Perspectives," *Plast. and Reconstr. Surg.*, Vol. 145, p. 865, 2020.
- Weichman K.E., Wilson S.C., Weinstein A.L., Hazen A., Levine J.P., Choi M. and Karp N.S.: "The use of acellular dermal matrix in immediate two-stage tissue expander breast reconstruction," *Plast. and Reconstr. Surg.*, Vol. 129, pp. 1049-1058, 2012.
- Bindingave V., Gaon M., Ota K.S., Kulber D.A. and Lee D.J.: "Use of acellular cadaveric dermis and tissue expansion in postmastectomy breast reduction," *J. Plast. Reconstr. Aesthet. Surg.*, Vol. 60, pp. 1214-1218, 2007.
- Nealon K.P., Weitzman R.E., Sobti N., Gadd M., Specht M., Jimenez R.B., Ehrlichman R., Faulkner H.R., Austen W.G., Jr. and Liao E.C.: "Prepectoral Direct-to-Implant Breast Reconstruction: Safety Outcome Endpoints and Delineation of Risk Factors," *Plast. Reconstr. Surg.*, Vol. 145: p. 898e, 2020.
- Chai L. and Zhang X.: "Application of serratus anterior muscle flap combined with breast implants for breast reconstruction after modified radical mastectomy," *Zhongguo Xiu Fu Chong Jian Wai Ke Za Zhi*, Vol. 31: pp. 1098-1101, 2017.
- Bordoni D., Cadenelli P., Rocco N., Tessone A., Falco G. and Magalotti C.: "Serratus anterior fascia flap versus muscular flap for expander coverage in two-stage breast reconstruction following mastectomy: Early post-operative outcome," *Aesthetic Plast. Surg.*, Vol. 41: pp. 26-30, 2017.
- Davis C., Boyd C., Mateo de Acosta Andino D.A., Kumbha P.A., Sanchez R.J., Kurapati S., King T.W. and de la Torre J.I.: "Dermal Autografts in Breast Reconstruction A Review of Past and Current Trends," *Ann. Plast. Surg.*, Vol. 84, pp. 618-622, 2020.
- Lynch M.P., Chung T.M. and Rinker T.B.: "Dermal autografts as a substitute for acellular dermal matrices (ADM) in tissue expander breast reconstruction: A prospective comparative study," *J. Plast. Reconstr. Aesthet. Surg.*, Vol. 66, pp. 1534-1542, 2013.
- North W.D., Kubajak C.S., St. Martin B. and Rinker B.: "Dermal Autograft Using Donor Breast as Alternative to Acellular Dermal Matrices in Tissue Expander Breast Reconstruction a comparative review," *Ann. Plast. Surg.*, Vol. 78: pp. S282-S285, 2017.
- Danker S., Schmitt M., Smith N., Chong J.H., Sandholm P.H., Murphy J.A. and Ladizinsky D.A.: "Bostwick Autoderm and Implant Technique - Improved Outcomes for Obese Patients in Immediate Breast Reconstruction," *Plast. Reconstr. Surg.*, Vol. 147: pp. 187e-197e, 2021.
- Rivet J.J., Day M.K., Rau F.J., Waldrop L.J. and Brzezienski A.M.: "Passot-Type Immediate Breast Reconstruction Obviates the Use of Acellular Dermal Matrix in Grades 2 and 3 Ptoisis," *Ann. Plast. Surg.*, Vol. 82, pp. S394-S398, 2019.
- Kronowitz S.J., Hunt K.K., Kuerer H.M., Babiera G., McNeese M.D., Buchholz T.A., Strom E.A. and Robb G.L.: "Delayed-Immediate Breast Reconstruction," *Plast. Reconstr. Surg.*, Vol. 113: pp. 1617-1628, 2004.
- Kronowitz S.J.: "Delayed-immediate breast reconstruction: Technical and timing considerations," *Plast. Reconstr. Surg.*, Vol. 125, No. 2, pp. 463-474, 2010.
- Breuing K.H. and Warren S.M.: "Immediate Bilateral Breast Reconstruction with Implants and Inferolateral AlloDerm Slings," *Ann. Plast. Surg.*, Vol. 55, pp. 232-239, 2005.
- Carstenson L.: "Visualized immediate breast reconstruction with dermal flap and implant," *Gland Surg.*, Vol. 8 (Suppl 4), pp. S255-S261, 2019.
- Saint-Cyr M., Dauwe P., Wong C., Thakar H., Nagarkar P. and Rohrich R.J.: "Use of the serratus anterior fascia flap for expander coverage in breast reconstruction," *Plast. Reconstr. Surg.*, Vol. 125, No. 4, pp. 1057-1064, 2010.