Scientific Research Publishing

Surgical Science, 2023, 14, 277-288
https://www.scirp.org/journal/ss
ISSN Online: 2157-9415
ISSN Print: 2157-9407

Surgical Outcomes Following Partial Breast Reconstruction with Chest Wall Perforator Flaps

Manas Kumar Dube[1], Rishabha Deva Sharma[2], Devanand Puthu[1]

[1]Sherwood Forest Hospitals NHS Foundation Trust, Kings Mill Hospital, Mansfield, UK
[2]University Hospitals Plymouth NHS Trust, Derriford Hospital, Plymouth, UK
Email: manasdube@doctors.org, srishabha@gmail.com, dev.puthu@nhs.net

How to cite this paper: Dube, M.K., Sharma, R.D. and Puthu, D. (2023) Surgical Outcomes Following Partial Breast Reconstruction with Chest Wall Perforator Flaps. *Surgical Science*, **14**, 277-288.
https://doi.org/10.4236/ss.2023.144031

Received: February 28, 2023
Accepted: April 15, 2023
Published: April 18, 2023

Abstract

Introduction: In the last two decades, chest wall perforator flaps (CWPF) have become a versatile tissue replacement technique for partial breast reconstruction following breast-conserving surgery (BCS) in well-selected cases. We present the surgical outcome of 81 patients with chest wall perforator flaps used for breast-conserving surgery. **Methods:** We recorded the outcomes of three oncoplastic breast surgeons who performed partial breast reconstruction with chest wall perforator flaps from 1st January 2018 to 30th June 2022 at Sherwood Forest Hospitals NHS Foundation Trust. Data were collected on patient demographics, including age, BMI, smoking status, bra size, previous treatments, type of CWPF procedure, tumor size (measured clinically, via imaging and histologically), biopsy results, specimen weight, margins involvement, re-operation rate, surgical site infection (SSI), flap loss, flap shrinkage, hematoma, and seroma rates. **Results:** A total of 81 patients were included in this study, with an average age of 55.7 years and a body mass index (BMI) of 26.7 kg/m^2. The bra size varied between A to FF with A (7.4%), B (28.3%), C (38.2%), D (13.6%), DD (11.1%), and FF (1.2%). 14.8% of the patients had neoadjuvant chemotherapy (NACT). For 45 patients, LICAP (lateral intercostal artery perforator), 16 AICAP (anterior intercostal artery perforator), 13 MICAP (medial intercostal artery perforator), and for seven patients, LTAP (lateral thoracic artery perforator) flaps were used. The average tumor was measured at 15.75 mm clinically, 19.1 mm via imaging, and 19.6 mm histologically. Biopsy showed that 16% of the tumors were ductal carcinoma in situ (DCIS), and 84% were invasive. 16% of patients had involved margins, and re-excision was required in 10 patients, and completion mastectomy was performed in 2 patients. A thirty-day SSI rate was 6.2%, with flap-related complications, including flap loss and shrinkage, at 3.7% and 4.9%, respectively. In addition, 3.7% had a hematoma, and 17.3% had other

complications. **Conclusion:** Partial breast reconstruction with perforator flaps is an excellent volume replacement technique in breast-conserving surgery with acceptable complications in well-selected cases.

Keywords

Breast-Conserving Surgery, Chest Wall Perforator Flap, Breast Reconstruction Surgery, Partial Breast Reconstruction, Breast Tissue Replacement

1. Introduction

Oncoplastic breast surgeries with a conservative approach have become a preferred option compared to radical procedures such as mastectomy due to their equivalent survival rate, breast preservation [1], improved aesthetic outcomes, and measurable psychological benefits [2]. About 60% of patients diagnosed with breast cancer in the United Kingdom undergo breast-conserving surgery (BCS), and a subset of them require either volume replacement or displacement technique to improve overall aesthetic outcomes [3] [4] [5] [6]. The decision to use either method is determined by the surgeons' experience and the size of the tumor in comparison to the remaining breast tissue [5] [7]. A volume replacement technique is indicated in small to medium-sized breasts with minimal ptosis, especially in larger tumors that lead to a more significant cavity defect. For decades, the latissimus dorsi (LD) flap has been a key donor site for total and partial breast reconstruction. Still, it is linked with donor site morbidity and impaired functional outcome [8] [9] [10].

