We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists

6,900
Open access books available

186,000
International authors and editors

200M
Downloads

Our authors are among the

154
Countries delivered to

TOP 1%
most cited scientists

12.2%
Contributors from top 500 universities

WEB OF SCIENCE™

Selection of our books indexed in the Book Citation Index in Web of Science™ Core Collection (BKCI)

Interested in publishing with us?
Contact book.department@intechopen.com

Numbers displayed above are based on latest data collected.
For more information visit www.intechopen.com

8

The Superficial Inferior Epigastric Artery (SIEA) Flap and Its Applications in Breast Reconstruction

Zachary Menn and Aldona Spiegel
Weill Cornell Medical College, The Methodist Hospital, Houston, Texas, USA

1. Introduction

The first choice in breast reconstruction is the use of autologous abdominal tissue due to its similar composition and texture. Free tissue transfer of the lower abdominal wall has become a crucial skill for all reconstructive surgeons to develop in order to keep up with the current progress in breast reconstruction. This involves mastery of the free transverse rectus abdominis muscle (free TRAM), deep inferior epigastric perforator (DIEP) and the superficial inferior epigastric perforator (SIEA) flaps, utilizing their donor abdominal tissue to reconstruct a breast defect.

The SIEA flap utilizes the unique characteristics of the lower abdominal tissue, without compromising the strength and integrity of the abdominal wall musculature and fascial layers. In contrast to other abdominal free flaps, the rectus fascia and musculature are left unaltered during elevation of the SIEA flap, and therefore they maintain their preoperative strength. Many patients prefer an abdominal donor site for free tissue transfer for reasons such as improved abdominal contour with the benefits of abdominoplasty, and a low-lying easily hidden scar that can be covered by most swimwear.

The initial published description of the SIEA flap was by Antia and Buch (1971), who used it to reconstruct a soft tissue deformity of the face. The first use of a free SIEA flap for breast reconstruction was reported by Holmström (1979), however Grotting is known for popularizing the SIEA flap for immediate breast reconstruction in 1991.

2. Anatomy

The SIEA flap gets its vascular supply from a more superficial, subdermal vascular plexus system that includes significantly smaller vessels supplied by the superficial inferior epigastric axial vessels. The SIEA flap is a direct axial adipocutaneous flap, unlike the free TRAM and DIEP flaps that are fed by perforating vessels. The superficial inferior epigastric vessels do not actually perforate a muscle or a septum, so it is not classified as a perforator flap.

The origin of the SIEA is 2-5 cm below the inguinal ligament as a branch of the common femoral artery. It most often originates as a shared trunk with the superficial circumflex iliac artery; however it may originate as an individual trunk or an assortment of other alternative

origins from the deep femoral artery or even the pudendal artery. The SIEA and its venae commitantes are normally found coursing lateral to the lateral row of deep inferior epigastric perforators. The superficial epigastric artery originates deep to Scarpa's fascia, and as it runs superiorly it penetrates through Scarpa's fascia and continues in the superficial subcutaneous tissue. As for the venous drainage of the SIEA flap, it is primarily from two venae comitantes that run alongside the SIEA before terminating into the femoral vein, and from the superficial inferior epigastric vein (SIEV) which terminates into the saphenous bulb. The arterial diameter ranges from 1.1-1.9 millimeters, with an average pedicle length of 5 - 8 cm. The area of the SIEA flap is lower abdomen that it is perfused by the SIEA; however there is some lateral overlap with the superficial circumflex iliac artery (SCIA). The sensory innervation of the SIEA flap is provided by the 10^{th} to 12^{th} intercostal nerves.

According to a 1975 anatomical investigation of the SIEA by Taylor and Daniels, the SIEA was found to be absent in 35 percent of their subjects. In the remaining subjects, the origins of the SIEA were inspected and discovered to be rather inconsistent, with 48 percent sharing a common trunk with the superficial circumflex artery, whereas 17 percent were found to be direct branches off of the common femoral artery. Our early clinical experience with lower abdominal dissection during breast reconstruction surgery confirmed this finding, showing a lack of an identifiable SIEA in 42 percent of our 278 total patients. These results were published along with data from further investigation of the other 58 percent of patients with an identifiable SIEA, which showed that 54 percent of these patients had arteries with external diameters of 1.5 mm or greater when measured at the level of the lower abdominal incision. This is important when considering our selection criteria for the SIEA flap requires such a diameter. Therefore, only 31 percent of all patients in our study had a SIEA sufficient for use in a free flap.

