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ROCHESTER INSTITUTE OF TECHNOLOGY

A Thesis Submitted to the Faculty of
The College Of Health Sciences & Technology

Medical Illustration

In Candidacy for the Degree of

MASTER OF FINE ARTS

in

Medical Illustration

The Transverse Musculocutaneous Gracilis Flap for Breast Reconstruction

Educational Illustration Series

by

Ryan Steenberg

August 16, 2016

**The Transverse Musculocutaneous Gracilis Flap for Breast Reconstruction
Educational Illustration Series**

By

Ryan Steenberg

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Abstract

Advancements in medicine have allowed surgeons a menu of options in post-mastectomy breast reconstruction. A conundrum exists, however, in flap selection when faced with varying patient body types. In the case of the athletic patient who does not have the appropriate amount of donor site tissue to warrant a Transverse Rectus Abdominus Musculocutaneuos Flap (TRAM) the Transverse Musculocutaneous Gracilis Flap (TMG) is an appropriate alternative due to its functional and aesthetic benefits. An intricate and timely process, the TMG procedure can be difficult to understand for the layperson. Therefore, a need for a condensed and standardized description exists. By breaking the process down and illustrating the procedure one can effectively deliver the information for use across all realms of publication and education.

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I. Introduction

In developing an effective thesis project and expanding on personal interests in traditional two-dimensional illustration, I began to explore opportunities involving the development of a patient educational exhibit. Approaching Dr. Stephen Vega, a pioneer in breast reconstruction via free flap reconstruction, a need for a pictorial explanation of the transverse musculocutaneous gracilis (TMG) flap procedure was apparent. The parameters of the project included an exhibit that would illustrate and simplify a rather complicated and extravagant surgical procedure into steps a layperson would understand. The challenge was to illustrate and explain a tremendous amount of information within the artwork that would capture the surgical essence of the procedure, as well as, soften a rather intense and emotional process. A logical and methodical approach to developing the exhibit was undertaken as surgical observation, photography, drafting, and digital illustrations were involved. Quick decision-making and a patient's perspective were important in developing an effective end result. The final result included two thirty-by-forty inch exhibits that condensed over six hours of surgical procedures into thirteen understandable surgical illustrations.

While implant-based reconstruction is the most widely utilized type of breast reconstruction post-mastectomy, publications have stated that autologous tissue yields a more desirable aesthetic result (Vega, 2009).

Reconstruction with autologous tissue is for those patients who require pre- or post-operative radiation therapy, correction of a failed implant reconstruction, or those who simply reject the idea of receiving implant reconstruction. The first reports of the possibilities of using

free flap or pedicled abdominal tissue for post mastectomy reconstruction were introduced to the medical community in 1979 by Holmstrom and Hartrampf et al. in 1982 (Schoeller, 2007). Since its inception significant efforts have been undertaken to improve on the donor site and optimize the reconstruction result. Although it was accepted by the medical community as a viable option for breast reconstruction it still only accounted for less than a quarter of the procedures performed in 2006 (Buntic, 2011). Reasons are unknown but it can be speculated that due to the complexity of the microsurgery in a free deep inferior epigastric perforator (DIEP) flap and the technical difficulty of the flap harvest the DIEP was not a desirable option for most surgeons (Rudolf 2011). A more sophisticated procedure the paraumbilical perforator flap yielded a desirable outcome in the preservation of the rectus abdominus muscle. This led to the development of the lower abdominal inferior epigastric artery perforator flap that left the function of the rectus abdominus intact (Schoeller, 2007). The only drawback to these previous procedures was that they left a visible scar at the base of the abdomen, numbness surrounding the umbilicus, and significant discussions linked to the inconsistencies in abdominal wall morbidity, as well as, pedicle availability.