Over two decades ago, Hamdi *et al.* [11] [12] [13] described perforator flaps as skin and fat flaps based on perforators arising from a deep vascular system through the underlying muscles or intermuscular septum. The introduction of perforator flaps in BCS has allowed surgeons to keep muscle function intact and reduce surgical morbidity while potentially filing the volume defect with an excellent aesthetic outcome [14] [15].

The chest wall perforator flaps (CWPF) are based on cutaneous perforator branches of posterior and anterior intercostal arteries, forming an arcade between the aorta and internal mammary artery. The arcade is divided into vertebral, costal, and muscular segments leading to the dorsal and lateral anterior perforators. A lateral thoracic artery perforator flap can be used exclusively or with a lateral intercostal artery perforator (LICAP) flap to reconstruct laterally situated excision defects. The potential advantages of these techniques could be sparing the LD muscle and avoiding a mastectomy in a large tumor [16].

Volume replacement technique using CWPF has become popular in the last two decades. Over 60 articles [5] [6] [7] [17]-[27] relating to partial breast reconstruction have been published, including systematic reviews on oncoplastic breast conservation surgery [28]. There has been a few landmark publications describing the techniques, feasibility and indications of chest wall perforator flap

based partial breast reconstructions which has significantly helped to bring this modalities in the in the reconstructive breast surgery field [11] [29]. However, there is a lack of high-quality randomized control trials (RCT) or prospective studies with long-term follow-ups to demonstrate the safety and acceptability of CWPF for partial breast reconstruction following BCS for breast cancer. Although in the past fewer centers routinely performed these procedures [30]-[35], the most recent systematic review by Pujji *et al.* has shown that the use of CWPF is a safe method for partial breast reconstruction with a low complication rate, acceptable short-term oncological outcomes, and satisfactory cosmetic outcome [28].

This article aims to conduct a feasibility study with outcome analysis of a prospectively maintained database of partial breast reconstruction using CWPF at Sherwood Forest Hospitals NHS Foundation Trust equipped with a full range of oncoplastic services.

2. Method

A database was set up to include all patients from 1st January 2018 to 30th June 2022 undergoing BCS and partial breast reconstruction with intercostal artery perforator (ICAP), or lateral thoracic artery perforator (LTAP) flaps at Sherwood Forest Hospitals NHS Foundation Trust. Patient information, including patients' age, body mass index (BMI), smoking status, bra size, type of CWPF procedure, and previous treatments were reordered for each patient.

Multidisciplinary team (MDT) meetings discussed patients considered suitable for the procedure. Only patients with primary cancer, small to moderate-sized breasts (with a few exceptions), grade I to II ptosis, non-diabetics, BMI below 35, no cardiovascular diseases, and no previous use of radiotherapy were considered. Further patient selection criteria included relative tumor-to-breast ratio for upper outer quadrants and any excision required in the lower inner and outer quadrants. Depending on the breast volume, presence of ptosis, and tumor size/location, the surgeon would also evaluate the patients to determine the appropriate technique for reconstruction. The area beneath the inframammary fold was divided into three sections; the medial segment is referred to as medial ICAP (MICAP), the middle third is referred to as anterior ICAP (AICAP) the lateral segment is referred to as lateral ICAP (LICAP). The LTAP (**Figure 1**) and LICAP (**Figure 2**) flaps were used for defects in the lateral quadrants of the breast, The MICAP (**Figure 3**) flap was used for lower inner quadrant defects, while the AICAP (**Figure 4**) flap was used for lower central breast defects. Therefore the perforator flap selection was primarily based on the tumor location. Patients were then examined in both sitting and lying down positions to indicate tumor location, post-BCS defect, and flap markings were made. The width of the flap is based on the estimated breast defect and the available donor skin facilitating adequate closure. The length of the flap can be variable, and up to 30 cm of the flap can be harvested without vascular compromise, and this would again depend on the amount of tissue needed for the defect. On the surgery day,

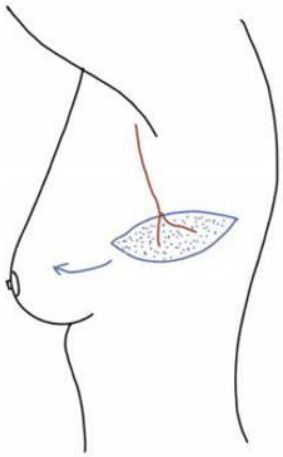

Figure 1. Lateral thoracic artery perforator (LTAP)—Closely related to the sentinel node, large size possible, easier dissection, can carry skin, and provides greater mobilization. Variable origin, damaged during axillary clearance and leaves a higher scar.

