



Case report of stacked intercostal artery perforator flaps: a novel technique using anterior and lateral intercostal artery perforator flaps for full autologous breast reconstruction post-mastectomy

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Abstract: Surgery is the mainstay of curative treatment for breast cancer with mastectomy offering the lowest risk of local recurrence. Post-mastectomy reconstruction options include autologous flaps and/or implants. Autologous flaps are commonly harvested from various areas, including rectus abdominis muscle, latissimus dorsi muscle, gracilis muscle and gluteal areas. While good cosmetic outcomes are often achieved, donor site morbidity and long patient downtime remain an issue. The intercostal perforator flaps have fewer of these problems but it often does not have sufficient volume for full reconstruction after mastectomy. Intercostal perforator flaps were developed for volume replacement after breast-conserving surgery. These perforator flaps are not used for full autologous reconstruction after mastectomy as the volume from a single perforator flap is often inadequate. Hence, the authors describe the first report of a novel approach of combining the anterior intercostal artery perforator (AICAP) flap and lateral intercostal artery perforator (LICAP) flap, the stacked intercostal artery perforator (STICAP) flaps, for full autologous reconstruction following an areolar-sparing mastectomy. Our patient is a 76-year-old lady diagnosed with a left breast 6 o'clock retro-areolar invasive ductal carcinoma measuring 2.8 cm × 1.6 cm × 2.3 cm. The patient underwent a left breast areolar-sparing mastectomy and axillary sampling followed by immediate STICAP (AICAP and LICAP) flaps reconstruction which achieved an excellent aesthetic appearance and high level of patient satisfaction.

Keywords: Mastectomy; autologous breast reconstruction; stacked intercostal artery perforator flaps (STICAP flaps); case report

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Introduction

Surgery is the mainstay of curative treatment for breast cancer with mastectomy offering the lowest risk of local recurrence (1,2). Post-mastectomy reconstruction options include autologous flaps and/or implants (3,4). Autologous flaps are commonly harvested from various areas, including rectus abdominis muscle, latissimus dorsi muscle, gracilis muscle and gluteal areas (5). While good cosmetic outcomes are often achieved, donor site morbidity and long patient downtime remain an issue (6). The intercostal

perforator flaps have fewer of these problems but it often does not have sufficient volume for full reconstruction after mastectomy (7,8). Volume replacement techniques after breast-conserving surgery using perforator flaps commonly include the anterior intercostal artery perforator (AICAP) and lateral intercostal artery perforator (LICAP) flaps (9,10). LICAP flap originates from perforators arising from the costal segment while AICAP flap originates from perforators arising from the muscular segment (9). These perforator flaps have not been used for full reconstruction

