Use of Pectoralis Major With or Without Pectoralis Minor Muscle Flap to Fill Lumpectomy in the Breast

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Abstract: Treatment of breast cancer has undergone a major change with breast conservation surgery (consisting of lumpectomy and axillary dissection or sentilel lymph node biopsy) and forms a major proportion of the total number of surgeries. To give an aesthetically pleasing breast after surgery has been a challenge and various techniques to fill the breast defect or to reconstruct the partial mastectomy defect are already in practice like local wedge closure, local tissue rearrangement, local advancement flap, thoracodorsal perforator flap, latissmus dorsi flap, silicone implant, reduction mammoplasty, etc. In this article we present the use of pectoralis major muscle with or without pectoralis minor muscle as an innovation, to fill the lumpectomy defects in the upper quadrants of the breast.

Ten patients with breast cancer in whom the cancer was between 2 and 4 cm were identified for the study, the prerequisite being that the tumor should be present in the upper quadrants of the breast. Patients with severe ptosis (grade 3) were excluded from the study. After lumpectomy was carried out, using the same incision, pectoralis major muscle flap was harvested based on thoraco-acromian pedicle, rolled over like a ball and used to fill the defect. Pectoralis minor muscle flap was supplemented in 2 patients where additional volume was required. All patients received standard protocol for breast cancer. The postoperative cosmesis was judged by 3 independent judges using visual analogue scale at the end of 9 months.

The average tumor size was 2.86 cm. Out of 10 patients in whom it was done, good cosmesis was achieved in 9. The average visual analogue scale score was 87.8. The average operative time was 126 minutes and the hospital stay was 3.5 days. No patient had any flap necrosis. One patient had minor wound infection. None of the patients had positive surgical margin for malignancy.

The technique, advantages, limitation, and further scope of this innovation have been dealt in the article. In our opinion this would be a very important armamentarium for the plastic surgeons involved in breast reconstruction.

Key Words: pectoralis major, pectoralis minor, lumpectomy, breast, reconstruction

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Changes in the treatment of breast cancer have necessitated the change in attitude of the surgeons over period of time. Modified radical mastectomy is less commonly used in early breast cancers now, being replaced by breast conservation surgery. Breast conservation surgery was introduced in the practice of oncologic surgery with the objective of providing aesthetically pleasing breast even after the surgery, preserving the normal breast tissue as much as possible so as to retain the shape as well as the feel of the breast. This had immense psychologic benefit as well. Over the period of time as breast conservation therapy has not only been limited to the T1 and T2 lesions but also to T3 lesions and after neo adjuvant chemotherapy. In such a scenario some reconstructive options become mandatory to preserve the shape of the breast.

In carrying out breast conservation surgery, the deformity after lumpectomy becomes more so obvious in small and medium size breast. But ultimately it is the proportion of breast tissue removed which determine the aesthetic outcome. Other factors which determine the aesthetic outcome are size of the tumor, depth of the tumor, whether skin is involved, the size of the breast, the volume of tissue removed, the surgical tumor free margins taken, and the quadrant of breast where the tumor is situated. Devoid of any primary reconstruction, the lumpectomy cavity fills with seroma. In fact it is advocated that the lumpectomy cavity should not be closed, in an attempt that the resulting seroma allows the breast contour to be maintained. Seroma fills small and deep lumpectomy cavities well, but only for large breasts and when the volume of tissue resected is less than 10% of the breast volume. For the larger ones, subsequent resorption leads to scarring and deformity. Cosmesis is not satisfactory in many patients undergoing breast lumpectomy if no primary reconstruction is done at the time of initial surgery.[1–3] This is evident more in small breasts and especially when the tumor is T2 and T3. Silicone implants have been used to fill the defect but not only are they costly but leave a feeling of having something foreign in the body. Various other techniques have been used to reconstruct partial mastectomy defects. Kronowitz et al have described the use of local tissue rearrangement by accessing the lump through periareolar incision. By separating the breast skin as an envelope from the breast tissue, they were able to drape the plicated cavity.[4] These techniques which use the tissue from the breast are the volume displacement techniques. In very large breasts reduction mammoplasty has been advocated. Volume replacement techniques which bring additional volume like perforator based fasciocutaneous flaps of thoracodorsal artery and intercostals arteries have been used to replace the loss of breast skin particularly of upper outer quadrants.[5] Latissimus dorsi (LD) flap has been used to reconstruct large breast defects[6–8] but has disadvantages like functional loss, additional scarring, position change during surgery, and more operative time. These issues prompted us to use the pectoralis major muscle, with or without the pectoralis minor to fill postlumpectomy defects as it is technically easy, less time consuming, of lesser magnitude, and has the ease of operation. Our technique also preserves the function of pectoralis major muscle and it obviates the need of reduction procedures in either the same breast or in both unless the patient demands it. One can consider our technique a local tissue arrangement as the volume of the muscle is redistributed and