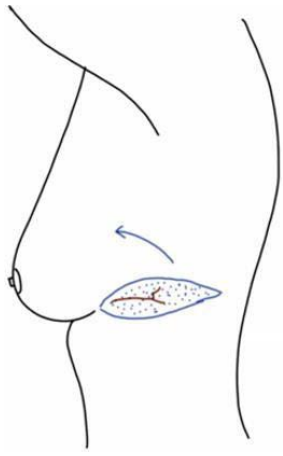

Figure 2. Lateral intercostal artery perforator (LICAP)—Short pedicle, usually turnover but could be propeller flap. Preferable to have more than one perforator, and venous compression is a risk.

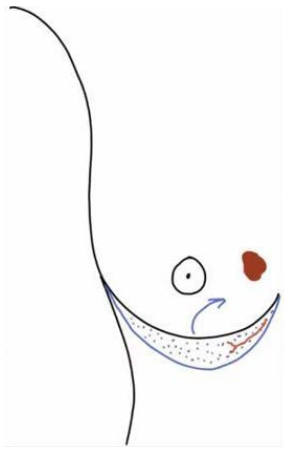

Figure 3. Medial intercostal artery perforator (MICAP)—Great care to raise flap and inset. Need more bulk to fill the aesthetically vulnerable area.

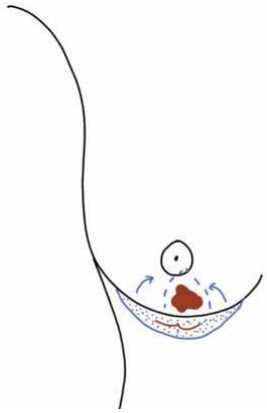

Figure 4. Anterior intercostal artery perforator (AICAP)—Small vessels, including more than one if possible, and can be random flap (crescent) Lowering of the IMF is a risk.

the surgeon drew the incision markings on the patient to explain where the scars would be after the operation. Hand-held Doppler was used for mapping out the underlying blood vessels for blood supply to the flap. All surgeries are done with wide local excision and reconstruction in a one-stage with or without axillary surgery, as indicated. Patients were positioned supine with arms extended in case of axillary surgery. To provide the best access to LTAP/LICAP donor site, a saline bag was placed beneath the ipsilateral para-spinal area. All patients were given one dose of antibiotics before surgery. The flaps were de-epithelized before putting them in the resection cavity. No drains were used. After the procedure, the patients were discharged on the same day or the next day, depending on each patient's circumstances. Patients were followed up one week after the procedure by the breast care nurse for a wound check and at three weeks by clinicians for consultation and review of post-op histology results to discuss plans regarding any further treatment needed as per national guidelines. Outcomes, including tumor size, measured clinically, via imaging and histologically, margins involvement, biopsy results, specimen weight, re-excision surgery, and complications, were recorded into the database.

The data was assembled in an excel sheet using Microsoft EXCEL 2016. Filters were applied to each column to calculate the total number of patients in each category. The average or percentage was derived from the total number of patients in the study for each recorded variable.

3. Results

Eighty-one patients were selected based on the following criteria: all presented with primary cancers, small to moderate-sized breasts (with a few exceptions), grade I to II ptosis, non-diabetics, BMI below 35, no cardiovascular diseases, and no previous use of radiotherapy. The demographic characteristics, treatment details, and tumor characteristics are given in Table 1. The average age of the patients was 55.7 years, with the average body mass index (BMI) at 26.7 kg/m^2. The bra size varied between A to FF with A (7.4%), B (28.3%), C (38.2%), D (13.6%),

Table 1. Demographic and tumour characteristics.