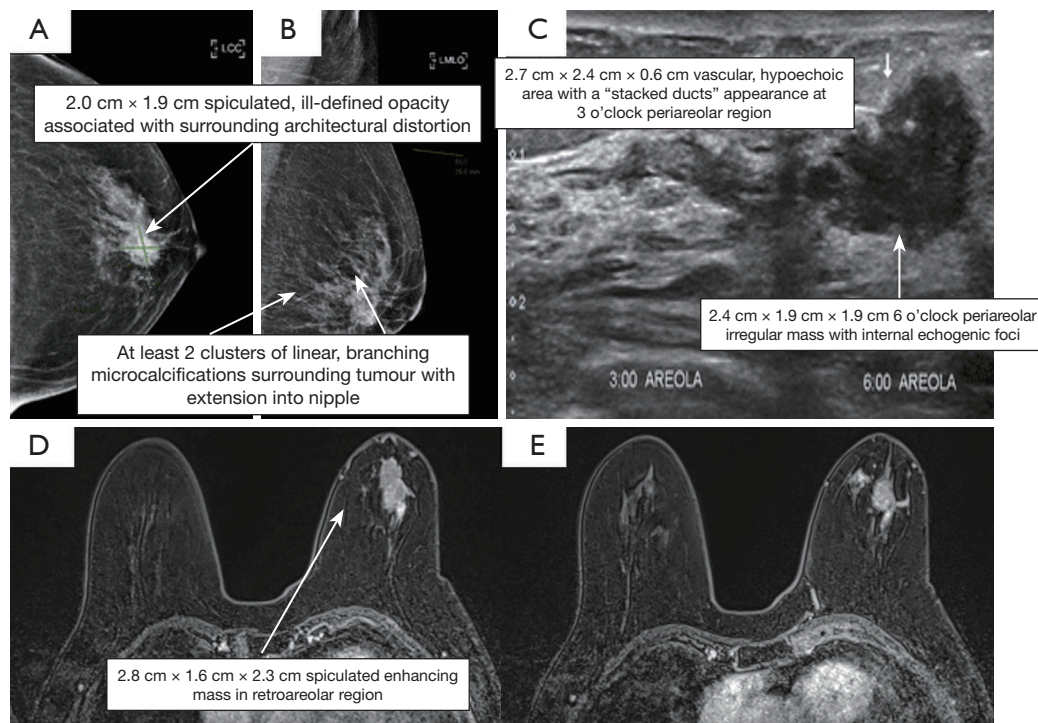


Figure 1 Pre-operative diagnostic imaging. (A,B) Mammogram of left breast in the craniocaudal and mediolateral oblique view respectively; (C) ultrasound of the left breast. MRI of the left breast showing a spiculated lesion (D) with an area of clumped non-mass enhancement superior to the tumour in the central breast (E).

following a mastectomy in view of their smaller bulk.

We present our experience in using a combination of the AICAP flap with the LICAP flap (STICAP flaps) in a patient for full post-mastectomy autologous reconstruction. To the best of our knowledge, this is the first reported case of a STICAP flaps reconstruction following areolar-sparing mastectomy with excellent aesthetic outcome. We present the following article in accordance with the CARE reporting checklist (available at <https://abs.amegroups.com/article/view/10.21037/abs-21-79/rc>).

Case presentation

Our patient is a 76-year-old lady who presented with a palpable 2.0 cm × 1.9 cm firm mobile left breast lump at the 6 o'clock peri-areolar region. Imaging showed a large spiculated enhancing mass in the left retro-areolar region measuring 2.8 cm × 1.6 cm × 2.3 cm (*Figure 1*). There was clumped non-mass enhancement superior to the tumour in the central breast. Clumped linear non-mass enhancement was also noted in the central breast medial and lateral to the tumour and near the inferior aspect of

the tumour. Hence, the collective size of the enhancing mass and surrounding, suspicious non-mass enhancement areas measured approximately 5.5 cm × 2.9 cm × 3.8 cm and occupied the whole retro-areolar and inferior half of the breast. In addition, nodular linear enhancement towards the left nipple was suspicious of ductal extension and nipple involvement. Ultrasound-guided core biopsy of the left breast lump confirmed invasive ductal carcinoma with negative estrogen receptor/progesterone receptor (ER/PR) status and positive human epidermal growth factor receptor 2 (HER2) status. Staging scans were negative for distant metastases. The patient was offered the options of upfront curative surgery versus neoadjuvant chemotherapy followed by curative surgery in view of tumour biology. All surgical options were offered and discussed in detail. The patient was not keen for a long and unsightly abdominal donor site scar and was assessed to have inadequate back tissue for a full reconstruction post-mastectomy. However, she had substantial tissue bulk at the AICAP and LICAP perforators region for full reconstruction by combining the two flaps. Pre-operative ultrasound doppler assessment demonstrated excellent doppler signals for both anterior and LICAP