The tissue perfusion and venous drainage from across the midline of a unipedicled SIEA flap has been a topic of great debate in the literature, the main question being reliability. Some studies reveal the perfusion and drainage across the midline to be unpredictable at best, while others have proven that reliable perfusion across the midline in free flap transfer is indeed, quite possible. The amount of tissue that will dependably perfuse across the midline will differ with each patient and should therefore be determined by intraoperative assessment of cross-flap perfusion.

3. Indications for SIEA flap

For breast reconstruction, we believe the lower abdomen is the ideal site for donor tissue. The SIEA flap is preferred; however we will use the DIEP flap if certain conditions are not met. We have developed and previously published an algorithm for choosing the SIEA flap, and a summary of this algorithm will be presented later on in this chapter. Patients who are not eligible for lower abdominal tissue reconstruction will be reconstructed with either a latissimus dorsi flap (with or without an implant), a superior gluteal artery perforator flap (SGAP), or occasionally with a breast implant alone.

4. Contraindications for the SIEA flap

We will avoid use of the SIEA in certain situations that are counterintuitive to flap survival. We do not routinely operate on patients who are active smokers. Patients are

required to quit smoking at least two months prior to surgery and continue to refrain for six weeks after surgery. We will postpone microsurgery on any patient who we believe to be noncompliant with the conditions stated above. Other relative contraindications to our microsurgical reconstruction include BMI greater than 35 kg/m^2, age greater than 65 years, and other medical comorbidities such as a coagulation disorder or uncontrolled diabetes. Finally, we will not use the SIEA flap if the intraoperative criteria of our selection algorithm are not met.

5. Preoperative markings

Vascular imaging may be performed preoperatively to help determine whether or not the diameter of the SIEA is sufficient, as well as to accurately map the path of the vessels. This can be accomplished with contrast enhanced CT scan. Marking begins with the abdominal site while the patient is in the supine position. A pencil Doppler is used to locate and mark the SIEA and its venae commitantes, generally found approximately halfway between the anterior superior iliac spine (ASIS) and the pubic symphysis, slightly superior to the inguinal crease. Second, we mark the SIEV, which is located medial to the SIEA, followed by the arterial and venous periumbilical perforators on both sides of the midline. Next we identify and mark both the medial and lateral row of the deep inferior epigastric perforators. The markings prepare for the possible harvest of both the SIEA flap and the DIEP flap.

It is important to keep in mind when marking the inferior abdominal incision line to keep as low as possible to hopefully encounter the SIEA at an acceptable caliber. If however the SIEA does not meet the 1.5mm diameter required by our algorithm, we then revert to a DIEP flap. Therefore we should be prepared for such a situation by including the periumbilical perforators when designing the flap. The typical dimensions of each SIEA flap is approximately 14 cm vertically and 17 cm from midline to ASIS.

6. Procedural details

To prepare for the procedure, the patient is placed in the supine position, with the arms tucked in to allow for easier microscope positioning over the recipient site. The flap is harvested with Loupe magnification X 5.5, however the microscope is used for the vessel anastomosis. We avoid the use of any vasoconstrictors or local anesthetic at both the donor and recipient sites.

The harvest of the SIEA flap is begun by careful subcutaneous dissection, making sure not to injure the superficially running SIEV. The SIEA and SIEV are then located and dissected away from the adjacent tissue. The size of the SIEA is then examined at the level of the skin incision. There is dual venous drainage, both the SIEV and the venae comitantes of the SIEA, and both are preserved during the dissection.