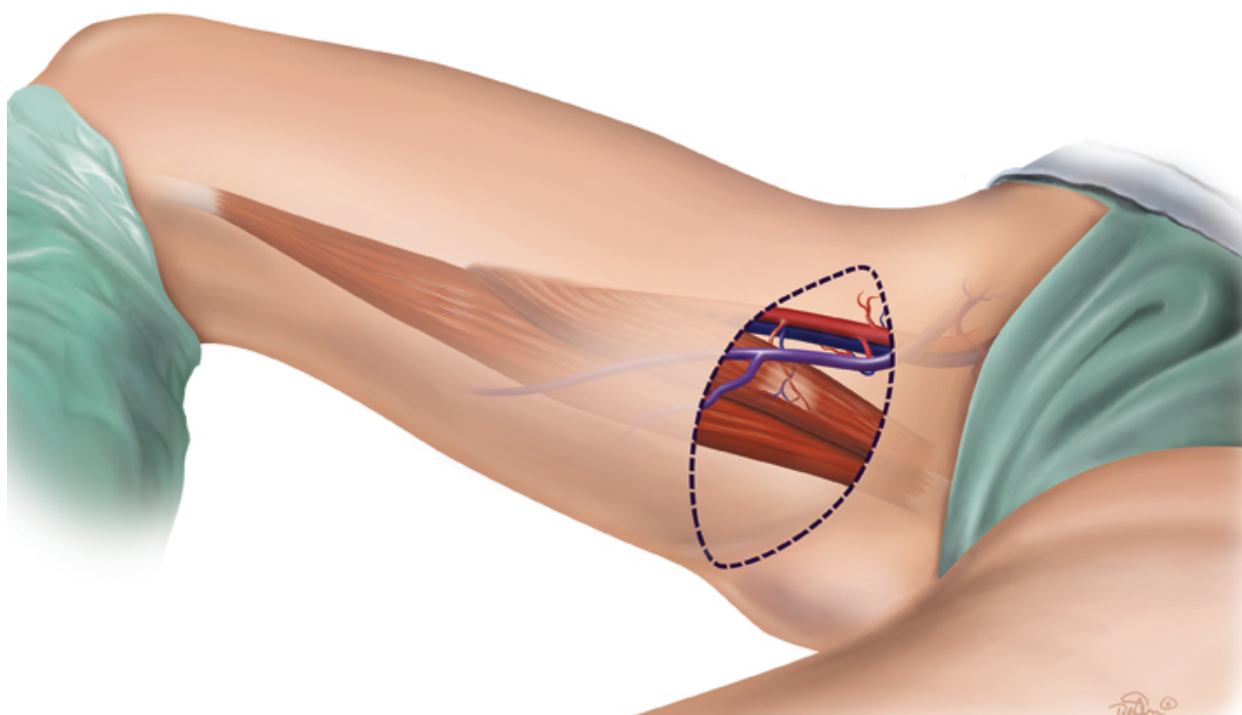
Furthermore, a challenge exists when dealing with an athlete or thinner patient in utilizing the TRAM flap due the absence of sufficient abdominal tissue at the donor site. Therefore, alternative sources of tissue need to be examined. Options exist in the extended latissimus flap, as well as the Superior Gluteal Artery Perforator Flap (SGAP) and the Inferior Gluteal Artery Perforator Flap (IGAP). However, significant scarring and abilities to affect athletic performance in more athletic patients exist (Vega, 2009). The Gluteal flaps have short pedicles and are arranged in such a way that a patient shift is needed duration the operation, as

well as, cause a cosmetic deformity of the donor site. The tissues of these flaps are often firmer and are more difficult to mold into a supple natural breast mound (Vega, 2009).