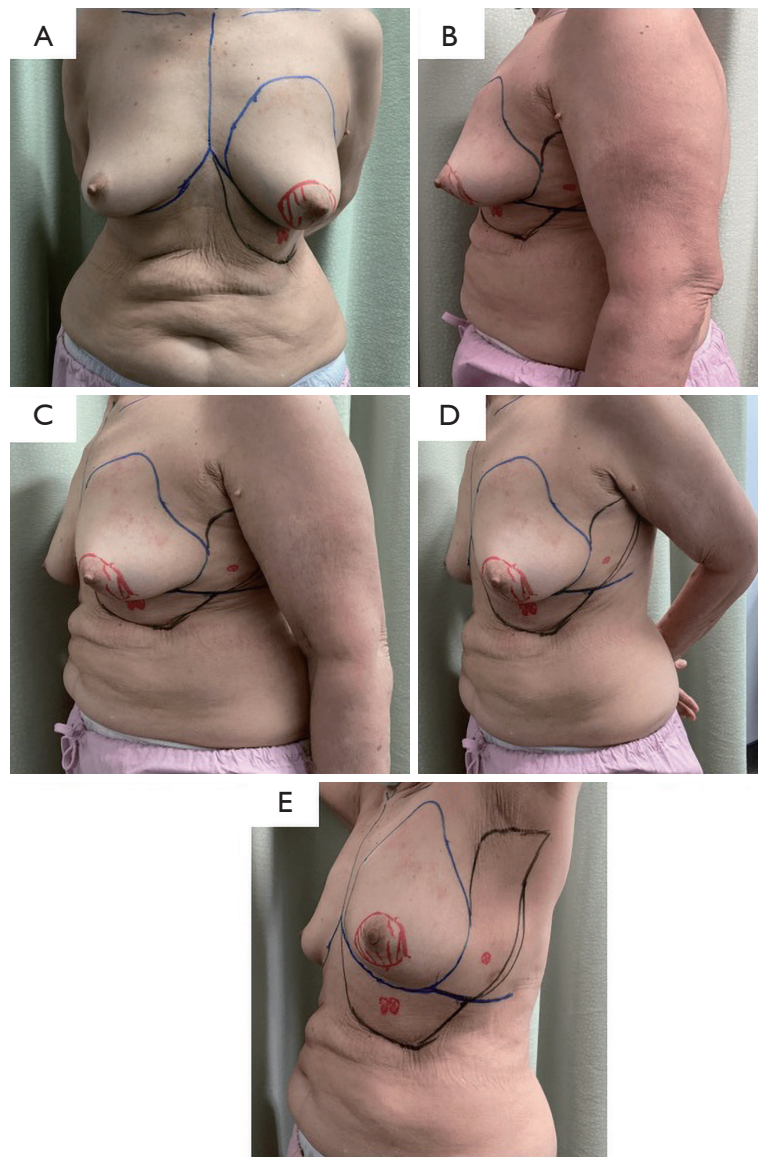


Figure 2 Pre-operative photos and planned markings of AICAP and LICAP flap. (A) Frontal view; (B,C) left lateral views with arms at the side; (D) left lateral view with arms abducted; (E) left lateral view with arms raised. AICAP, anterior intercostal artery perforator; LICAP, lateral intercostal artery perforator.

vessels. Pre-operative photos are shown in *Figure 2*.

Our patient underwent a left breast areolar-sparing mastectomy and axillary sampling followed by immediate STICAP (AICAP and LICAP) flaps reconstruction. An infra-mammary fold (IMF) incision with lateral extension was used for the left areolar-sparing mastectomy and sentinel lymph node biopsy. For STICAP flaps harvest, dissection is carried down to the chest wall from the same IMF incision used for the mastectomy. Following

identification of the latissimus, dissection continues above the muscle fascia from medial to lateral (LICAP) and cranial to caudal (AICAP). Subsequently, the fasciocutaneous flaps were dissected off the chest wall towards the anterior axillary line in the suprafascial plane. Thereafter, both AICAP and LICAP flaps were raised based on their respective perforators, identified pre-operatively with ultrasound doppler. Following which, indocyanine green (ICG) fluorescence imaging was used to assess the

