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## Short Communication

# Shaping of the abdominal flap in breast reconstruction: The coning technique in muscle sparing TRAM

Claire Louise Rutherford<sup>a</sup>, Bien-Keem Tan<sup>a,\*</sup>, Sue Zann Lim<sup>b,c</sup>, Khong-Yik Chew<sup>a</sup>

<sup>a</sup> Department of Plastic, Reconstructive and Aesthetic Department, Singapore General Hospital, Outram Road, Singapore

<sup>b</sup> Singhealth Duke-NUS Breast Disease Centre, Singapore

<sup>c</sup> Department of General Surgery, Singapore General Hospital, Singapore

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## ABSTRACT

In the setting of autologous breast reconstruction, achieving an aesthetic outcome through shaping of the flap is of the upmost importance. We describe the abdominal flap folding technique of 'coning' and the indications. We define 'coning' as the technique of folding the abdominal flap in a circular fashion to create a conical breast mound, with the line of fusion forming a pillar of tissue for structural integrity. A retrospective study of 34 patients undergoing unilateral muscle-sparing TRAM flap was performed. Of these patients, the majority (79.4%) underwent immediate reconstruction, with the thoracodorsal vessels largely acting as the recipients (94.1%). Three (8.8%) patients were noted to have a contour defect secondary to incomplete folding of the flap. Two (5.9%) patients had partial skin envelope necrosis. One patient had 50% flap loss, requiring return to theatre for excision. In conclusion, coning was used exclusively in the muscle-sparing TRAM flap. This cuff of muscle protected the pedicle during folding through cushioning the perforators at their most vulnerable points. This technique allowed for muscle cuff harvest whilst minimising

\* Corresponding author.

E-mail address: [bienkeem@gmail.com](mailto:bienkeem@gmail.com) (B.-K. Tan).

anterior sheath sacrifice. Coning achieved long-term maintenance of shape, volume and projection.

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## Introduction

The primary focus of breast reconstruction is the creation of a breast that closely resembles, or improves upon, the natural breast shape.<sup>1</sup> ‘Coning’ is the folding of an abdominal flap ellipse in a circular fashion to create a conical breast mound. Coning is indicated in those with a minimal abdominal pannus, skin deficiency, large volume and well-projected breasts.

## Surgical technique

The flap outline is marked out and centred over the paraumbilical perforators identified using Doppler. The flap height should ideally not exceed two-thirds of the distance between the umbilicus and the pubic symphysis. In thin patients in whom abdominal closure is expected to be tight, we design a long and narrow ellipse not exceeding 8 cm in height. With this dimension, the diameter of the breast footprint ranges from 12 to 15 cm.

The flap is raised with a cuff of muscle to protect two to three chosen perforators whilst sacrificing minimal anterior rectus sheath. The muscle segment may be medial, lateral or central. The lateral cuff based on lateral perforators can be raised quickly, although the pedicle tends to be shorter. Using the medial cuff based on medial perforators provides crossover blood supply and a longer pedicle, although it is more time-consuming to dissect.

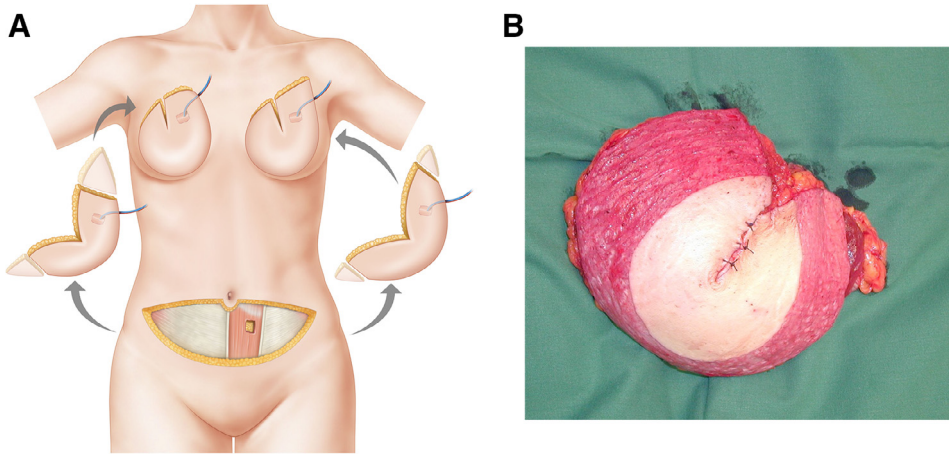
The thoracodorsal vessels are first preference recipient vessels due to their consistently large calibre and axillary access, which allows for optimal flap inset and orientation (Figure 1). The internal mammary vessels can also be used, though the vessels tend to be of a smaller calibre compared to the thoracodorsal vessels in our experience. When using a contralateral flap, the internal mammary vessels are best used due to pedicle orientation (Figure 1).