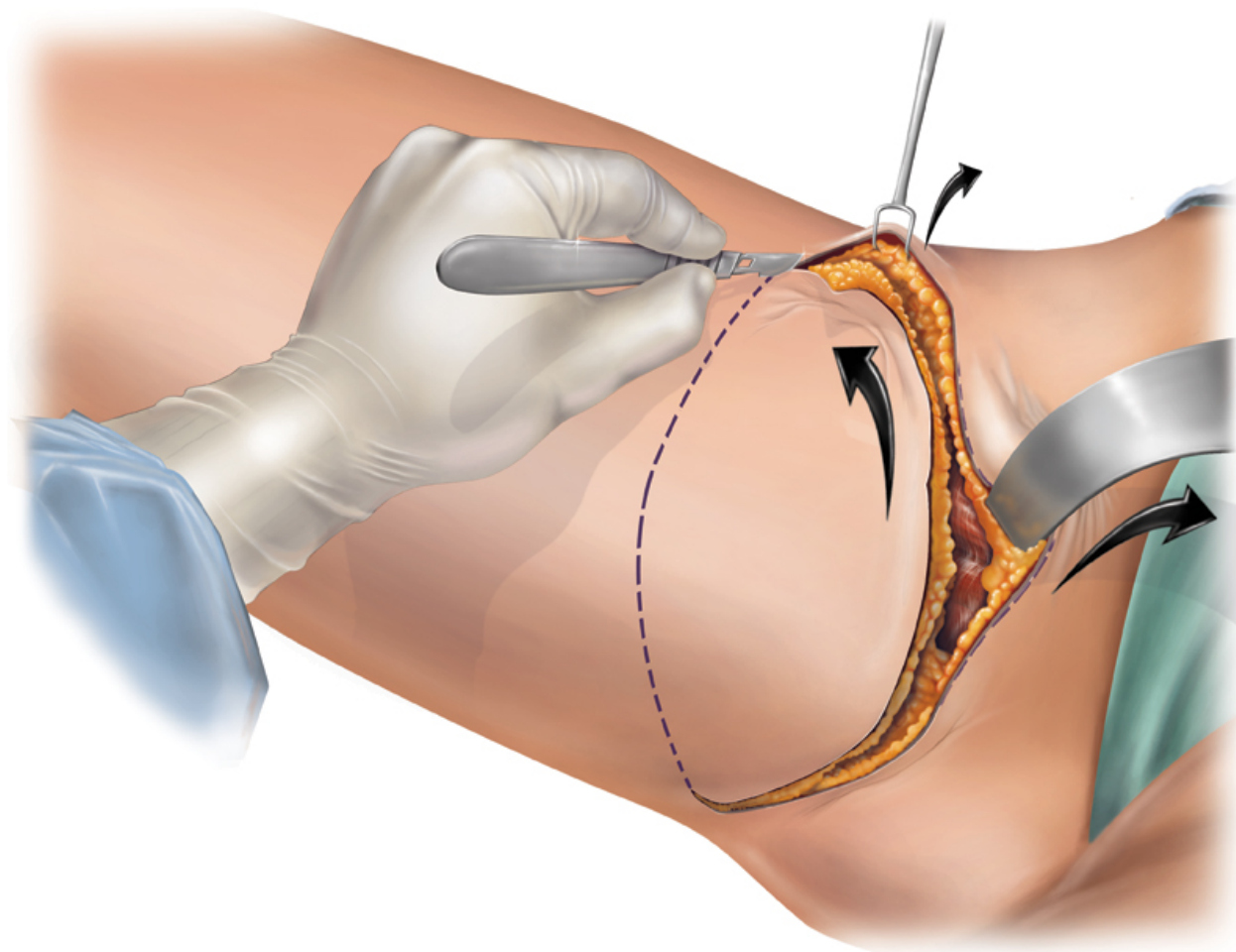
The end result yields the Gracilis Musculocutaneous Flap as the best choice for thinner and more athletic patients. Even though the donor site does not yield a significant amount of tissue, the properties of the tissues are desirable to provide a natural breast mound in 3 ways: First donor site tissue allows for a more natural and straightforward coning of the breast mound due to versatility in paddle shape construction. Second, adequate projection and proper dimensions allow for immediate nipple-aerola complex reconstruction, which negates the need for secondary surgeries. Third, inner thigh skin carries a darker pigment than that of chest skin where when puckered correctly becomes even darker. This color variance allows for a much more natural looking aerola than that of a post-op tattoo. Finally the donor site also provides a concealed scar hidden within the groin crease providing for a more aesthetic result upon recovery (Buntic, 2011).

