Delivery technique for the pedicled transverse rectus abdominis myocutaneous flap

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INTRODUCTION

Since Hartrampf et al. [1] first introduced the rectus abdominis myocutaneous flap with a transverse skin island, the transverse rectus abdominis myocutaneous (TRAM) flap has become one of the most popular techniques for breast reconstruction. As other techniques have evolved and been refined for better microsurgical outcomes, pedicled TRAM flaps now seem outdated and are used less frequently. However, this flap can still be a practical method for most patients, yielding satisfactory aesthetic results with an acceptable complication rate comparable to microsurgical techniques [2,3].

The pedicled TRAM flap method is relatively well known, but some aspects of the technique remain matters of debate. After elevating the flap, the upper abdominal skin and subcutaneous fat are removed from the fascia up to the costal margins, and a medial tunnel is created to connect this dissection area to the mastectomy defect while avoiding detachment of the inframammary fold. This tunnel should accommodate four of the surgeon's fingers, although this may vary depending on flap volume. Wider tunneling facilitates flap delivery, but can damage the breast and inframammary fold. Therefore, we introduce a technique to move the flap easily and safely through a small tunnel. During breast reconstruction using a pedicled TRAM flap, a tunnel was made in the mastectomy defect along the meridian of the breast. This tunnel accommodated a width of three of the surgeon's fingers (6 cm). After completely elevating the flap, it was inserted into a funnel with an inner surface made of polymeric vinyl and a hydrophilic coating. The flap was propelled into the mastectomy defect via the funnel. Our novel technique for pedicled TRAM flap delivery using a funnel was easy and safe, and it is deemed to be suitable for delivering a pedicled TRAM flap.

Keywords Breast reconstruction / Rectus abdominis / Myocutaneous flap / Pedicled flap

IDEA

The patient was a 52-year-old woman with the chief complaint of a
deformity of the right breast, which had been ablated because of breast cancer (Fig. 1). The breast was reconstructed using a pedicled TRAM flap [4]. We used a contralateral single-pedicled TRAM flap with 180° of flap rotation. A tunnel was made in the mastectomy defect along the meridian of the breast. This tunnel accommodated a width of three of the surgeon’s fingers (6 cm). After completely elevating the flap, the entirety of zone IV and part of zone II were discarded. The flap was inserted into a funnel (EZ funnel; UN Healthcare, Okcheon, Korea) for easy delivery to the mastectomy defect. The flap was propelled into the mastectomy defect via the funnel, and the muscle pedicle was cut with scissors (Fig. 2). Once the flap had been positioned, it was tacked down and examined in an upright position to confirm its symmetry. The flap was trimmed to conform to the mastectomy flap and breast shape. The abdominal wall defect was then closed (Fig. 1). At 1 year postoperatively, the patient had fully recovered, the IMF was well maintained, and complications were absent (Fig. 3).

In this case, a tunnel with a width corresponding to three of the surgeon’s fingers was made. The elevated flap was turned over and fixed with a suture to prevent damage to the pedicle by the dissected muscle and subcutaneous fat of the flap. The next step involved passing the flap through the sterile funnel, which had been soaked with irrigation solution to reduce friction prior to delivery. The flap orientation was then confirmed in the funnel, and a maneuver of squeezing the flap slowly and carefully through the funnel with pressure exerted on the back of the funnel allowed the flap to slip into the mastectomy site.

In this way, we delivered the pedicled TRAM flap to the mastectomy site through a tunnel that could accommodate three of the surgeon’s fingers. We found that the funnel made it easy to deliver the flap even through a small incision. Therefore, we minimized damage to the breast footprint (particularly the medial portion of the IMF) and pedicle during delivery.