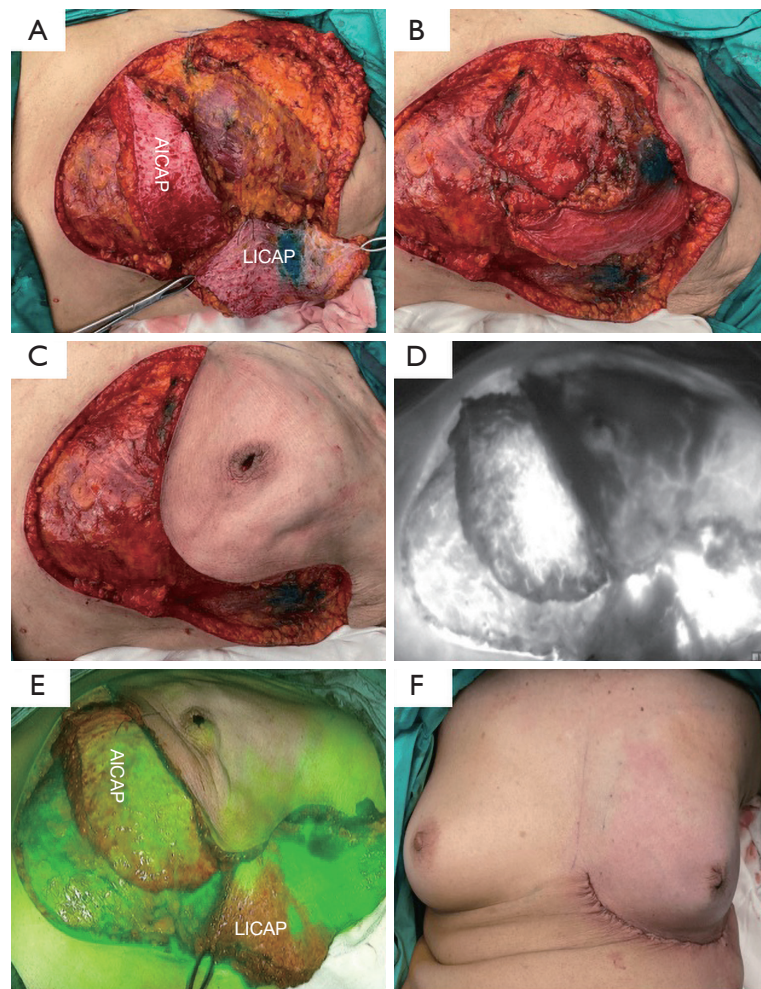


Figure 3 Intra-operative photos of left areolar-sparing mastectomy and axillary sampling with immediate AICAP and LICAP flap reconstruction. (A) AICAP and LICAP flaps fully elevated after areolar-sparing mastectomy (before flaps inset); (B) STICAP flaps rotated and inset into mastectomy cavity; (C) mastectomy skin flaps over STICAP flaps (prior to wound closure); (D) ICG fluorescence imaging assessment of vascularity of flaps using the pure fluorescence mode; (E) ICG assessment of vascularity of flaps using overlay mode; (F) immediate on-table post-operative view showing satisfactory aesthetic outcomes. AICAP, anterior intercostal artery perforator; LICAP, lateral intercostal artery perforator; STICAP, Stacked intercostal artery perforator; ICG, indocyanine green.

vascularity of the flaps using the pure fluorescence and overlay modes. ICG fluorescence imaging assessment demonstrated good vascularity of the STICAP flaps as well as the mastectomy skin flaps. The STICAP flaps were de-epithelised and rotated into the mastectomy cavity, fashioned and inset with absorbable stitches. Additional tacking sutures were placed to secure the flap to the anterior chest wall and avoid torsion of the perforator pedicle. The IMF was recreated with absorbable stitches (*Figure 3*). The surgery was uneventful, the patient recovered well and went home with two surgical drains. She was reviewed in the

outpatient clinic at regular intervals until both drains were removed.