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concentrated in a very small area but since the loss of projection is so less after the pectoralis major flap is taken (see below), it in effect behaves like a volume replacement technique.

Pectoralis major muscle is in the most ideal position for the purpose of breast reconstruction. Situated just under the breast, it can be easily accessed from the breast incision. Its dual blood supply allows one to raise a superiorly based flap based on the thoraco-acromian pedicle and a medially based flap based on the perforators of internal mammary artery. The former flap can be rolled over like a ball to fill any lumpectomy defect in the upper quadrant of the breast. The latter flap can be used for filling the defects in the medial part of the breast. Since the breast mount starts from a little below the clavicle, the uppermost clavicular portion of the pectoralis major muscle remains intact and the dissection does not proceed unto the superior most portion of the muscle. It means that the adduction movement at the shoulder joint remains unaffected. Our concern was also if there is animation of the muscle. We did not find significant animation probably because the lower fibers behaved functionally different than the upper clavicular portions of the muscle.[9] Corten et al in their study concluded that a separate nerve innervated the clavicular and upper medial sternocostal portions of the pectoralis major muscle. This nerve arose craniomedial to the main vascular pedicle of the pectoralis major flap.

While we thought of options for filling the defects created by the lumpectomy, we felt that the volume of breast tissue lost is best replaced by similar volume of tissue from elsewhere, like in case of LD muscle particularly when no skin loss is there. Use of pectoralis major muscle as a tissue for volume replacement would mean a net loss of volume from the lower part of the chest wall, thus affecting the overall volume of the breast. While it was a pertinent point, anatomically pectoralis major does not lie beneath the lower lateral portion of the breast. Additionally, the large flat area over which the muscle lies in the lower part, when lost when the flap is elevated, would mean a loss of projection of the breast by a few millimeters. Further the clavicular portion of the muscle is preserved preventing depression in the subclavicular area. The little difference in the breast projection would hardly be appreciated by the naked eye and the muscle flap when rolled into a ball creates the required volume to fill the defect (over a smaller area). The benefits of the use of this muscle as a flap far outweigh the loss of projection by a few millimeters (akin to that in the cleft lip surgery). Every effort should be made to overcorrect the defect because in the long-term there is bound to be some atrophy of the muscle.

MATERIALS AND METHODS

A pilot study of 10 patients with carcinoma breast were enrolled in the study. The patients were informed in detail about the pros and cons of breast conservation surgery from an oncology point of view. Only after informed consent for the above had been obtained, we explained about the reconstructive options to preserve their breast shape. A separate consent was taken for their enrollment in the study.