Characteristics	Value
Total Patients	81
Age (year)	55.7 (27 - 78)
Bra Cup Size	A: 6 (7.4) B: 23 (28.3) C: 31 (38.2) D: 11 (13.6) DD: 9 (11.1) FF: 1 (1.2)
BMI (kg/m^2)	26.7 (19 - 36)
Smoker	7 (8.6)
CWPF Type	AICAP: 16 (19.8) LICAP: 45 (55.6) LTAP: 7 (8.6) MICAP: 13 (16)
Previous Treatment	NACT 12 (14.8)
Clinical Size (mm)	15.75 (0 - 80)
USS/MRI Size	19.1 (7 - 64)
Histology Size (mm)	19.6 (0 - 70)
Margins Involved	13 (16)
Biopsy	DCIS—13 (16) Invasive—68 (84)
Specimen Weight (g)	62.8 (11 - 169)
Re-Excision Surgery	10 (12.3)
Complete Mastectomy	2 (2.5)
SSI	5 (6.2)
Flap Complication	3 (3.7)
Flap Shrinkage	4 (4.9)
Hematoma	3 (3.7)
Other Complications	14 (17.3)

Values are average with (range) or percentage (%). BMI, body mass index; CWPF, chest wall perforator flap; LTAP, lateral thoracic artery perforator; LICAP, lateral intercostal artery perforator; AICAP, anterior intercostal artery perforator; MICAP, medial intercostal artery perforator; NACT, Neoadjuvant chemotherapy; USS, ultrasound; MRI, magnetic resonance imaging; DCIS, ductal carcinoma in situ; SSI, surgical site infection.

DD (11.1%) and FF (1.2%). Seven patients were smokers at the time of their surgery. 14.8% of the patients had neoadjuvant chemotherapy (NACT). LICAP and/or LTAP flaps were used in 64.2% of patients, AICAP was used in 19.8%, and MICAP was used in 16%. The average specimen weight was 26.7 g. Most pa-

tients were discharged the same day or the next day after surgery. The average tumor size measured clinically was 15.75 mm, via imaging was 19.1 mm, and histologically measured tumor size was 19.6 mm. 16% of the patients had involved margins on histology, and 12.3% underwent re-excision surgery. Biopsy results showed that 16% of the tumors were DCIS and 84% were invasive. 2 patients underwent a completion mastectomy.

Five patients had surgical site infections (SSI). Three patients had flap complications, including sinus and infection, leading to loss. Four patients had flap shrinkage. Three patients had a hematoma. Fourteen patients had other complications, including seroma requiring aspiration and fat necrosis. No delayed complications were reported. None of the patients required a symmetrization procedure on the contralateral side.

4. Discussion

Various oncoplastic procedures have been reported for resecting large tumors with an acceptable safety margin and satisfactory outcomes [20] [25] [26] [36] [37] [38] [39] [40]. The procedure selection process depends on factors such as breast size/ptosis, tumor location, and morbidity. Although volume replacement techniques can maintain the volume and shape of the breast and avoid contralateral surgery to reach symmetry [6] [26], this technique is related to higher donor site morbidity due to its complexity [11] [12] [29] [41]. Lateral thoracic skin and subcutaneous tissue, introduced in 1986 [23], have been used as fasciocutaneous flaps for breast reconstruction. As described by Clough *et al.* [20] and Kroll *et al.* [37], these techniques lead to excessive and unpleasant scarring and overall unsatisfactory results. In the 1970s, the musculocutaneous flap was introduced [42] [43] [44] [45] but later the ICAP flap was reintroduced as a perforator flap for reconstructing defects over the thorax [11]. According to Hamdi *et al.*, these flaps could be based on intercostal perforators arising from coastal or muscular segments of the intercostal vessels and lead to reliable use for the BCS reconstruction [11]. Roy and Tenovici [34] initially reported a two-stage surgical approach for patients with a high tumor to breast ratio. In this case, after a wide local excision is made the resection cavity was filled with saline, and the LICAP/LTAP flap reconstruction was performed after the histology results were reviewed to dictate the second surgery. Over time with experience and surgical advancement, this technique is now performed as a one-stage surgery for those with an ideal tumor to breast ratio. The skin of the ICAP flap from the lateral and anterior thoracic region has the same texture as breast skin leading to a favorable result. Secondly, the LICAP flap is based on the anterior perforator to the LD muscle, so it does not compromise the thoracodorsal vessels [46]. Compared to the latissimus flap, the present technique has further advantages as it is less time-consuming, does not require any unique positioning for the procedure, and there is no loss of muscle function. In fact, with the CWPF method, the latissimus flap is spared as an option for future use in case of local recurrence. The

scars are also well concealed postoperatively on frontal view images.