**DISCUSSION**

Among the surgical methods using autologous tissue, the pedicled TRAM flap using the skin, subcutaneous fat, and muscle of the lower abdomen has various complications, such as additional scars, problems related to the abdominal incision, herniation, longer operative times, infection, flap necrosis, and hematoma [5]. However, the pedicled TRAM flap is considered a useful option for breast reconstruction because it is easy to make a more natural shape of the breast than is possible with implants, and there are secondary aesthetic benefits by removing excess loose and sagging skin from the abdomen [6,7]. Furthermore, this method avoids anxiety about inserting a foreign substance, while providing satisfactory aesthetic outcomes to patients and helping them to keep this important aspect of their femininity, ultimately improving their quality of life [8-10].

In the current pedicled TRAM flap method, the upper abdominal skin and subcutaneous fat are removed from the fascia up to
the costal margins, and a tunnel is made in the mastectomy defect along the meridian of the breast. This tunnel should typically accommodate four of the surgeon’s fingers or be approximately large enough to pass a fist through, although the width of the tunnel can vary based on flap volume [4]. Wider tunneling makes it easier to deliver the flap, but it is an arduous process that destroys the natural IMF. In general, the tunnel through which the flap passes is made at the 5- and 7-o’clock positions of the IMF, especially preserving the medial portion without damage [11]. Additional widening of the tunnel or dissection to avoid tension or kinking of the pedicle may be required. For a flap with a large volume that is difficult to pass through the tunnel, the surgeon conducts resection laterally to place the flap on the mastectomy site, and then sutures the dissected IMF. In this case, the IMF and mastectomy pocket may be resected beyond the aesthetic margins of the breast. This damages the IMF, thereby deforming the location and shape of the final results. Instead, if the tunnel is not wide enough, the flap is compressed or the pedicle may be damaged or kinked during the delivery procedure, potentially leading to life-threatening complications such as flap necrosis [11-13].

The Keller funnel, introduced in 2009, has an inner surface made of polymeric vinyl with a hydrophilic coating. The coating facilitates the low-friction delivery of implants. In addition, the clear funnel promotes easy delivery of implants into the breast pocket, without the need to touch the implants. Furthermore, this method involves making only a small incision, and it significantly reduces skin contact and contamination. Using the funnel also reduces capsular contracture, results in only a small postoperative scar, and is associated with relatively mild postoperative pain. Due to these advantages, funnels are now used considerably more frequently during breast augmentation and reconstruction using implants [12-15].

We hypothesized that by using a funnel with these characteristics, the flap could be delivered relatively easily and safely when passing through the tunnel to the mastectomy site in pedicled TRAM flap surgery. If a funnel had not been used in this case, there would have been an incision with a width of four of the surgeon’s fingers (7.5–8 cm), but the method using the funnel was sufficient to deliver the flap through the incision with a width of three of the surgeon’s fingers (6 cm). The funnel made it easy to deliver the flap even through a small incision.

There are limitations to this study, including the single-patient sample size, its retrospective study design, the lack of a control group, and the volumetric effect of the flap. Therefore, further research is needed with a larger number of cases to establish the relationship between the volume of a flap and the width of the incision required for delivering it. We plan to perform a prospective study with this method as an elective surgical option for the pedicled TRAM flap, and we expect that the delivery technique using a funnel will lead to more satisfactory outcomes.

We confirmed that the implant delivery method using a funnel, which has been mainly used in breast reconstruction and augmentation using implants, can be applied easily and safely in pedicled TRAM flap surgery without damaging the pedicle. This maneuver provides minimal contact and manipulation, which have been associated with reduced damage to the pedicle and a lower risk of flap infection. The funnel allows easier flap placement with potentially smaller tunnel requirements compared to manual placement, reducing the operation time and maintaining the IMF without destruction. These advantages are expected to enable more satisfactory outcomes to be obtained through the reconstruction method using a funnel, and this method can be considered a useful option for pedicled TRAM flap procedures.

NOTES
Conflict of interest
No potential conflict of interest relevant to this article was reported.

Ethical approval
The study was approved by the Institutional Review Board of Chungnam National University Hospital (IRB No. 2022-06-050).

Patient consent
The patient provided written informed consent for the publication and the use of her images.

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