II. Surgical Technique

In the operating room the patient is placed in the lithotomy position with the knee flexed and the hip externally rotated. After determining the amount of skin and tissue needed, an adequate skin paddle is marked oriented transversely to the adductor longus and gracilis muscles (Figure 1-1).

Figure 1-1

A pinch technique is utilized to measure the width of the paddle to ensure a tension-free closure. While palpating the tendon of the adductor longus muscle, an incision is made close to the groin and the raising of the adipocutaneous portion of the skin paddle commences moving toward the dorsal tip of the skin paddle (Figure 1-2).

Figure 1-2

At this point the first view of the vascular pedicle can be seen. The leg is then flexed as the posterior tip of the flap is incised down to the level of the musculature spanning into the gluteal fold. The skin paddle is then freed from the fascia overlying the gracilis muscle at the caudal border of the flap (Figure 1-3). The saphenous vein running parallel with the adductor longus muscle is located and retracted. A posterior branch of this vessel, which is almost

uniformly present, is included within the flap for secondary drainage (Vega, 2009) (Figure 1-4). Superior to the plane of the adductor longus muscle and the adductor magnus muscle an assistant with a retractor aids in the exposure of the vascular pedicle. Remaining within their investing fascia, a gracilis artery and communicating vein are dissected down to the level of the deep profunda system of the upper leg. The nerve accompanying the vascular pedicle is sacrificed as Dr. Vega and his team elected not to neurotize their flaps (Vega, 2009).