In our study, we aimed to prove the effectiveness of CWPF for BCS and partial breast reconstruction. All 81 patients presented with primary cancers, small to moderate-sized breasts (with a few exceptions), grade I to II ptosis, non-diabetics, BMI below 35, no cardiovascular diseases, and no previous use of radiotherapy. Hand-held Acoustic Doppler was used to assess vessel location preoperatively and intra-operatively to avoid dissecting vessels and ultimately minimize chances of injury. LICAP/LTAP flaps are good options for one-stage partial breast reconstruction in small to moderate-sized breasts with minimal ptosis. During LICAP, the flap is turned at its junction with the vessels, subsequently limiting mobility and making it suitable for lateral breast defects. On the contrary, the LTAP flaps have increased mobility due to the vessels being placed superiorly, letting the flap rotate freely and filling the cavity better [33]. In our sample, 64.2% of patients had LICAP or LTAP and 19.8% AICAP, and 16% underwent MICAP. All surgeries were done as a one-stage procedure. These procedures are suitable for most patients as the main potential contraindications for ICAP is lack of adequate donor tissue or previous surgery in the donor area, which can be linked to prior perforator damage. These procedures can be performed either by a breast surgeon trained in oncoplastic techniques or a combined team of breast and plastic surgeons.

According to our study, most complications were minor; 12.3% of patients required re-excision, and only two needed completion mastectomy. Similar to a recent study by Soumian S. *et al.* [47] where 13.39% of the patients required margin re-excision, and only one patient ultimately received a mastectomy due to persistent positive margins after re-excision. None of the complications increased the hospital stay or interfered with the adjuvant treatment. Flap complications, including flap shrinkage, were experienced by seven patients. Extra care must be taken with high-risk patients such as smokers and patients with associated comorbidities.

The main limitation of our study is that as it is a case series, it needs long-term follow-up. A longer follow-up is required for significant conclusions regarding patient satisfaction. Therefore, we are currently working on a study with patient-reported outcomes and long-term follow-up data. We hope this future study will provide further insight into the effectiveness of this procedure and provide robust data, including patient satisfaction and the effect of radiotherapy on the flaps.

5. Conclusion

Our observational study demonstrated that partial breast reconstruction performed with chest wall perforator flaps is an acceptable option for volume replacement technique in breast-conserving surgery in well-selected patients. It yields satisfactory results for the patients and acceptable post-operative complications. Future studies specifically considering long-term follow-up are recommended to establish this technique's effectiveness further.

Acknowledgements

We sincerely thank Dr. Muzina Akhtar, Mr. Ghassan Elamin, Dr. Brindusa Muntean, Mr. Ali Jahan and Dr. Wajiha Tehniyat for their help with the study.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Veronesi, U., Cascinelli, N., Mariani, L., *et al.* (2002) Twenty-Year Follow-Up of a Randomized Study Comparing Breast-Conserving Surgery with Radical Mastectomy for Early Breast Cancer. *New England Journal of Medicine*, **347**, 1227-1232. https://doi.org/10.1056/NEJMoa020989

[2] Chen, J.Y., Huang, Y.J., Zhang, L.L., Yang, C.Q. and Wang, K. (2018) Comparison of Oncoplastic Breast-Conserving Surgery and Breast-Conserving Surgery Alone: A Meta-Analysis. *Journal of Breast Cancer*, **21**, 321. https://doi.org/10.4048/jbc.2018.21.e36

[3] Jeevan, R., Cromwell, D.A., Trivella, M., Lawrence, G., Kearins, O., Pereira, J., *et al.* (2012) Reoperation Rates after Breast Conserving Surgery for Breast Cancer among Women in England: Retrospective Study of Hospital Episode Statistics. *BMJ*, **345**, e4505. https://doi.org/10.1136/bmj.e4505