Inclusion Criteria

1. Tumor size between 2 and 4 cm which corresponded to moderate defects (type B) as classified by Munhoz et al.[10] Munhoz et al have described a very useful classification system for breast conservation surgery defects based on the volume of breast tissue resected and in reference to the size of the breast. Breasts have been classified as small (bra size A and B), medium (bra size C) with or without ptosis, and large (bra size D) a ptotic. Accordingly, in each breast the defects were classified as A, B, and C depending on the volume of the defect in respect to the breast volume. Type A defects were 10% to 15% of the breast volume, type B 15% to 40%, and type C defects formed more than 40%. This is a very useful classification but unfortunately not available at the time of our study. In our study, size of the tumor was considered a parameter and the volume of the excised specimen was approximately calculated. When it was thought that the volume of pectoralis major muscle flap (rolled over in spherical shape) will be similar to or more than the volume of excised specimen (volume of the cavity), this particular reconstructive option was considered. Typically tumor sizes of 2 to 4 cm diameter were only thought to be suitable for this study as pectoralis major flap will fall considerably short of the volume of the defect if the size is more.
2. Tumors situated in the upper quadrant of the breast (upper outer, upper central, and overlapping).
3. Breast of all sizes were included and mild and moderate ptosis was not considered as contraindication.

Exclusion Criteria

1. Tumor size of more than 4 cm were not considered as the total volume of the pectoralis major muscle flap when rolled as a ball will be considerably less than the volume of the cavity (malignant breast tumors are removed with additional 1 to 2 cm margins on all sides) so the volume of the excised specimen (cavity) is much larger than the volume of the tumor.
2. Involvement of skin, as we have in this particular series done only muscular flaps.
3. Tumor situated in the lower quadrant of the breast as the flaps were superiorly based.
4. Severe ptosis (grade 3).
5. Very large breasts where local tissue arrangements or reduction mammoplasty could be better options.

All patients received the standard protocol for chemotherapy/hormonal therapy. As per the policy all patients received radiotherapy to whole breast. All these patients were followed-up regularly. Opposite breast was considered as the end point for comparison. Their aesthetic outcome was assessed by 3 independent observers using visual analogue of 10 cm scale at the end of 9 months of surgery. The longest follow-up has been for 2 years and the least for 11 months. Additional assessment that was made was if any of these patients had any significant animation of the pectoralis major muscle.

Technique

After the lumpectomy is carried out, in the same position, from the same incision, pectoralis major flap based on thoraco-acromian pedicle is harvested. The muscle flap is then rolled over itself like a ball and is sutured to itself. The flap is then sutured to the chest wall and to the walls of the cavity thus obliterating it. This flap can easily fill the lumpectomy defects of the upper central, upper medial, and upper outer quadrant. The clavicular head of the muscle can in most circumstances be kept intact thus preserving the function of the pectoralis major muscle. To fill the defect of the medial aspect of the breast, the flap is raised on the perforators of internal mammary artery.

If further bulk is required, especially in the upper outer quadrant, pectoralis minor muscle flap can be additionally used. While using the pectoralis minor flap, the pectoral nerve can be preserved by longitudinally dividing the muscle so as to have 2 flaps which can be oriented in different directions to suit the defect (Figs. 1–4).

RESULTS

Average size of the tumor was 2.86 cm. The average operative time required was 126 minutes including the excision

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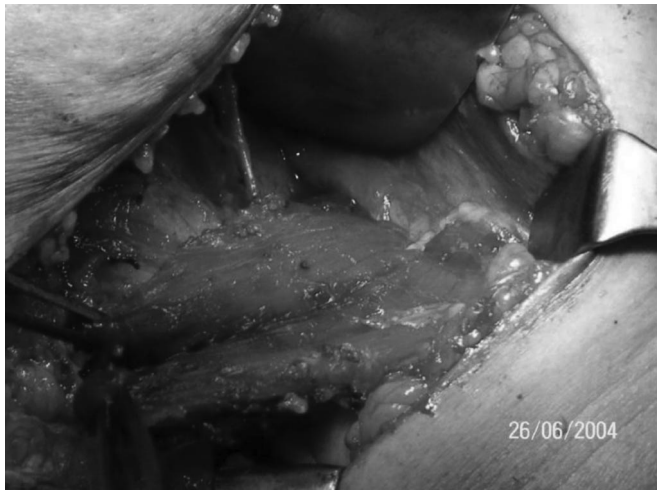

FIGURE 1. Harvest of pectoralis minor muscle. The muscle has been verically split to preserve the lateral pectoral nerve.

