LIPOSUCTION FOR THINNING AND EXPANDING DEEP INFERIOR EPIGASTRIC PERFORATOR FLAP IN RECONSTRUCTION

Hoang Tuan Hoang[1], Hoang Thanh Tuan[1], Vu Quang Vinh[1]

Summary

Objectives: To evaluate the flap thinning efficiency for expanding the deep inferior epigastric perforator flap. ***Subjects and methods:*** A clinical study was conducted on ten patients (two retrospectives and eight prospectives) with a diagnosis of a massive scar on the chin and neck postburn to cover the scars with a "thin" deep inferior epigastric perforator flap at the Plastic and Reconstructive Aesthetic Surgery Centre, Le Huu Trac National Burn Hospital, from April 2021 to December 2022. ***Results:*** Females were predominant in our study (60%). The mean age was 35.4 ± 9.536 years. The DIEP flap has an average length of *27.8 ± 2.74 cm*, a maximum of 32 cm, an average width of 12.3 ± 2.54 cm, and a maximum of 18 cm. All flaps (10/10) survived ultimately; the IV area was well supplied with blood; the wound healed primarily; the flap was soft; the flap color matched the skin near the defect; and the flap thinness reduced significantly with the reconstructive requirements. ***Conclusion:*** The liposuction technique is a safe, initial technique that showed clinical effectiveness in the ability to thin and expand the deep inferior epigastric perforator flap while ensuring the functions and aesthetics of the flap.

** Keywords: DIEP flap; Flap thinning; Liposuction.*

INTRODUCTION

The flaps must meet specific criteria when reconstructing the chin and neck area with high aesthetic standards. The flap thinning method is necessary to create flaps that best match the regions to be reconstructed. Flap thinning and exceptionally microsurgical flaps always interested domestic and foreign authors. Along with the development of

[1]Plastic and Reconstructive Aesthetic Surgery Centre, Le Huu Trac National Burn Hospital
Corresponding author: Hoang Tuan Hoang (tuanhoangst1204@gmail.com)
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plastic surgery techniques, many flap expansion methods have been applied, such as tissue expansion, delayed flap, and "supercharging" microsurgery. In the neck burn, scar contractures are reconstructive, requiring a thin, wide flap; other reconstructive methods, such as the occipital cervical dorsal flap (OCD) and the "supercharging" of the supraclavicular flap, have been applied very successfully. Unfortunately, in patients with widespread deep burns, the sites for the donor flap may have been damaged, so the selection, in this case, is always challenging for surgeons.

The DIEP flap is the best material for breast reconstruction after mastectomy for breast cancer; according to Hartrampf's study [1], zone 4 of the flap often resections due to being outside the blood supply range of the flap. The choice of a thin DIEP flap that is large enough to cover is necessary for expansive lesions after scar cutting.

This study aims to: *Evaluate the liposuction technique for thinning and expanding the deep inferior epigastric perforator flap in cervicomental scar reconstruction.*

SUBJECTS AND METHODS

1. Subjects

A clinical study was conducted on ten patients (two retrospectives and eight prospectives), who were diagnosed with wide cervicomental scars and had indications to reconstruct with the thin deep inferior epigastric perforator flap at the Plastic and Reconstructive Aesthetic Surgery Centre, Le Huu Trac National Burn Hospital, from April 2021 to December 2022.

* *Inclusive criteria:*

- Patients who had a large scar on the chin and neck that was not treated by conventional plastic surgery methods such as using local flaps, direct sutures, and tissue expansion, affecting the function and aesthetic.

- Patients who had healthy donor skin (the abdominal region).

- Patients who did not receive long-term anticoagulation therapy.

- Patients who did not have a chronic critical illness (cancer, tuberculosis, COPD)

* *Exclusive criteria:*

- Patients with comorbidities, vascular disease, or prolonged use of coagulation.

- Patients who had anesthetic problems (such as allergies).

- Patients who had a history of TRAM flap, DIEP flap, or abdominoplasty.

- Patients with lesions and scars around the umbilicus whose surveys showed no deep inferior epigastric perforator artery.

2. Methods

* *Research design:* A retrospective and prospective clinical study.

* *Surgical technique:*

Excision of the entire scar tissue until the healthy tissue is soft, releasing the most significant amount of contracture. Measure the size of the lesion to determine the exact size of the skin flap to be reconstructed.