The wound healed well with a satisfactory aesthetic appearance as shown in *Figure 4*. The patient expressed a high level of satisfaction with the outcome. Histology revealed a 40 mm invasive ductal carcinoma with extensive high-grade ductal carcinoma in-situ, grade 3, five axillary lymph nodes were negative, stage 2A (pT2N0M0). A multidisciplinary discussion held recommended for her to receive adjuvant chemotherapy and targeted therapy.

All procedures performed in this study were in

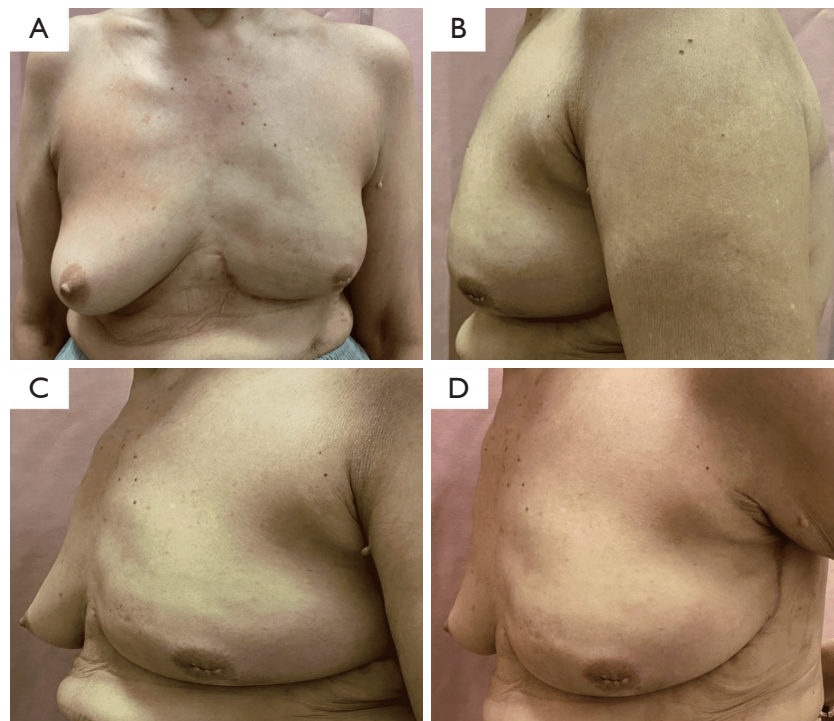


Figure 4 Aesthetic outcomes 2 months post-operatively of Madam B who underwent left areolar-sparing mastectomy and immediate reconstruction with AICAP and LICAP flap (STICAP flaps). (A) Frontal view; (B,C) left lateral views; (D) left lateral view with arms abducted.

accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

Discussion

Full reconstruction with autologous tissue post-mastectomy is frequently the preferred option. However, there are several disadvantages with autologous reconstruction. These include but are not limited to a long and unsightly donor scar, donor site morbidity and longer recovery duration (11,12). In addition, free flap reconstruction has several associated morbidities (13). These include higher risk of vascular compromise of the flap, fat necrosis, wound infection and dehiscence. In addition, abdominal wall hematomas or seromas can occur which may occasionally require drainage or further surgical intervention (14).

In contrast, intercostal perforator flaps have less morbidity as it does not sacrifice the underlying muscle compared with myocutaneous flaps and can be considered as an attractive alternative to free flap reconstruction. These flaps were originally developed for partial reconstruction after breast-conserving surgery and not for full reconstruction due to their small volume. The original blood vessel supply to perforator flaps come off on the deep surface of the muscle supplying overlying skin as well as fat through musculocutaneous perforators (15). The flaps comprising skin and fat alone may be obtained from various anatomic areas by delicately dissecting these perforating vessels as they travel through the muscle without needing to sacrifice muscle (16). Furthermore, these techniques provide an ideal option for breast reconstruction in women with small to moderate size breasts. Moreover, this prevents the need to harvest the latissimus dorsi flap in these patients. As such, ICAP flaps present an excellent alternate option for breast reconstruction with minimal morbidity and positive aesthetic outcomes. Various perforator flaps used for partial breast reconstruction after breast-conserving surgery include