FIGURE 2. Pectoralis major muscle flap harvested to fill a lumpectomy cavity of 6 cm diameter. The clavicular head has been preserved.

FIGURE 3. Pectoralis major flap has been rolled like a ball to fill the defect.

FIGURE 4. Postoperative result after 3 months.

and the stay averaged to 3.5 days. The average visual analogue scale (VAS) score was 87.8. VAS score of more than 80 was considered a good result (Table 1). None of the patients had the problem of animation to any significant level to bother them. We carried out the pectoralis major muscle flap alone in 8 patients. The defects were in upper outer and upper central quadrants. Of these, 7 patients had good cosmesis. In 1 patient, some breast skin was removed during initial lumpectomy. We could not mobilize the skin enough since the flap is purely muscular, there was a paucity of skin causing some distortion. In 2 patients pectoralis minor muscle flap was used in addition to pectoralis major muscle. The results were judged by 3 independent judges using VAS of 10 cm at the end of 9 months. The judges judged the reconstructed breast and compared them to the opposite breast for symmetry. The longest follow-up was for 2 years and the minimum follow-up for 11 months. Overall 9 of 10 patients had good results (VAS >80).

DISCUSSION

While planning for reconstruction of partial mastectomy defects, there is a difference in perception between the plastic surgeon and the patient as to what should be a good postoperative breast. As plastic surgeons, our perception of a perfect breast is where the breast is young looking with upright nipple areola complex with no ptosis and the nipple lying in the center of the breast mount. While it is ideal, patients with breast cancer are not necessarily as aggressive about the cosmesis as patients who come primarily for ptosis correction or for cosmetic enhancement of their breast, more so when they are facing a life threatening disease. While a proportion of patients would want correction of ptosis of the opposite breast at the same time, what majority of the patients aspire is that they should have a breast which is like their opposite breast, and at the end of their surgery they should have a symmetrical breast. While it is perfect on our part to educate them, it may be improper to do massive reduction mammoplasties on both breasts unless the patient specifically desires so or when there is no other option left. Having kept this in mind, our aim of the reconstruction of the lumpectomy defect was to fill it in such a way that their preoperative look was

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TABLE 1. Details of the Patient in the Study

Patient Number	Size of Tumor (cm)	Size of Breast	Location	Ptosis (Regnault)	Average of VAS	Operative Time	Hospital Stay (d)
1	3	Medium	Upper outer	None	100	130 min	3
2	2.7	Medium	Upper outer	Mild	91.6	110 min	3
3	3.3	Large	Upper central	Mild	86.6	140 min	3
4	3.4	Large	Upper outer	None	86.6	140 min	4
5	3.2	Large	Upper outer	Mild	80	150 min	4
6	2.4	Large	Upper central	Moderate	100	120 min	4
7	2	Medium	Upper outer	Moderate	88.3	100 min	3
8	3.1	Medium	Upper central	Mild	65	130 min	3
9	3	Large	Upper outer	None	88.3	120 min	4
10	2.5	Medium	Upper outer	Moderate	91.3	120 min	4
Average	2.86 cm				87.8	126 min	3.5 d

maintained (although in the study we excluded patients with massive ptosis). This required replacement of the volume lost by almost identical volume of the muscle shaped like a spherical ball.

When one considers a lump of 3 cm diameter, the minimum diameter of the excised specimen would be 5 to 6 cm, ie, a volume of 65 to 113 mL, for a 2 cm lump the volume would be about 33 to 65 mL and for a 3.5 cm lump the volume would be 100 to 200 mL depending on whether 1 or 2 cm margin is taken. Pectoralis major muscle flap (whole) when rolled into the shape of a ball will have a volume of about 100 to 150 mL. Substituting volume for volume, it appears that a lump size of less than 3.0 cm, when excised, would create a cavity which can be adequately filled by the muscle flap. For tumors smaller in size, the flap may be trimmed. If some additional volume is required, supplementation with pectoralis minor muscle or local tissue rearrangement can be added. We used the pectoralis minor muscle as a supplement in 2 patients for defect in the upper outer quadrant. Further larger series are required to ascertain these facts to standardize the reconstructions.