Figure 1-3

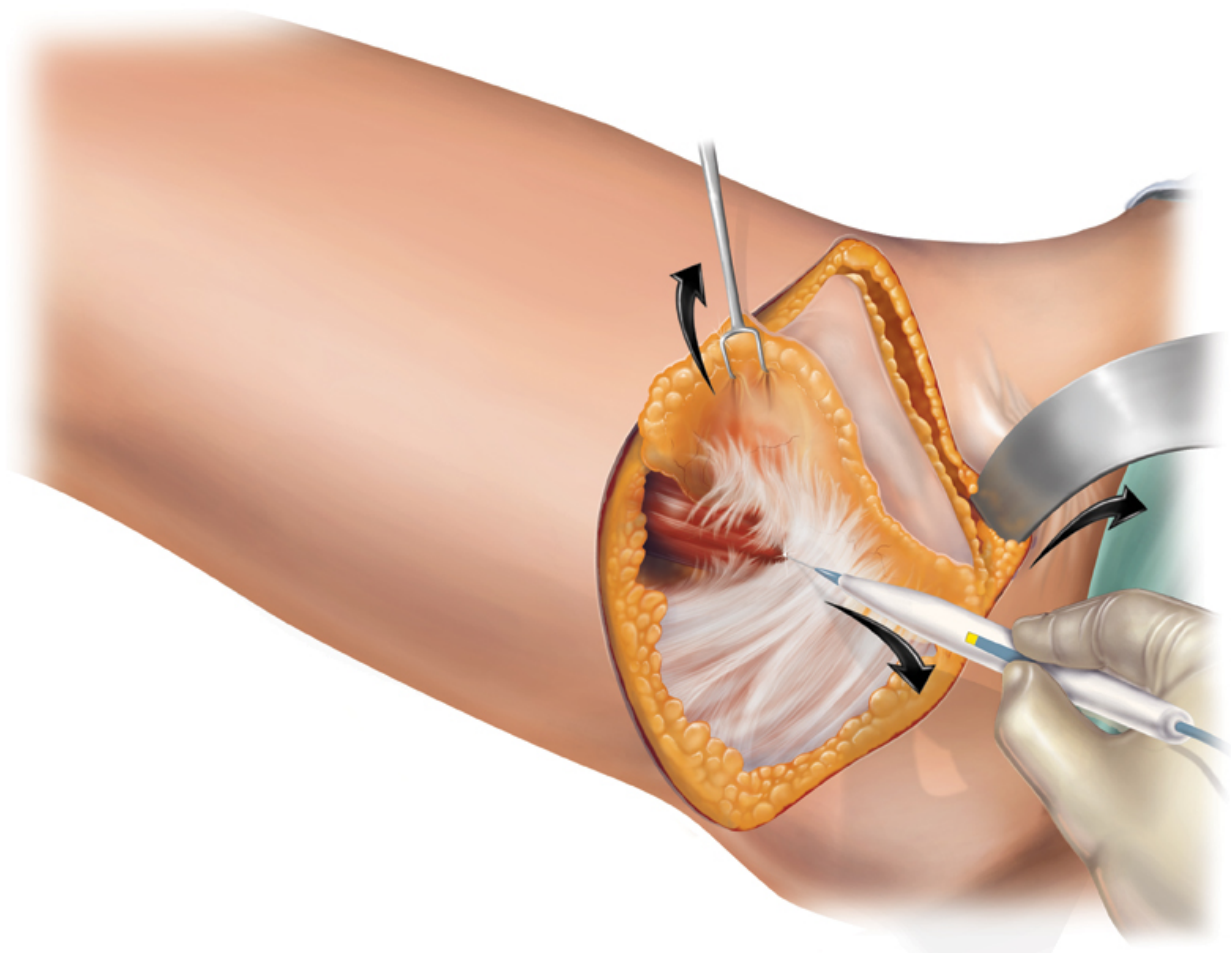
