British Journal of Plastic Surgery (1987), **40**, 367–370

Augmentation of circulation of pedicled transverse rectus abdominis musculocutaneous flaps by microvascular surgery

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Summary—The biggest problem of the TRAM flap for breast reconstruction is distal necrosis or fat lysis due to poor circulation. In order to utilise the entire TRAM flap tissue in extensive tissue defects, the contralateral rectus muscle is used as a pedicled carrier and the ipsilateral superficial or inferior epigastric vessels are anastomosed with appropriate recipient vessels in the axilla. This procedure has been performed in three cases with no necrosis, fat lysis or hardening of the flap tissue, proving adequate circulation in the flap.

The transverse rectus abdominis musculocutaneous flap (TRAM) (Hartrampf *et al.*, 1982) is a preferred method of breast reconstruction with autogenous tissue. However, as is admitted by the developers themselves (Elliot and Hartrampf, 1983), distal circulation of the flap is not always reliable, especially on the non-pedicle side, and resection of those tissues which may necrose is recommended. When the tissue defect is very extensive, as after a full radical mastectomy, one needs to make full use of all available flap tissues. We have developed a new technique to solve this problem.

Operative method

A TRAM flap is designed as usual or larger than usual (Fig. 1). The contralateral rectus muscle is used as a pedicle. When the inferior incision on the ipsilateral side is made, special attention is paid to preserving the superficial epigastric vessels. These vessels are traced as far proximal as possible and clamped and divided. If appropriate superficial epigastric vessels cannot be located, the inferior epigastric system is harvested, including a cuff of rectus muscle and anterior sheath (Fig. 2).

The TRAM flap is elevated as usual except for this inclusion of the superficial or inferior epigastric system on the ipsilateral side. After the flap is brought into the proposed site through a subcutaneous tunnel, it is fixed temporarily with sutures and its superficial or inferior epigastric vessels are anastomosed with appropriate recipient vessels in the axilla which have been prepared by another team. After restoration of flow, the breast is reconstructed by trimming, deepithelialisation and suturing of the flap into the defect.

Cases

Since July 1984 we have used this technique in three patients. The maximum size of the flap was 36 × 14 cm and in all three cases the flaps survived completely. There were no signs of fat lysis, fat absorption or hardening of flap tissue due to impaired circulation (Figs 3 and 4).

The superficial epigastric system was used for anastomosis in one case and in the other two cases the inferior epigastric vessels were utilised because the superficial system could not be located. The length of the vascular pedicle of the superficial epigastric system was 5 cm in each case and of the inferior epigastric system 8–10 cm. The diameter of the superficial epigastric artery was 1.5 mm and of the vein 2 mm. The diameter of the inferior epigastric arteries was about 2 mm and of the veins 2–2.5 mm. For recipient vessels, the thoracodorsal artery and vein were used in one case with end-to-end anastomosis, and in the other two cases the subclavian arteries were used with end-to-side anastomosis; the subclavian vein and cephalic vein were selected for venous drainage with end-to-side and end-to-end anastomosis respectively.

In the cases in which the inferior epigastric system was used, primary approximation of the anterior rectus sheath was possible but teflon mesh was used for reinforcement.

Discussion

It is difficult to evaluate how much the circulation can be augmented with this procedure. According