The flap is de-epithelised save for a hemi-circular zone of skin surrounding the umbilicus. The flap is trimmed as necessary, and their apices opposed. The flap is most commonly folded upwards, but it can also be folded downwards in the more ptotic breast.<sup>2</sup> The central fold, consisting primarily of Dinner’s zones I and III, has good vascularity.<sup>3</sup> Less well-perfused areas of the flap over zones II and IV may require trimming.

The cone is maintained through apposition of the flap in two layers in a loose fashion – deep and superficial along the line of the central fold. It is this central fold that creates a pillar of tissue and provides structural support to the flap. If the two sides of the flaps cannot be completely opposed then spanning 2-0 vicryl sutures are placed with minimal tension. The potential gap created may be fat-grafted at a later date. The residual skin paddle is at the apex of the cone, which forms the new nipple areolar complex (NAC) (Figure 1). Once the final shape has been decided, the remainder of the flap is de-epithelised as necessary.

Once the cone is created, it is passed into the mastectomy skin envelope via a generous axillary curvilinear incision. During inset of the flap there is usually adequate pedicle length to allow for orientation, for placement to recreate symmetry, medial fullness and the infra-mammary fold. It is imperative to ensure no twist or kink is present in the pedicle prior to closure. This is checked at several points during the operation: before revascularisation, following revascularisation and once the flap is rotated into position.

The anterior rectus sheath may be closed concurrently during flap inset. A Prolene mesh is used as the standard when repairing the sheath under minimal tension to minimise the risk of abdominal



**Figure 1.** Folding technique and pedicle orientation.

(A) Due to pedicle orientation, if an ipsilateral TRAM is raised, the preferred recipient vessels are the thoracodorsal vessels; if contralateral, the preferred recipient vessels are the internal mammary vessels. (B) A loosely folded flap.

**Table 1**  
Case series of 34 patients.

Characteristics	Value (%)
Age (yr)	45
BMI (kg/m <sup>2</sup> )	22.1
Timing of surgery	
Immediate	27 (79.4)
Delayed	7 (20.6)
Perforators	
Lateral	28 (82.4)
Medial	5 (14.7)
Central	1 (2.9)
Recipient vessels	
Thoracodorsal	32 (94.1)
Internal mammary	2 (5.9)
Folding	
Upwards	31 (91.2)
Downwards	3 (8.8)
Complications	
Gap from folding	3 (8.8)
Mastectomy skin necrosis	2 (5.9)
Partial flap loss	1 (2.9)
Total flap loss	0 (0.0)
Abdominal wall bulge	2 (5.9)

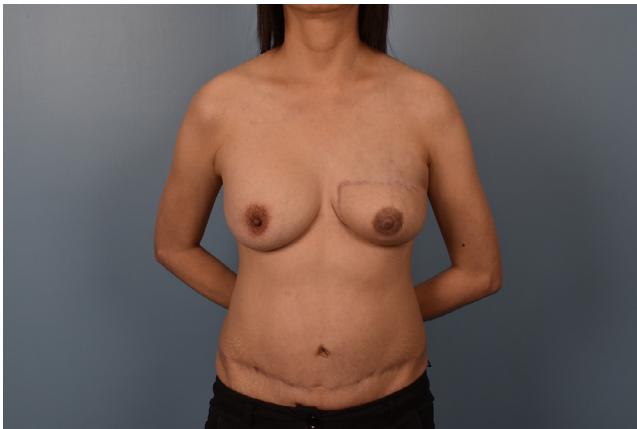
wall hernias. It is secured in sublay fashion where the sheath is closed directly over it. The mesh could potentially be avoided in the setting of a pure DIEP.

### Patients and outcomes

A case series of patients undergoing unilateral coning reconstruction were collated. A single surgeon carried out all the operations assessed. A total of 34 female patients were assessed (Table 1). The mean age was 45 years old (32–63), with a median BMI of 22.1 (14.6–29.1). All of the reconstructions were unilateral. Twenty-seven of these reconstructions were immediate (Figure 2), versus 7 delayed (Figure 3). The majority of perforators used were lateral row (28 vs 5 medial vs 1 central).