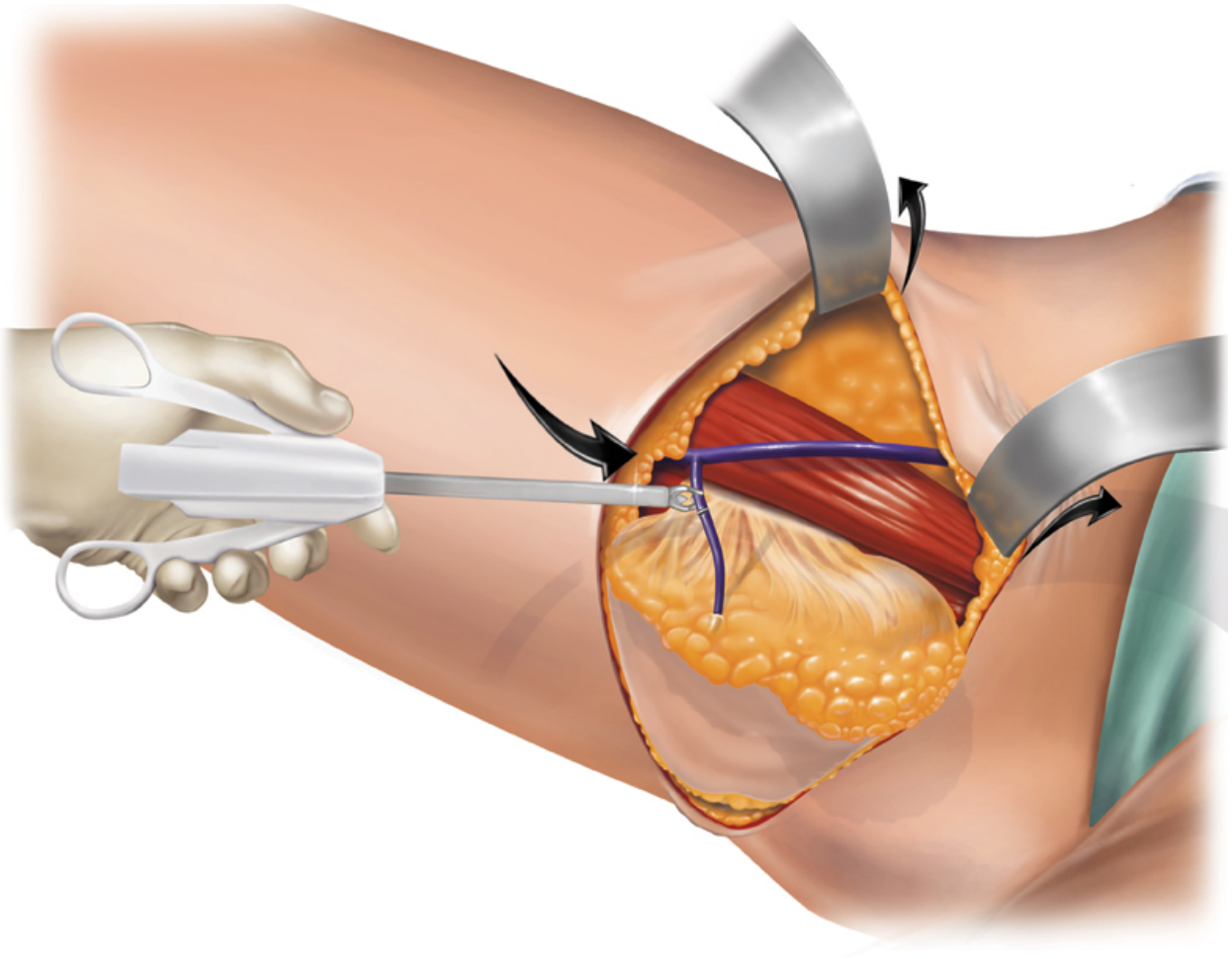
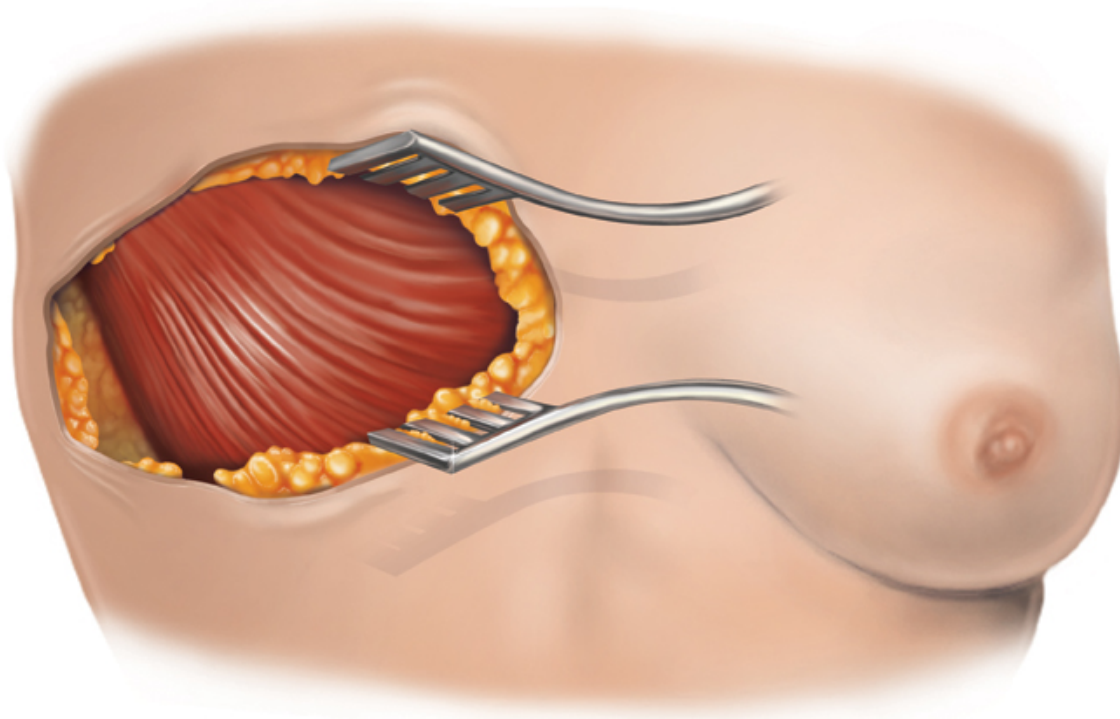