To design a DIEP flap, use the Pinch test to measure the thickness of the pre-operative flap: Pinch a fold of skin and pull. Make a "C" with the left thumb and index finger, grab a large part of a skinfold until it hurts, then pull outward.

Hold the pair of calipers using the right hand with the thumb on the upper arm and the index finger on the lower arm. Place the jaw ends over the skinfold while pinching the skinfold with the left hand (measure the center of the skinfold between the fingers). Press down where indicated on the caliper using the right thumb until feeling a slight click. Repeat this step three times for each landmark to ensure reliability. If the measurements differ, obtain and record the average of the three sizes.

The IV region of the flap was administered subcutaneously with saline solution with Lidocaine at 35 mg/kg weight at a ratio of 1 mL per square centimeter [2].

A flap area outside the circle defines the liposuction zone with a radius of 3 cm; the center is the location of the perforator. Perform liposuction with a 3 mm cannula parallel to the skin surface, 1.2 - 1.7 cm from the skin surface. Liposuction that is too shallow will damage the subdermal plexus, affecting the blood supply to the skin. Then lift the flap and dissect the perforator.

Measure the thickness of the post-operative flap by the Pinch test.

Check for IV bleeding by removing a small subcutaneous tissue and observing the bleeding.

The flap was rotated for defect coverage; the donor's vessel was anastomosed in an end-to-end fashion to the recipient's vessel with the aid of an operating microscope. Blood circulation after anastomosis must be meticulously inspected. A negative pressure suction drain was placed. The flap was closed in place with separate stitches.

* *Research criteria:*

Flap receiving area: Flap thinning, the living condition of the skin flap, especially the IV area of the flap, the amount and color of the postoperative

drain fluid, and the softness and flexibility of the skin flap after surgery.

The donor site: Primary closure, the wound's condition healed the donor area's scar.

** Statistical analysis:*

Research data were processed according to conventional statistical algorithms. Using statistical software IBM SPSS 20.0.

RESULTS

Our research observed a large burn scar on the chin and neck in the youngest patients, aged 23 years. The oldest was 55 years, with an average age of 35.4 years, and 100% of the patients were aged 18 - 60. This is an active age group in social activities; therefore, the demand for functional and aesthetic rehabilitation is relatively great.

Table 1: Distribution of scars site in the cervicomental region.

Location of scars	Number of patients (n)	Percentage (%)
Anterior cervical region	1	10
Lateral cervical region	2	20
Anterolateral region of the neck	0	0
Entire neck	7	70
Total	10	100

Large scar contracture in the entire neck was present in most patients (7/10); two patients had a scar in the lateral neck, and one had a scar in the anterior cervical region.

Table 2: Properties of scars.

Properties	Morphology of scars				Total
	Keloids	Hypertrophic	Atrophic scars	Flat scar	
Number of patients	1	8	0	1	10
Percentage (%)	10	80	0	10	100

The hypertrophic scar was predominant (80%), with no atrophic, and 1 case with a flat scar was found in the study. Keloids were encountered in 01 patient (10%).

Table 3: The size of the deep inferior epigastric perforator flap.

Parameters	Value		
	Average	Min	Max
The length of the flap (cm)	27.8 ± 2.74	25	32
The width of the flap (cm)	12.3 ± 2.54	9	18
Area (cm^2)	344.3 ± 95.33	250	576

The "thin" DIEP flap can reach up to 32 cm in length and 18 cm in width, ensuring reliability.

Table 4: Pre-operative and post-operative flap thickness.

The flap thickness	Value		
	Average	Min	Max
Pre-operative (mm)	35.6 ± 4.27	28	41
Post-operative (mm)	10.9 ±1.66	8	13
p_{t-s}	$p < 0.05$		

Abdominal flaps had a pre-operative thickness measured by the Pinch test up to 41 mm, an average of 35.6 ± 4.27mm, while the post-operative liposuction flap was significantly thinner: The flap thickness recorded after surgery was down to 8mm, with an average of 10.9 ± 1.66mm.

All flaps (10/10) survived ultimately; the IV area was well supplied with blood; the wound healed primarily; the flap was soft; the flap color matched the skin near the defect; and the flap thinness reduced significantly with the reconstructive requirements. The donor site was primarily closed, not to compromise the functions while improving the aesthetics of the abdominal region.