The algorithm developed and used by our institution for choosing the SIEA flap in breast reconstruction has previously been published. There are three criteria that we use to determine whether the anatomy is suitable for SIEA flap harvest; an arterial vessel diameter that is at least 1.5 millimeters, as well as a visible and a strong palpable pulse. Another key point to note during pedicle dissection is to avoid skeletonizing the vessels. We prefer to

leave a small piece of subcutaneous tissue or fat just deep to the vessels to help protect the vascular pedicle from kinking during inset. Caution should be taken though, since adding too much excess tissue around the pedicle could lead to a lingering, unnecessary seroma formation due to elimination of the lymphatics. The only area of the vessel that should be fully skeletonized is the distal most section, in preparation for the anastomosis.

We generally use the ipsilateral side as our hemi-abdomen of choice for unilateral reconstructions. There are several reasons behind our favor of the ipsilateral flap. The SIEA pedicle enters the abdominal flap on its lateral aspect, so when the flap is rotated (180 degrees) for inset, the pedicle and the recipient internal mammary vessels are much closer together in an ipsilateral flap. Also, the final positioning of an ipsilateral flap leaves the area with the least reliable blood supply on the lateral aspect of the reconstructed breast and not medially, therefore if there is any flap loss it will most likely be laterally as preferred. Suturing of an ipsilateral flap at the previous umbilical excision site will cone the breast at the desired lateral position.

In certain instances in which the caliber of the SIEA is questionable, we will examine the SIEV diameter before making the final call between the SIEA and DIEP flaps. If a substantial SIEV is present, we can presume superficial draining system dominance and we will strongly consider using the SIEA flap, rather than the DIEP flap, in spite of the unimpressive SIEA caliber.

After the SIEA flap has been selected and all aspects of the algorithm are met, the pertinent vessels are dissected and then we proceed with the rest of the flap elevation. The upper incision begins at the lateral termination of the upper incision line marked earlier (generally the ASIS) and continues to approximately 1 cm superior to the umbilicus. This incision is now continued deeply, through the adipose tissue to the loose areolar tissue plane just superficial to the muscular fascia of the abdominal wall. Next, careful elevation of the flap takes place from lateral to medial, using Bovie cautery to ensure that hemostasis is obtained. Complete hemostasis will provide an uncompromised view of the correct surgical planes and help to prevent any unwanted fascial incision. After that, the umbilicus is dissected away from the adjacent flap tissue. Avoid skeletonization of the umbilical stalk to ensure that enough blood supply is maintained with the umbilical stalk.

For bilateral reconstruction, we will complete the anastomosis of the first flap, before addressing the superficial inferior epigastric artery and vein of the second hemi-abdomen. The caliber of the vessels is evaluated, as earlier, and the algorithm is used once again to decide if the SIEA is the appropriate flap.

When the flap elevation is complete but the pedicle is still attached, we mark the superficial aspect of the pedicle for future use. Next, the flap edges are brought back together and stapled, and finally the mastectomy defects are addressed.

In almost all of our reconstructive cases the internal mammary vessels are the recipient vessels of choice. The dissection site will be either the second or third intercostal space, chosen based on the palpated width of the intercostal space. We may occasionally widen the intercostal space by resecting part of the rib costochondrium using a rongeur, although this is rarely necessary. After that, a small window is excised from the pectoralis muscle, and the intercostal muscles are then carefully resected for access to the internal mammary artery and vein. Next,

the artery and vein are prepared for microanastomosis using Loupe magnification. We now compare the diameter of the recipient vessel, the IMA to the SIEA. If there is an arterial size discrepancy greater than 0.5mm between the recipient vessel and the SIEA, we will most likely consider reverting to a DIEP flap. For optimal exposure of the internal mammary vessels for anastomosis, the mastectomy skin should be carefully retracted. Next, the internal mammary vessels are prepared for anastomosis under the microscopic.

When the internal mammary vessels are ready, the SIEA, its venae commitantes, and the SIEV are ligated from the donor site. As mentioned earlier, the flap is rotated 180 degrees to properly position the pedicle for anastomosis. The coupler device is usually used for the venous anastomosis and 9-0 suture for the arterial anastomosis.

We prefer to use the venae commitantes (proximal to where they unite) instead of the SIEV that actually exits the flap separately. The similar caliber as well as the desirable proximity of the venae commitantes, which course alongside the SIEA, make these vessels more favorable and in our experience have shown lower risk of complication from vessel kinking when compared to utilization of the SIEV. As a result, we only tend to use the SIEV for cases in which the venae comitantes are insufficient or if a second venous anastomosis is needed.

