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Breast

Determining the Trimming Layer in Breast Reconstruction with a Free TRAM Flap Using Intraoperative Video-angiography

Sang Keon Lee, MD
Dong Won Lee, MD, PhD
Dae Hyun Lew, MD, PhD
Seung Yong Song, MD, PhD

Summary: In breast reconstruction using a free transverse rectus abdominis myocutaneous or deep inferior epigastric perforator flap, the trimming process for the flap area, which is usually the upper portion of the reconstructed breast, is critical to creating a natural-looking breast. In this study, we investigated which subcutaneous fat layer of the abdominal flap benefited most from a well-maintained blood supply during the trimming process using intraoperative fluorescent angiography system in a cross-sectional view of the elevated abdominal flap. We concluded that, for cosmetic purposes, the deep subcutaneous fat layer (beneath Scarpa's fascia) should be trimmed first to minimize fat necrosis due to fat ischemia. *(Plast Reconstr Surg Glob Open 2017;5:e1266; doi: 10.1097/GOX.0000000000001266; Published online 13 March 2017.)*

INTRODUCTION

Free transverse rectus abdominis myocutaneous (TRAM) flap and deep inferior epigastric perforator (DIEP) flap are known to be reliable methods for breast reconstruction. However, these flap surgeries can lead to unsatisfactory outcomes due to bulkiness and firmness of the upper reconstructed breast from fat necrosis. Fat necrosis, which is one of the most common complications of breast reconstruction with a free TRAM or DIEP flap, occurs at a rate of 4–16% and is caused by ischemic conditions to the subcutaneous fat.[1,2] For this reason, the trimming process for making a natural contour for the reconstructed upper breast should take fat necrosis into consideration. According to Hartrampf's concept, distal parts of zones II and III are mostly expected to become the upper pole of the reconstructed breast and are trimmed in general. Here, zone IV is mostly discarded during surgery due to its poor blood perfusion, which has been described using laser-induced fluorescence of indocyanine green in a previous study.[3] There have been no reports describing which subcutaneous fat layer, whether superficial or deep, should be trimmed first to achieve a satisfactory appearance of the upper reconstructed breast to remove tissue that is vulnerable to fat necrosis. Our institution has studied tissue perfusion of the abdominal flap before its division from the DIEA with the SPY intraoperative fluorescent angiographic imaging system (Novadaq Technologies, Inc., Toronto, Canada; distributed in North America by LifeCell Corp., Branchburg, N.J.), which produces a real-time image of large- and small-caliber blood vessels.[4]

PATIENTS AND METHODS

According to our protocol, which was approved by the Yonsei University Medical Center Institutional Review Board, we performed a retrospective review of 6 consecutive patients who underwent immediate breast reconstruction with a free TRAM or DIEP flap with the SPY-based deep subcutaneous fat-trimming technique from April 2015 to October 2015. The main outcome measures included demographics, 12-month postoperative breast photograph, fat necrosis of the upper breast area, and patient satisfaction by questionnaire. Of these, fat necrosis was evaluated through palpation and routine ultrasonographic examination by the author.

Surgical Technique

All reconstructions using the free TRAM or DIEP flap were performed by a single surgeon (Seung Yong Song). Abdominal flaps were elevated in a standard manner as introduced previously with muscle-sparing TRAM and DEIP based on Hartrampf's concept of the conventional zones,

From the Department of Plastic and Reconstructive Surgery, Institute for Human Tissue Restoration, Severance Hospital, Yonsei University College of Medicine, Seoul, Korea.
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according to their perforator's caliber and distribution.[5] Before dividing the flap from the DIEA, SPY was applied with an indocyanine green injection through peripheral or central intravenous access. After bolus administration, flap perfusion was recorded by real-time video image. Zone IV was almost discarded (average over 80%) and the flap-trimming area was determined by considering the optimal contrast enhancement level for tissue perfusion according to both anteroposterior (Fig. 1) and cross-sectional views (Fig. 2). Trimming was processed using a SPY-based method to detect any poorly vascularized area; mainly the deep subcutaneous fat tissue under Scarpa's fascia in the distal parts of zone II or III were excised obliquely to achieve a natural concave appearance. This procedure was repeated until fresh bleeding was confirmed in remnant zone II or III. After trimming, the TRAM flap was transposed to the mastectomy site and a flap in-setting process was performed using the vertical in-setting method (90-degree angle, clockwise or counterclockwise) in which zone II or III was positioned in the upper pole. To prevent spontaneous rotation and displacement of the flap, it was fixed using Vicryl sutures. Finally, in the center of the upper pole, the distal parts of zone II or III were positioned; proximal zone I was positioned in the middle pole and zone III or II was positioned in the lower pole, while the perforator was ipsilateral or contralateral to the mastectomy site, respectively.