Figure 1: Case clinical report: A 25-year-old female.

(a) Preoperative view (frontal view). (b) Flap design. (c) Elevated flap. (d) Immediately after the operation (frontal view). (e) (f) Immediately after the operation (lateral view).

(g) One-year post-surgery (frontal view). (h) (i) One year post-surgery (lateral view). (j) The donor site after surgery.

DISCUSSION

1. Reasons for choosing the DIEP flap

The DIEP flap is an autologous material and is increasingly used in breast reconstruction after post-cancerous breast resection and in the treatment of contracture scars of the chin and neck area. With the advantage of being autologous material, the DIEP flat can be harvested in large sizes, combined with flap thinning, which brings high cosmetic properties and softness while having little effect on the functions as well as improving the body contouring.

The DIEP flap is a fasciocutaneous flap from the lower abdominal wall that is supplied blood by the perforator branch from DIEA, which is one of the two superior vessels of the rectus muscle. (category III according to the classification of Mathes S. J. et al.) [3]. According to the description of Scheflan M. et al. [4], there are four physiological perfusion areas of the DIEP flap (Hartrampf perfusion zones), which are areas I, II, III, and IV.

There is a difference in the areas of blood supply. Areas I, II, and III are where safe blood supply is ensured, and area IV is the area located far from the site I with the worst blood flow - the location of blood supply with the highest risk of necrosis. Many studies show a high flap rate, which has low or no perfusion to zone IV on Fluorescence Imaging by ICG was 55.6% in the article by Chirappapha et al. [5] and 46.7% by Fluorescein according to Nguyen Van Phung et al. [6]. Therefore, to ensure the survival of the flap, many authors now advocate for routine discarding of zone IV to avoid fat or flap necrosis.

2. The results of thinning the skin flap by liposuction to expand the flap size

** Effectiveness of flap thinning:*

Liposuction is a surgical procedure that uses suction to remove fat from specific body areas. The general rule is that after fluidifying the subcutaneous fat tissue structure (by the classical method, with the aid of a mechanical machine, by ultrasound, or by laser), the fluid containing the fat will be aspirated by the suction negative pressure machine. The subcutaneous fat in the abdomen is divided into two superficial and deep layers. The superficial layer consists of small fat lobes with a solid structure and regular septum; the deep layer has larger fat lobes with a loose structure. In this study, after injecting fluid into the subcutaneous fat layer, wait about 10 minutes. The center is the location

of the perforator. Perform liposuction with a 3 mm cannula parallel to the skin surface, 1.2 - 1.7 cm from the skin surface. Liposuction that is too shallow will damage the subdermal plexus, affecting the blood supply to the skin. The amount of fat removed depends on the size of the flap and the subcutaneous fat of the specific patient.

According to the study of many authors, DIEP flaps are provided in large sizes and volumes due to their significant flap thickness. María Alejandra Cerón et al. [7] used dynamic computed tomography (CTA) to assess DIEP flap volume and thickness, with a mean flap thickness of 38.07 mm. The thickest one was 51.7 mm. The study by Rohini L Kadle et al. [8] on 94 flaps recorded a mean size of 32 mm, the thickest one was 51 mm. In our study, the average pre-operative flap thickness was 35.6 ± 4.27 mm; the thickness flap was 41 mm, resembling the studies of other authors worldwide. With the above flap thickness, the issue of thinning the flap before lifting the flap to cover the defect after cutting the scar is necessary to ensure the thinness matches the surrounding defects. After liposuction surgery, flap thinning was significantly reduced to an average of 10.9 ± 1.66 mm, just around 1/3 of the original flap thickness. The change in pre-operative and post-operative flap thickness was statistically significant with $p < 0.05$. With the thinning of the flap after surgery following the skin thickness of the neck chin area, the softness of the flap can reconstruct the natural lines in the neck area, such as the neck chin angle.