Before closure of the donor site skin, we address any diastasis recti found intra-operatively by plicating the rectus fascia. The umbilicus is delivered, and sutured in place using 3-0 and 4-0 interrupted Monocryl sutures. Two 15F Blake drains placed in the lateral edge of the donor site defect before the abdomen closed in layers. The Scarpa's fascia is closed with interrupted 2-0 Monocryl sutures, followed by deep subcutaneous interrupted 3-0 Monocryl sutures, and finally a running subcuticular 4-0 Monocryl. The approximated edges of the skin are now sealed with liquid skin adhesive, and a dry dressing is placed on top.

7. Pitfalls

7.1 Crossing the midline in SIEA flaps

Tissue harvest across the midline involves resecting all of zone IV, as well as any inadequately perfused zone III tissue. The amount of remaining tissue across the midline that is satisfactorily perfused varies from patient to patient.

Visually delineate the zone of inadequate perfusion and mark the line of proposed resection on the flap skin. Most of the time, an obvious line of demarcation will appear on the flap skin. A more accurate estimate of flap perfusion can be achieved while the flap is still attached to the vessels at the abdominal site, compared to evaluating a reperfused flap following anastomosis, as it takes time for the true line of demarcation to appear on a recently reperfused flap. After the anastomosis is complete and the planned resection markings are reevaluated, some excess flap tissue will be excised.

7.2 Flap inset and the SIEA pedicle

The orientation is key when handling the final inset of the SIEA flap. The anatomy of the SIEA pedicle is very distinctive. In perforator based abdominal flaps the pedicle enters the flap from beneath, however the SIEA pedicle enters horizontally from the flap's inferior edge at the superficial subcutaneous tissue. The primary recipient vessels are the internal mammary vessels, found within the intercostal space. The recipient vessels are better

positioned for abdominal perforator flaps. With pedicles on the underside of the flap, the vessels are less likely to kink along their course to the anastomosis. The pedicle of the SIEA flap travels from a more superficial plane to a deeper one, making it more vulnerable to vascular compromise from kinking, compression or malrotation.

7.3 Persistent donor site seromas after flap harvest

Abdominal drains usually remain in place longer in SIEA patients than with perforator flaps. This is most likely due to the more extensive dissection into the groin area and possible disruption of additional lymphatic channels. We remove the drains only when drainage is less than 25cc per day.

8. References

Arnez, Z. M., Khan, U., Pogorelec, D., and Planinsek, F. Breast reconstruction using the free superficial inferior epigastric artery (SIEA) flap. *Br. J. Plast. Surg.* 1999;52: 276-79.

Antia NH, Buch VI. Transfer of an abdominal dermo-fat graft by direct anastomosis of blood vessels. Br. J.Plast. Surg. 1971;24: 15- 9.

Chevray PM. Breast reconstruction with superficial inferior epigastric artery flaps: a prospective comparison with TRAM and DIEP flaps. Plast. Reconstr. Surg. 2004;114:1077-83.

Granzow JW, Levine JL, Chiu ES, Allen RJ. Breast reconstruction using perforator flaps. J Surg Oncol. 2006;94:441-54.

Grotting JC. The free abdominoplasty flap for immediate breast reconstruction. Ann. Plast. Surg. 1991;27: 351-4.

Hester TR Jr, Nahai F, Beegle PE, Bostwick J. Blood supply of the abdomen revisited, with emphasis on the superficial inferior epigastric artery. Plast. Reconstr. Surg. 1984;4:657-70.

Holm C, Mayr M, Ho¨fter E, Ninkovic M. The versatility of the SIEA flap: a clinical assessment of the vascular territory of the superficial epigastric inferior artery. J Plast Reconstr Aesthet Surg. 2007;60:946-51.

Holmström H. The free abdominoplasty flap and its use in breast reconstruction. An experimental study and clinical case report. Scand J Plast Reconstr Surg. 1979;13:423-27.