[4] Clough, K.B., Kaufman, G.J., Nos, C., Buccimazza, I. and Sarfati, I.M. (2010) Improving Breast Cancer Surgery: A Classification and Quadrant per Quadrant Atlas for Oncoplastic Surgery. *Annals of Surgical Oncology*, **17**, 1375-1391. https://doi.org/10.1245/s10434-009-0792-y

[5] Munhoz, A.M., *et al.* (2008) Assessment of Immediate Conservative Breast Surgery Reconstruction: A Classification System of Defects Revisited and an Algorithm for Selecting the Appropriate Technique. *Plastic and Reconstructive Surgery*, **12**, 716-727. https://doi.org/10.1097/01.prs.0000299295.74100.fa

[6] Munhoz, A.M. (2009) Tissue Replacement Methods Using Local Flaps. In: Losken, A. and Hamdi, M., Eds., *Partial Breast Reconstruction*, Quality Medical Publishing, St Louis, 317-334.

[7] Kronowitz, S.J., *et al.* (2006) Determining the Optimal Approach to Breast Reconstruction after Partial Mastectomy. *Plastic and Reconstructive Surgery*, **117**, 1-10. https://doi.org/10.1097/01.prs.0000194899.01875.d6

[8] Adams, W.P., *et al.* (2004) Functional Donor Site Morbidity Following Latissimus Dorsi Muscle Flap Transfer. *Annals of Plastic Surgery*, **53**, 6-11. https://doi.org/10.1097/01.sap.0000106430.56501.b5

[9] Lee, K.T., *et al.* (2014) A Systematic Review of Functional Donor-Site Morbidity after Latissimus Dorsi Muscle Transfer. *Plastic and Reconstructive Surgery*, **134**, 303-314. https://doi.org/10.1097/PRS.0000000000000365

[10] Smith, S.L. (2014) Functional Morbidity Following Latissimus Dorsi Flap Breast Reconstruction. *Journal of the Advanced Practitioner in Oncology*, **5**, 181-187. https://doi.org/10.6004/jadpro.2014.5.3.3

[11] Hamdi, M., *et al.* (2008) The Lateral Intercostal Artery Perforators: Anatomical Study and Clinical Application in Breast Surgery. *Plastic and Reconstructive Surgery*, **121**, 389-396. https://doi.org/10.1097/01.prs.0000298317.65296.cf

[12] Hamdi, M. and De Frene, B. (2006) Pedicled Perforator Flaps in Breast Reconstruction. *Seminars in Plastic Surgery*, **20**, 73-78. https://doi.org/10.1055/s-2006-941713

[13] Hamdi, M., *et al.* (2006) The Versatility of the Inter-Costal Artery Perforator (ICAP) Flaps. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, **59**, 644-652. https://doi.org/10.1016/j.bjps.2006.01.006

[14] Saint-Cyr, M., *et al.* (2009) The Perforasome Theory: Vascular Anatomy and Clinical Implications. *Plastic and Reconstructive Surgery*, **124**, 1529-1544. https://doi.org/10.1097/PRS.0b013e3181b98a6c

[15] Taylor, G.I. (2003) The Angiosomes of the Body and Their Supply to Perforator Flaps. *Clinics in Plastic Surgery*, **30**, 331-342. https://doi.org/10.1016/S0094-1298(03)00034-8

[16] McCulley, S.J., *et al.* (2015) Lateral Thoracic Artery Perforator (LTAP) Flap in Partial Breast Reconstruction. *Journal of Plastic, Reconstructive & Aesthetic Surgery*, **68**, 686-691. https://doi.org/10.1016/j.bjps.2015.01.008

[17] Blomqvist, L. and Malm, M. (1999) Clinical Experience with the Lateral Thoracodorsal Flap in Breast Reconstruction. *Annals of Plastic Surgery*, **43**, 7-12. https://doi.org/10.1097/00000637-199907000-00002

[18] Blomqvist, L., Malm, M., Holmström, H. and Lossing, C (2000) The Lateral Thoracodorsal Flap in Breast Reconstruction: A Comparison between Two Plastic Surgical Centers. *Scandinavian Journal of Plastic and Reconstructive Surgery*, **34**, 327-332. https://doi.org/10.1080/028443100750059101