thoracodorsal artery perforator (TDAP), lateral thoracic artery perforator (LTAP), AICAP and LICAP (17,18). The LICAP flap originates from perforators arising from the intercostal segment of the intercostal vessels which are usually located in fifth to seventh intercostal spaces between 2.5 and 3.5 cm medial to the anterior border of the latissimus dorsi muscle (19). The LICAP flap is the most appropriate option for lateral quadrant defects. In addition, the scar following LICAP flap reconstruction is hidden under the arm and less visible. The LICAP flap could be an alternative to the TDAP flap as it provides ease of identification of perforators through anterior dissection (20). In contrast, the AICAP flap originates from perforators arising from the intercostal vessels through external oblique or rectus abdominus muscles typically located within 1 to 3 cm lateral to the sternal border (21). For the correction of small defects, the AICAP flaps have been described in a V-Y or propeller manner. It is well-suited to cover defects that extend over the medial or inferior quadrants for which other volume displacement or replacement techniques are challenging as it has a short pedicle (22).

To the best of our knowledge, this is the first reported case on the use of STICAP flaps for full autologous reconstruction post-mastectomy. It is novel to combine two intercostal flaps together to obtain sufficient volume for full reconstruction post-mastectomy.

The advantage of the STICAP flaps is that both perforator flaps were raised through the same scar, hence minimising donor site morbidity and post-operative pain. By combining two perforator flaps, the STICAP flaps allowed for sufficient volume to achieve full post-mastectomy reconstruction. Together with the well-hidden scar, good cosmetic outcome is achieved.

However, as with all autologous flaps, the STICAP flaps carry an associated risk of fat necrosis due to possible venous congestion (23). A case series by Kim *et al.* included 40 patients that underwent LICAP flap by either the propeller method or the turnover method. Notably, venous congestion occurred in two cases of the propeller method and three cases needed treatment for fat necrosis (24). ICG dye-based fluorescent angiography is a useful technique for the evaluation of vascularity and tissue perfusion in skin flaps. Intra-operative ICG fluorescence imaging has been used for perfusion mapping of flaps, to predict and prevent flap complications (25,26). In our centre, flap perfusion is routinely assessed using ICG intra-operatively. In the event of poor perfusion noted intra-operatively, flap tissue shown to be poorly perfused will be trimmed and fashioned prior

to final inset to reduce risk of subsequent fat necrosis and its associated complications.

Due to the relatively short follow-up in our case, long-term aesthetic outcomes need to be ascertained. Although this technique provides a good breast mound, symmetry with the contralateral breast may not be the most ideal. Mobilisation of the perforator flaps creates an asymmetry in the upper abdominal area and lateral aspect of patient's chest which may reduce patient satisfaction in certain patients. Moving forward, further validation of this technique and its long-term outcomes could be evaluated in a larger group of patients in a case series. In addition, lipofilling may be offered to address any asymmetry or volume deficit in patients who might require it. This will be assessed after at least 6 months after completion of treatment to allow for complete tissue remodeling to take place.

Conclusions

In conclusion, our experience with the STICAP (combined AICAP and LICAP) flaps for full post-mastectomy reconstruction demonstrates that it is a feasible option which can provide favourable oncological and cosmetic outcomes. Careful patient selection, detailed pre-operative planning and flap design are essential to achieving an ideal outcome.

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Footnote

Reporting Checklist: The authors have completed the CARE reporting checklist. Available at <https://abs.amegroups.com/article/view/10.21037/abs-21-79/rc>

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://abs.amegroups.com/article/view/10.21037/abs-21-79/coif>). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are

appropriately investigated and resolved. All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this case report and accompanying images.

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