Although the breast size is important and better cosmesis would be in patients of larger breast (cup sizes B, C, and above), since the volume lost is replaced by the volume of the muscle, even smaller breasts have good cosmesis, as long as the skin is preserved. A comparison with LD muscle flap can easily be drawn. LD muscle flap has been used with good success and gives good cosmesis.[6,7,11] The drawbacks of LD flap is that it leaves a scar at the donor site which is not the case with pectoralis major muscle as it is harvested from the lumpectomy incision. It also requires change of position and increased operative time. Further, function of LD muscle is completely lost.

Various local breast flaps and mastopexy techniques have also been used. McCully et al have used wedge resection and closure as well as advancement flaps with nipple reconstruction for centrally located tumors.[8] These are good techniques, but are valid only for central tumors. Wedge closure can be done for small and deep cavity. Naguib[12] have used inferior-laterally based skin-glandular breast flap for centrally located tumor with good results. Mastopexy and reduction mammoplasty have also been done after breast lumpectomy.[13] Kronowitz et al have described various dermoglandular pedicle to repair partial meastectomy defects when reduction mammoplasty is contemplated.[4] Mastopexy or reduction mammoplasty is suitable only if surgery of the opposite breast is also done simultaneously. Pectoralis major muscle based on either of the pedicle is capable of filling most of the lumpectomy defects in the upper quadrants of the breast. It can be supplemented with pectoralis minor on lateral aspect. There are a few obvious advantages of this technique: (1) good cosmesis, (2) can be approached from the lumpectomy incision hence no additional scarring, (3) no change of position, (4) less operative time, and (5) pectoralis major muscle function can be preserved if the flap is based on the thoracoacromian pedicle (Fig. 5). This flap has less morbidity than LD flap and has many advantages over it, but only if there is no skin loss as the flap is purely muscular. Although not used in this series, when there is a skin loss, pectoralis major myocutaneous flap may be a good option to consider, the modification in the technique would include stacking of the muscle instead of making it like a ball and deep epithelializing it when skin is not required. The donor area could be closed primarily from upper abdominal skin with a scar in the inframammary fold. One of our patients had a skin loss in addition to loss in breast tissue. We raised the pectoralis major flap to cover the defect. But the paucity of the skin led to distortion of the breast as we could not mobilize the breast skin enough to minimize distortion. A myocutaneous flap could have helped us in such a situation. In that particular patient, complete mobilization of the entire breast skin as an envelope as described by Kronowitz would have been another good option.

FIGURE 5. Preserved function of pectoralis major muscle.

Another important advantage of our technique is that the function of shoulder adduction is not lost as the clavicular head of pectoralis major is preserved. Our patients had no weakness of shoulder adduction.

Based on the experience with these cases, we would recommend this flap, purely in the muscular form for defects in the upper outer quadrants and upper central quadrants where the defects are less than 3 cm in size corresponding to the cavity size diameter of

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about 5 to 6 cm in size. It is suitable for all types of breast lumps in these locations. Further larger series for the utility of this flap and myocotaneous flap (both with normal skin paddle and deep epithelialized skin paddle where large volume is required) will immensely help in using this flap as a regular flap for reconstruction.

SUMMARY

This novel approach for filling breast lumpectomy of upper outer quadrant and upper central quadrant defects in patients undergoing lumpectomy for cancer or benign disease has tremendous scope. Pectoralis major muscle flap from the same breast with or without pectoralis minor muscle fills the lumpectomy cavity very well and provides good breast contour preserving the function of the muscle as well as the contour of anterior axillary fold. This technique has a lot of advantages over LD flap for such defects and is one of the best options to fill them.

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