[19] Chaturvedi, S. (2003) Subaxillary Dermocutaneous Fat Flap for Reconstruction of the Upper Outer Quadrant of the Breast Following Conservation Surgery. *British Journal of Surgery*, **90**, 45-51. https://doi.org/10.1002/bjs.4480

[20] Clough, K.B., Kroll, S.S. and Audretsch, W. (1999) An Approach to the Repair of Partial Mastectomy Defects. *Plastic and Reconstructive Surgery*, **104**, 409-416. https://doi.org/10.1097/00006534-199908000-00014

[21] Cronin, T.D., *et al.* (1977) Reconstruction of the Breast after Mastectomy. *Plastic and Reconstructive Surgery*, **59**, 1-7. https://doi.org/10.1097/00006534-197701000-00001

[22] Garcia, E.B., *et al.* (2000) Retalho tóraco-axilar na reparação imediata da quadrantectomia supero-lateral da mama. *Revista Brasileira de Mastologia*, **10**, 185-190.

[23] Holmstrom, H. and Lossing, C. (1986) The Lateral Thoracodorsal Flap in Breast Reconstruction. *Plastic and Reconstructive Surgery*, **77**, 933-939. https://doi.org/10.1097/00006534-198606000-00010

[24] Hudson, D. (2004) Verifying Surgical Results and Risk Factors of the Lateral Thoracodorsal Flap. *Plastic and Reconstructive Surgery*, **113**, 204-205. https://doi.org/10.1097/01.PRS.0000096706.29150.12

[25] Munhoz, A.M., Montag, E., Fels, K.W., Arruda, E.G., Sturtz, G.P., Aldrighi, C., *et al.* (2005) Outcome Analysis of Breast-Conservation Surgery and Immediate Latissimus Dorsi Flap Reconstruction in Patients with T1 to T2 Breast Cancer. *Plastic and Reconstructive Surgery*, **116**, 741-749. https://doi.org/10.1097/01.prs.0000176251.15140.36

[26] Munhoz, A.M., *et al.* (2006) The Role of the Lateral Thoracodorsal Fasciocutaneous Flap in Immediate Conservative Breast Surgery Reconstruction. *Plastic and Reconstructive Surgery*, **117**, 1699-1707. https://doi.org/10.1097/01.prs.0000209943.13682.42

[27] Woerdeman, L.A. *et al.* (2004) Verifying Surgical Results and Risk Factors of the Lateral Thoracodorsal Flap. *Plastic and Reconstructive Surgery*, **113**, 196-201.

https://doi.org/10.1097/01.PRS.0000097257.47540.D0

[28] Pujji, O.J.S., Blackhall, V., Romics, L. and Vidya, R. (2021) Systematic Review of Partial Breast Reconstruction with Pedicled Perforator Artery Flaps: Clinical, Oncological and Cosmetic Outcomes. *European Journal of Surgical Oncology*, **47**, 1883-1890. https://doi.org/10.1016/j.ejso.2021.03.249

[29] Levine, J.L., Soueid, N.E. and Allen, R.J. (2005) Algorithm for Autologous Breast Reconstruction for Partial Mastectomy Defects. *Plastic and Reconstructive Surgery*, **116**, 762-767. https://doi.org/10.1097/01.prs.0000176892.38430.8a

[30] Carrasco-Lopez, C., *et al.* (2017) Anterior Intercostal Artery Perforator Flap in Immediate Breast Reconstruction: Anatomical Study and Clinical Application. *Microsurgery*, **37**, 603-610. https://doi.org/10.1002/micr.30171

[31] Hamdi, M. (2013) Oncoplastic and Reconstructive Surgery of the Breast. *Breast*, **22**, 100-105. https://doi.org/10.1016/j.breast.2013.07.019

[32] Kim, J.B., *et al.* (2018) The Usefulness of Pedicled Perforator Flap in Partial Breast Reconstruction after Breast Conserving Surgery in Korean Women. *Archives of Plastic Surgery*, **45**, 29-36. https://doi.org/10.5999/aps.2017.01200