** DIEP flap size expansion efficiency:*

DIEP skin flap is designed with the lower part of the incision horizontal on the pubic bone. This line extends outward, curves upward, passes over the inguinal ligament, and ends above the anterior superior iliac spine. According to research around the world, DIEP flaps are flaps with large volumes and sizes. For example, Moustapha Hamdi et al. [9] described in the medical literature as ranging from 30 - 45 cm in length and 12 - 15 cm in width; H. Cheng et al. conducted a study on 74 patients recording an average flap size of 30.1 x 12 cm. In Vietnam, the study of Nguyen Van Phung et al. [6] harvested flaps with an average flap size of 35.1 x 12.5 cm, or the study of Pham Thi Viet Dung [10] on 29 patients with a size of 35 x 12.4 cm. This shows that although Asian people, in general, have a smaller body frame and a smaller volume than Americans, the skin organization is

also thin; however, the size of Vietnamese resemble Americans. It is due to the fact that there is a high rate of giving birth to more than one child in Vietnam, which results in breast lift grade and a lot of fat on the wall of the abdomen; thus, the flap of the abdomen was harvested is resemble studies of other authors around the world. However, due to the large flap size and the poor safety of area IV according to the recommendations, the authors always remove area IV before transferring the flap to cover the areas, so the actual flap size used is only around 75% of the flap size harvested as Pham Thi Viet Dung reported that the flap size using 28.32 x 12 cm [10]. Other authors often do not mention the actual size used.

Unlike the results of the above authors, we observe that all flaps in our study have the distal liposuction side located in the IV region according to the classification of Lepage C. et al. (2006) but are still very well supplied with blood without distal blood stasis. From there, we obtained a large flap without having to remove part of the flap with just pedicle vessels, preserving the size of the flap to reconstruct for cases of significant defects after cutting the scar postburn the chin and neck area. Specifically, in the study of flap harvest size, it is also the actual size used to cover the largest defects up to 32 x 18 cm to ensure safety.

We propose some possible explanations for the results. The liposuction technique does not damage the subcutaneous vascular network while reducing the tissues to be supplied, thereby resulting in alteration in intravascular pressures and changes in the dynamic equilibrium, leading to a readjusting of flow and a change in the size of the areas perfused so that the perforator can supply blood further, beyond the anatomical territories of the flap.

CONCLUSION

The liposuction technique is a safe, initial technique that showed clinical effectiveness in the ability to thin and expand the deep inferior epigastric perforator flap while ensuring the function and aesthetics of the flap.

REFERENCES

1. Hartrampf C., Scheflan M. and Black P. W. (1982). Breast reconstruction with a transverse abdominal island flap. *Plastic and reconstructive surgery*; 69 (2): 216-224.

2. Ince B., Yarar S. and Dadaci M. (2019). Simultaneous flap thinning with ultrasound-assisted liposuction during free flap surgery: Preliminary results. *Microsurgery*; 39 (2): 144-149.

3. Mathes S. (2014). Classification of the vascular anatomy of muscles: Experimental and clinical correlation 1981. *50 Studies Every Plastic Surgeon Should Know*; CRC Press, 57-62.

4. Scheflan M. and Dinner M. I. (1983). The transverse abdominal island flap: part I. Indications, contraindications, results, and complications. *Annals of plastic surgery*; 10 (1): 24-35.

5. Chirappapha P., Chansoon T., Bureewong S. et al. (2020). Is it reasonable to use indocyanine green fluorescence imaging to determine the border of pedicled TRAM flap zone IV?. *Plastic and Reconstructive Surgery Global Open*; 8 (9).

6. Phung N.V. (2019). Nghiên cứu sử dụng vạt da nhánh xuyên động mạch thượng vị dưới sâu trong điều trị di chứng phẫu thuật cắt bỏ ung thư vú. Luận án tiến sĩ. Học viện Quân y.

7. Cerón, M. A., Duque, J. L., Verdoy, S. B., et al. (2021). Characterization of the volume and thickness of DIEP flap by CTA image processing, in 2021 XXIII *Symposium on Image, Signal Processing and Artificial Vision* (STSIVA).

8. Kadle R. L., Cohen J., Kuhn J. F.. et al. (2020). Using DIEP Flap Thickness As a Predictor of Fat Necrosis. Plastic Surgery. (October 16-19, 2020).

9. Hamdi, M. and A. Rebecca (2006). The deep inferior epigastric artery perforator flap (DIEAP) in breast reconstruction. *Seminars in plastic surgery*; Thieme Medical Publishers, Inc., NewYork, 95-102.

10. Phan T. N., Phạm T. V. D. and Tạ T. H. T. (2021). Clinical anatomy of d.i.e.p flap in breast reconstruction after total mastectomy by cancer. *Vietnam Medical Journal*; 506 (2).