RESULTS

Three patients underwent breast reconstructions with free TRAM flaps, while 3 other patients underwent free DIEP reconstructions using our proposed SPY-based deep subcutaneous fat-trimming techniques. The average age of our patients was 49 years (range, 42–56) and the mean

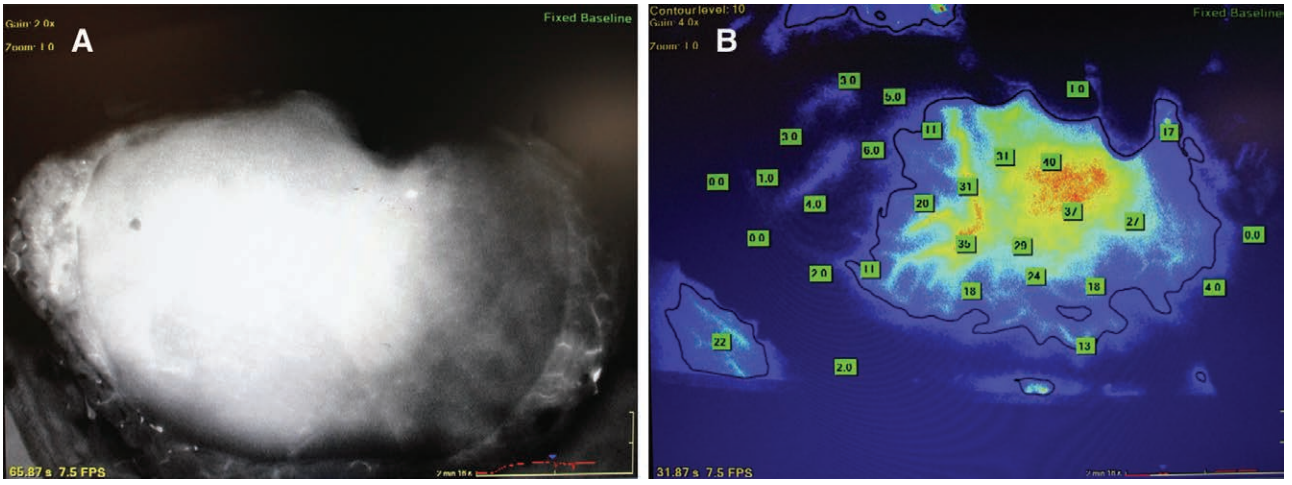

Fig. 1. SPY image of tissue perfusion-level, anteroposterior view. Increased enhancement of the free TRAM flap before dividing it from the DIEA was shown: zones I and III exhibited good perfusion, while relatively decreased enhancement in zones II and IV was observed. A, Zone IV was mostly resected and zone II became the upper pole of the reconstructed breast. B, The SPY system revealed different enhancing levels according to our quantitative data.