**Figure 2.** 54-year-old patient with right breast cancer. Right skin sparing mastectomy with immediate reconstruction with ipsilateral MS TRAM flap coning and subsequent nipple reconstruction with CV flap. Four-year follow-up.



**Figure 3.** 48-year-old patient with left breast cancer treated with radical mastectomy and radiation a decade ago. She presented with atrophic skin over the chest which had to be discarded. Delayed reconstruction was performed with a coned ipsilateral MS TRAM flap. Three years post-operatively.

The recipient vessels used were largely the thoracodorsal (94.1%), with the exception of 2 cases which were contralateral MS TRAMs, where the internal mammary was used. In terms of folding technique, the majority (91.2%) were folded superiorly to obtain maximal projection, with only 3 being folded downwards in the more ptotic breast. 12 patients went on to have nipple reconstruction.

Three (8.8%) patients were noted to have a contour defect secondary to incomplete folding of the flap. Two (5.9%) patients had partial skin envelope necrosis, one of which required excision and re-suture, the other of which healed by secondary intention with dressings only. One patient had 50% flap loss, requiring return to theatre for excision. Dinner's zones II and IV were excised, resulting in lower pole volume deficiency. The patient chose not to undergo another flap reconstruction although a lateral intercostal artery perforator flap would have been an option for salvage. The loss was attributed to over-aggressive folding along the thick central portion of the TRAM flap. There were no cases of complete flap loss. Two patients died as a result of their disease progression.

## Discussion

Various methods of abdominal flap shaping in breast reconstruction have been described.<sup>2–6</sup> Flap coning is ideally used in the setting of the muscle-sparing TRAM due to the protection of the pedicle offered by the muscle cuff. Since all four zones are utilised, the folded abdominal flap itself offers a large skin paddle in patients with skin deficiency, which is of particular use in the setting of delayed reconstruction.<sup>5</sup> We do not hesitate to include more perforators, especially in cases where the apical zones (zones II and IV) are critical for skin cover. A pure DIEP flap without any muscle cover could potentially be coned, but one needs to inspect the lie of the perforators after flap inset to avoid kinking or compression.

The ease of folding is dependent on flap thickness. The flap is not surgically thinned, as it may compromise vascularity. The height of the flap is usually kept below 8 cm and centred over the paraumbilical perforators to capture the blood supply crossing the midline. Ensuring that the flap is not too wide and thick at the midline is essential for the ease of flap folding, and to avoid creating a gap between the apices, resulting in a contour defect in the reconstructed breast. If complete opposition cannot be safely achieved, the defect can potentially be fat grafted in future. By creating a central notch in the inferior aspect of the abdominal flap this may aid in coning, however care must be taken not to impair crossover blood supply. It also acts as a marker of the midline, and helps to relieve tension along the lower abdominal suture line when closing.<sup>4,7</sup> The apex of the fold, which is the peak of the cone, represents the future nipple in most of the skin-sparing mastectomy cases.

Zone IV of the flap has the most tenuous vascularity and patients must be counselled as to the risk of fat necrosis and flap hardening. In patients who do not require this additional tissue, it may simply be rounded off or excised accordingly.

Another surgical coning technique described by Chae et al., involves the placement of loose purse-string sutures to encircle the breast base. Additional sutures are placed as needed to create the desired amount of projection.<sup>8</sup> The advantage of this technique is the creation of projection with minimal folding of the flap. This technique is routinely used in our practice for subtle projection where not all four zones are needed.

## Declaration of Competing Interest

None of the authors has a financial interest in any of the products, devices or drugs mentioned in this manuscript.

## CRediT authorship contribution statement

**Claire Louise Rutherford:** Conceptualization, Visualization, Formal analysis, Funding acquisition, Data curation, Writing - original draft, Writing - review & editing. **Bien-Keem Tan:** Conceptualization, Visualization, Formal analysis, Funding acquisition, Data curation, Writing - original draft, Writing - review & editing. **Sue Zann Lim:** Conceptualization, Visualization, Formal analysis, Funding acquisition, Data curation, Writing - original draft, Writing - review & editing. **Khong-Yik Chew:** Conceptualization, Visualization, Formal analysis, Funding acquisition, Data curation, Writing - original draft, Writing - review & editing.

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