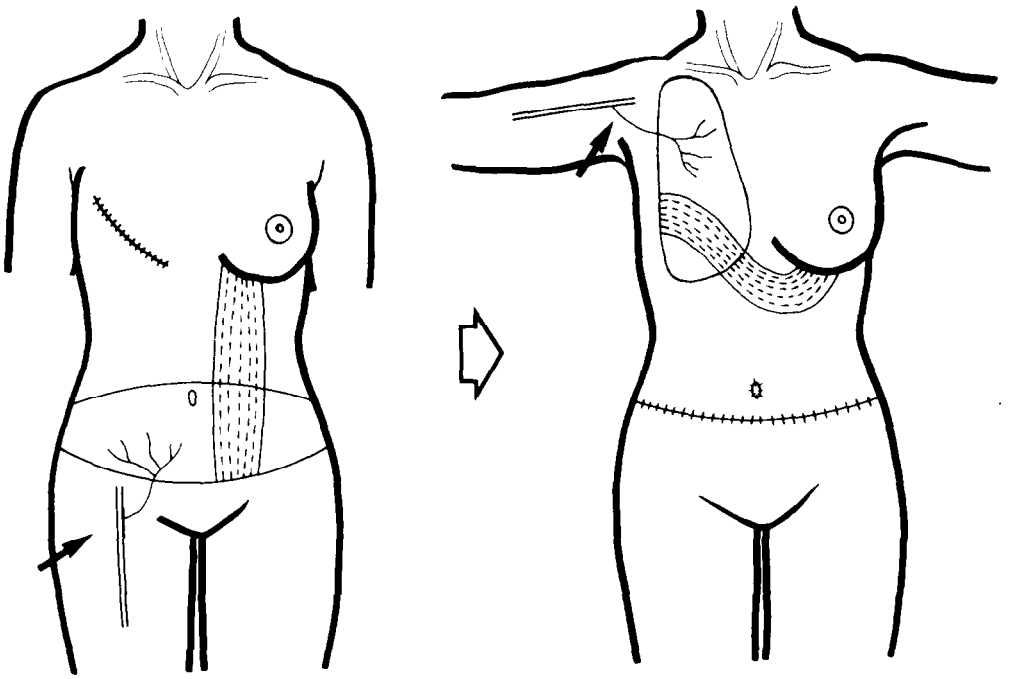

Fig. 1

Figure 1—Schematic view of the procedure. (Left) A TRAM flap is designed with a contralateral rectus muscle as pedicle. Superficial or inferior epigastric vessels on ipsilateral side are mobilised. (Right) Prepared donor vessels are anastomosed with appropriate recipient vessels in the axilla to augment flap circulation.

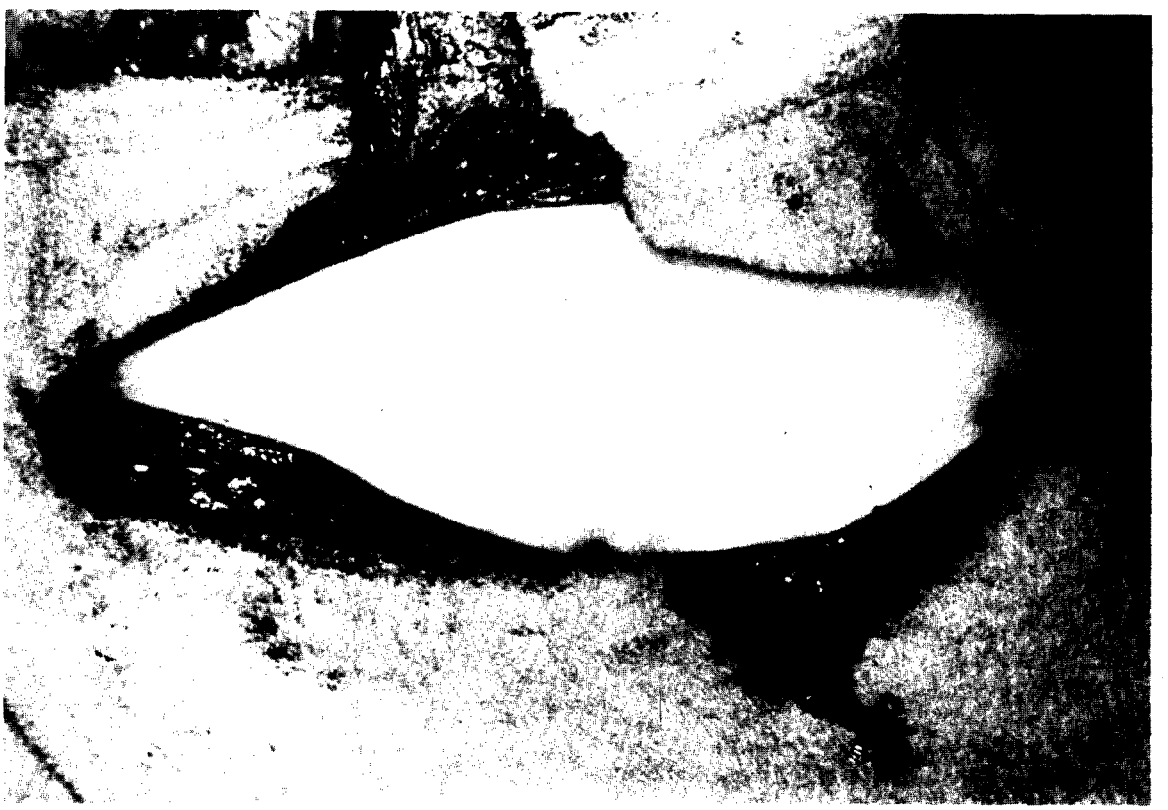

Fig. 2

Figure 2—Elevated flap with right rectus muscle as the pedicle and left inferior epigastric vessels dissected for anastomoses.