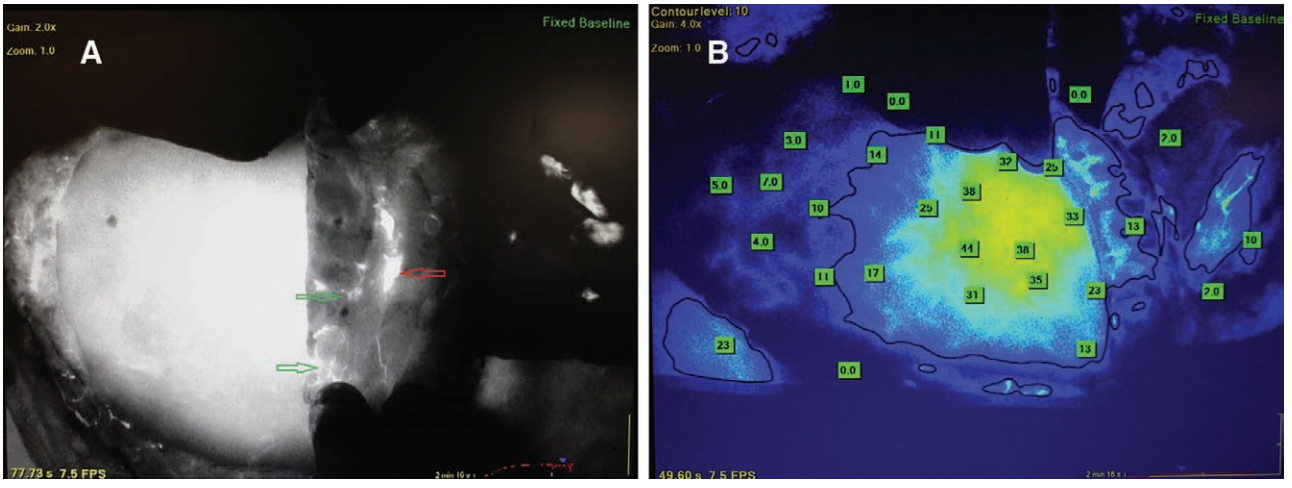

Fig. 2. SPY image of tissue perfusion-level, cross-sectional view. A cross-sectional SPY view of zone IV shows a better perfusion state in the superficial subcutaneous fat layer than in the deep layer. A, The red arrow indicates Scarpa's fascia and the green arrows indicate the subdermal plexus. B, Quantitative data also support good vascularity of the superficial subcutaneous fat layer.

body mass index was 22.17 kg/m² (range, 20.83–22.94). Four patients (1 DIEP and 3 TRAM) underwent breast procedures using an ipsilateral perforator, and 2 (1 DIEP and 1 TRAM) patients' procedures used a contralateral perforator. There were no intra- and perioperative complications among our patients. After 12 months of follow-up, patient satisfaction score in questionnaire regarding breast contour was high in all cases and no bulkiness, firmness, or tenderness inducing area in flap implying fat necrosis was reported by author's palpation. Ultrasonographic examination also revealed absence of fat necrosis in the upper pole of the reconstructed breast.

DISCUSSION

Fat necrosis of the upper pole of the reconstructed breast remains a perplexing challenge for plastic surgeons. Furthermore, no previous reports have described effective trimming methods for preventing fat necrosis in free TRAM or DIEP breast reconstruction. Therefore, we suggest a method for processing zone II or III, based on the vascular anatomy of the abdominal flap using the SPY intraoperative fluorescent angiographic imaging system. In 2009, Saint Cyr et al.[6] described perfusion patterns for free TRAM and DIEP flaps in breast reconstruction under Hartrampf's concept—that if the medial perforator is dominant, zone II should be perfused before zone III, and if the lateral perforator is dominant, zone III should be perfused before zone II, using the linking-vessel concept and recurrent subdermal plexus flow with 3- and 4-dimensional computed tomography, which also advocated Holm's perfusion concept.[3] Based on his study,[6] perforator branches to the zone II area cross the midline using linking vessels and there is no vascular filling under Scarpa's fascia in zone II. Likewise, in zone III cases, which receive recurrent subdermal plexus flow, the deep subcutaneous fat is more vulnerable to ischemic conditions. Therefore, deep subcutaneous fat should be trimmed in both zones II and III[6–8] theoretically to improve aesthetic outcomes by reducing fat necrosis. Also, by using the SPY system, we could identify poor vascular perfusion of deep subcutaneous fat with a real-time image. However, this study is limited as visualized image only represents the state of tissue perfusion at the time of examination and change in perfusion pattern would be possible after microanastomosis or with alteration of blood pressure. Nevertheless, this study is significant in that SPY system may allow identification of areas with potential ischemia before transfer. This information is more reliable than confirmation of margin bleeding in trimmed area as bleeding alone is unable to reflect tissue viability, and SPY can help decide whether a questionable tissue is viable or not in the trimming process. Also, despite the small sample size in this study, SPY showed consistent perfusion image of superficial subcutaneous fat layers based on linking vessels and subdermal plexus.

CONCLUSIONS

An essential consideration when performing breast reconstruction using a free TRAM or DIEP flap is the trimming process for the flap, which is usually performed on the upper pole of the reconstructed breast. In this study, we found that superficial layers of subcutaneous fat tissue are better perfused than deeper layers according to findings from the SPY intraoperative fluorescent angiography system. Consequently, deep subcutaneous fat layers should be trimmed first to reduce the risk of fat necrosis. Both retrospective nature and small sample size are significant limitations of this study. For more robust conclusions about the relationships between the trimming area and fat necrosis, prospective studies with larger sample size and longer follow-up are needed.

Seungyong Song, MD, PhD
Department of Plastic and Reconstructive Surgery
Yonsei University College of Medicine
50–1 Yonsei-ro, Seodaemun-gu
Seoul 1599-1004, Korea
E-mail: pssysong@yuhs.ac

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