Reardon CM, O'Ceallaigh S, O'Sullivan ST. An anatomical study of the superficial inferior epigastric vessels in humans. Br J Plast Surg. 2004;57:515-19.

Schaverien M, Saint-Cyr M, Arbique G, Brown SA. Arterial and venous anatomies of the deep inferior epigastric perforator and superficial inferior epigastric artery flaps. Plast Reconstr Surg. 2008;121:1909-19.

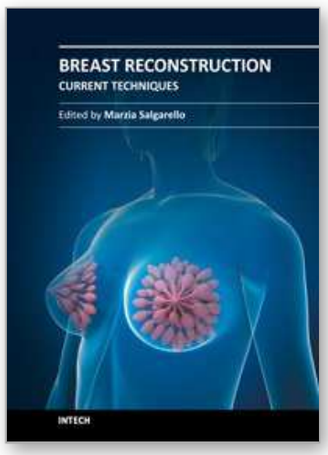
Spiegel AJ, Khan FN. An Intraoperative algorithm for use of the SIEA flap for breast reconstruction. Plast Reconstr Surg. 2007;120:1450-9.

Stern HS, Nahai F. The versatile superficial inferior epigastric artery free flap. Br J Plast Surg. 1992;45:270-74.

Taylor GI, Daniel RK. The anatomy of several free flap donor sites. Plast Reconstr Surg. 1975;56:243-53.

Ulusal BG, Cheng MH, Wei FC, Ho-Asjoe M, Song D. Breast reconstruction using the entire transverse abdominal adipocutaneous flap based on unilateral superficial or deep inferior epigastric vessels. Plast Reconstr Surg. 2006;117:1395-403.

Volpe AG, Rothkopf DM, Walton RL. The versatile superficial inferior epigastric flap for breast reconstruction. Ann Plast Surg. 1994;32:113-17.



Breast Reconstruction - Current Techniques

Edited by Prof. Marzia Salgarello

ISBN 978-953-307-982-0
Hard cover, 276 pages
Publisher InTech
Published online 03, February, 2012
Published in print edition February, 2012

Breast reconstruction is a fascinating and complex field which combines reconstructive and aesthetic principles in the search for the best results possible. The goal of breast reconstruction is to restore the appearance of the breast and to improve a woman's psychological health after cancer treatment. Successful breast reconstruction requires a clear understanding of reconstructive operative techniques and a thorough knowledge of breast aesthetic principles. Edited by Marzia Salgarello, and including contributions from respected reconstructive breast plastic surgeons from around the world, this book focuses on the main current techniques in breast reconstruction and also gives some insight into specific topics. The text consists of five sections, of which the first focuses on the oncologic aspect of breast reconstruction. Section two covers prosthetic breast reconstruction, section three is dedicated to autogenous breast reconstruction, and section four analyzes breast reconstruction with a fat graft. Finally, section five covers the current approaches to breast reshaping after conservative treatment.

How to reference

In order to correctly reference this scholarly work, feel free to copy and paste the following:

Zachary Menn and Aldona Spiegel (2012). The Superficial Inferior Epigastric Artery (SIEA) Flap and Its Applications in Breast Reconstruction, Breast Reconstruction - Current Techniques, Prof. Marzia Salgarello (Ed.), ISBN: 978-953-307-982-0, InTech, Available from: http://www.intechopen.com/books/breast-reconstruction-current-techniques/the-siea-flap-and-its-applications-in-breast-reconstruction

INTECH
open science | open minds

InTech Europe
University Campus STeP Ri
Slavka Krautzeka 83/A
51000 Rijeka, Croatia
Phone: +385 (51) 770 447
Fax: +385 (51) 686 166
www.intechopen.com

InTech China
Unit 405, Office Block, Hotel Equatorial Shanghai
No.65, Yan An Road (West), Shanghai, 200040, China
中国上海市延安西路65号上海国际贵都大饭店办公楼405单元
Phone: +86-21-62489820
Fax: +86-21-62489821

© 2012 The Author(s). Licensee IntechOpen. This is an open access article distributed under the terms of the Creative Commons Attribution 3.0 License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

IntechOpen

IntechOpen