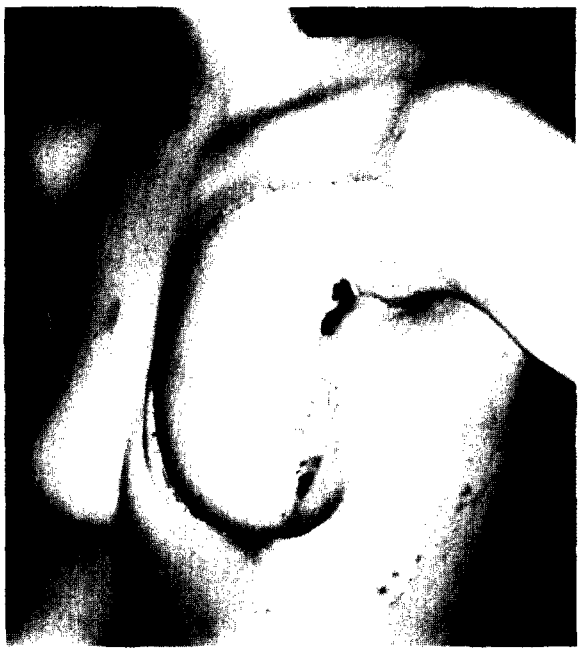

Figure 3—A 32-year-old patient 2 weeks after reconstruction. There is some sloughing of the surrounding skin but the flap survives in its entirety up to its distal tip.

Fig. 4

Figure 4—A 33-year-old patient before and 6 months after reconstruction. The size of the flap is 14 × 36 cm.

to our experience of the conventional TRAM flap, if the entire flap tissue is utilised there is inevitably flap tip necrosis, fat lysis or absorption.

Taylor *et al.* (1984) reported the following findings through their dye injection studies of the epigastric vessels in cadavers:

(i) The anatomical skin territory of the superior pedicle is in the ipsilateral upper abdominal quadrant, above the umbilicus.
(ii) The anatomical skin territory of the inferior pedicle is in the paraumbilical region with extension across the midline through subdermal and subcutaneous vascular plexus.
(iii) The superior and inferior deep epigastric pedicles are connected by a series of small intramuscular vessels in a watershed area located above the umbilicus.

Therefore, the lower TRAM flap used in breast reconstruction seems to be more directly supplied by the inferior pedicle so it is quite reasonable that, if the flow through this pedicle is restored, survival can be improved.

Ishii *et al.* (1985) advocated the use of bilaterial rectus muscles as pedicles. However, the presence of two pedicles may limit free rotation of the flap and sacrifice of both rectus muscles may weaken the abdominal wall. Friedman *et al.* (1985) reported a successful breast reconstruction with a free TRAM flap pedicled on unilateral deep inferior epigastric vessels. In their case almost the entire flap was utilised without distal necrosis. This case report also supports the findings of Taylor *et al.* (1984) that the inferior epigastric system is the dominant blood supply to the TRAM flap. In their procedure survival of the entire flap depends solely on microvascular anastomoses which are often difficult in a heavily scarred area and in this regard we feel safer if the circulation is guaranteed through a pedicled carrier. Moreover, our method is applicable even when there is a lower midline abdominal scar which is not uncommon in middle-aged females.

A similar principle has already been used by Harii *et al.* (1981) in their combined flap of latissimus dorsi musculocutaneous and groin skin flap. This flap was transferred, pedicled on one end, and the other vascular pedicle was anastomosed with appropriate recipient vessels to augment the circulation.

Problems of our method are increased operating time and the sacrifice of both rectus muscles if the superficial epigastric vessels cannot be found. Operating time can be shortened with a two team approach, and sacrifice of the ipsilateral rectus muscle may be justified because only a cuff of muscle is excised and function of the rest of the muscle can be preserved.

In our three cases there was only one in which the superficial epigastric vessels were found. Hester *et al.* (1984) reported that in their 16 cases of free flap transfer using the superficial epigastric system as a stem, there was only one case in which this vessel could not be found. Since we began this procedure we have routinely searched for this vessel but in Japanese it seems to be poorly developed or often completely absent. In Caucasian patients the chance of avoiding the use of bilateral rectus muscles may be greater than in Japanese.

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