[33] Roy, P.G. (2016) One-Stage vs. Two-Stage Approach for Partial Breast Reconstruction with Lateral Chest Wall Perforator Flaps. *Cancer Treatment and Research Communications*, **9**, 56-61. https://doi.org/10.1016/j.ctarc.2016.06.003

[34] Roy, P.G. and Tenovici, A.A. (2017) Staged Approach to Partial Breast Reconstruction to Avoid Mastectomy in Women with Breast Cancer. *Gland Surgery*, **6**, 336-342. https://doi.org/10.21037/gs.2017.03.08

[35] Yang, J.D., *et al.* (2012) Usefulness of Oncoplastic Volume Replacement Techniques after Breast Conserving Surgery in Small to Moderate-Sized Breasts. *Archives of Plastic Surgery*, **39**, 489-496. https://doi.org/10.5999/aps.2012.39.5.489

[36] Asgeirsson, K.S., *et al.* (2005) Oncological and Cosmetic Outcomes of Oncoplastic Breast Conserving Surgery. *European Journal of Surgical Oncology*, **31**, 817-824. https://doi.org/10.1016/j.ejso.2005.05.010

[37] Kroll, S.S. and Singletary, S.E. (1998) Repair of Partial Mastectomy Defects. *Clinics in Plastic Surgery*, **25**, 303-309. https://doi.org/10.1016/S0094-1298(20)32509-8

[38] Munhoz, A.M., *et al.* (2006) Critical Analysis of Reduction Mammaplasty Techniques in Combination with Conservative Breast Surgery for Early Breast Cancer Treatment. *Plastic and Reconstructive Surgery*, **117**, 1091-1102. https://doi.org/10.1097/01.prs.0000202121.84583.0d

[39] Slavin, S.A. and Halperin, T. (2004) Reconstruction of the Breast Conservation Deformity. *Seminars in Plastic Surgery*, **18**, 89-94. https://doi.org/10.1055/s-2004-829043

[40] Spear, S.L., *et al.* (2003) Experience with Reduction Mammaplasty Combined with Breast Conservation Therapy in the Treatment of Breast Cancer. *Plastic and Reconstructive Surgery*, **111**, 1102-1110. https://doi.org/10.1097/01.PRS.0000046491.87997.40

[41] Hamdi, M., *et al.* (2006) Pedicled Perforator Flaps. In: Spear, S.L., Willey, S.C. and Robb, G.L., Eds., *Surgery of the Breast: Principles and Art*, Lippincott Williams & Wilkins, Philadelphia, 833-846.

[42] Badran, H.A., El-Helaly, M.S. and Safe, I. (1984) The Lateral Intercostal Neurovascular Free Flap. *Plastic and Reconstructive Surgery*, **73**, 17-23. https://doi.org/10.1097/00006534-198401000-00003

[43] Beahm, E. (2009) Timing and Key Considerations in Reconstruction for Breast

Conserving Therapy. In: Nahabedian, N., Ed., *Oncoplastic Surgery of the Breast*, Elsevier, Philadelphia, 23-45. https://doi.org/10.1016/B978-0-7020-3181-6.00009-4

[44] Daniel, R.K. and Williams, H.B. (1973) The Free Transfer of Skin Flaps by Microvascular Anastomoses. An Experimental Study and a Reappraisal. *Plastic and Reconstructive Surgery*, **52**, 16-31. https://doi.org/10.1097/00006534-197307000-00003

[45] Dibbell, D.G. (1974) Use of a Long Island Flap to Bring Sensation to the Sacral Area in Young Paraplegics. *Plastic and Reconstructive Surgery*, **54**, 220-203. https://doi.org/10.1097/00006534-197407001-00025

[46] Hamdi, M. (2009) Pedicled Perforator Flap Reconstruction. In: Losken, A. and Hamdi, M., Eds., *Partial Breast Reconstruction*, Quality Medical Publishing, St Louis, 375-400.

[47] Soumian, S., Parmeshwar, R., Chandarana, M., Marla, S., Narayanan, S. and Shetty, G. (2020) Chest Wall Perforator Flaps for Partial Breast Reconstruction: Surgical Outcomes from a Multicenter Study. *Archives of Plastic Surgery*, **47**, 153-159. https://doi.org/10.5999/aps.2019.01186