Figure 1-4

Once the skin paddle and vascular pedicles have been dissected, the surgeon moves to the site of the mastectomy to dissect the recipient vessels at the level of the third or fourth interspace (Figure 2-1).

Figure 2-1

The fourth interspace is preferred as it allows for an agreeing size match between donor and recipient vessels (Figure 2-2). The cartilage of the third or fourth rib is resected exposing the internal mammary artery and vein (Figure 2-3). The flap is not transected and transferred until the integrity of the recipient vessels have been established by the surgeon. In this case a viable inflow and outflow must be present in order to produce viable vascularized flap.

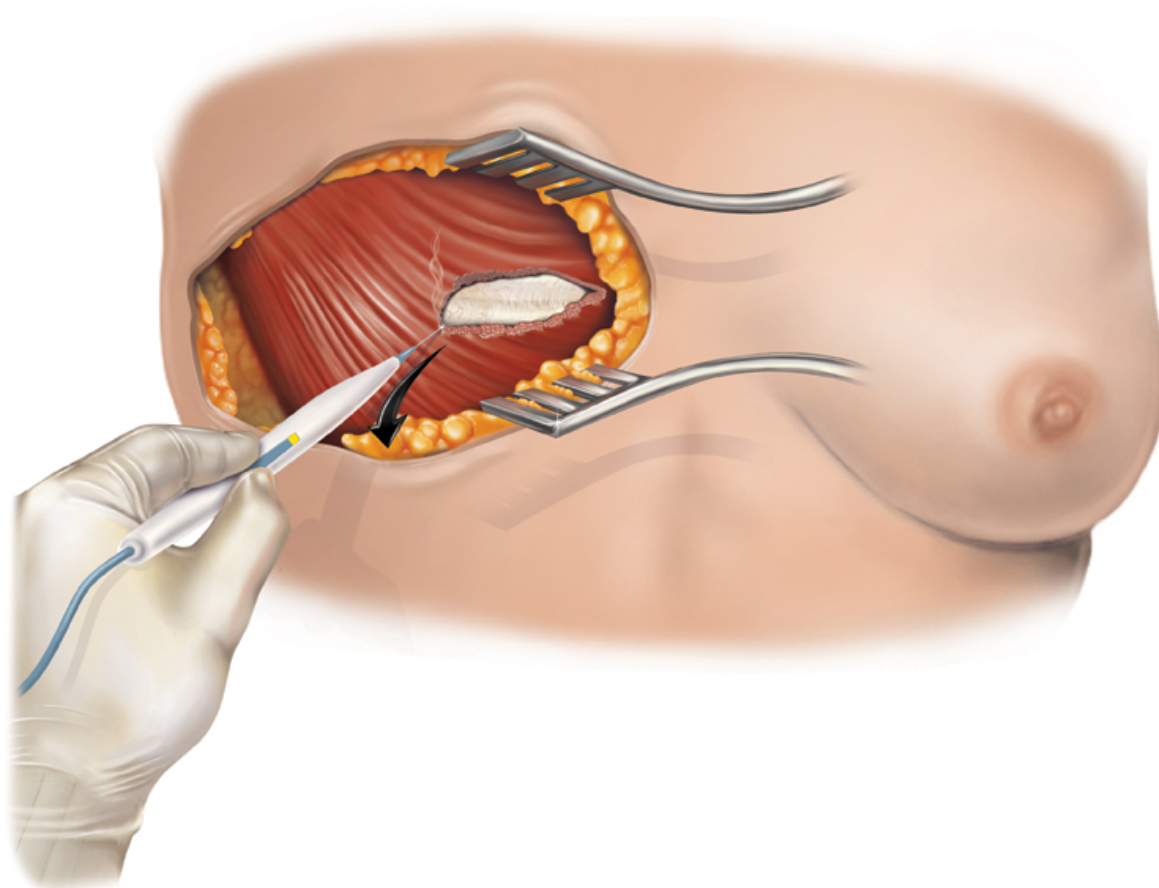
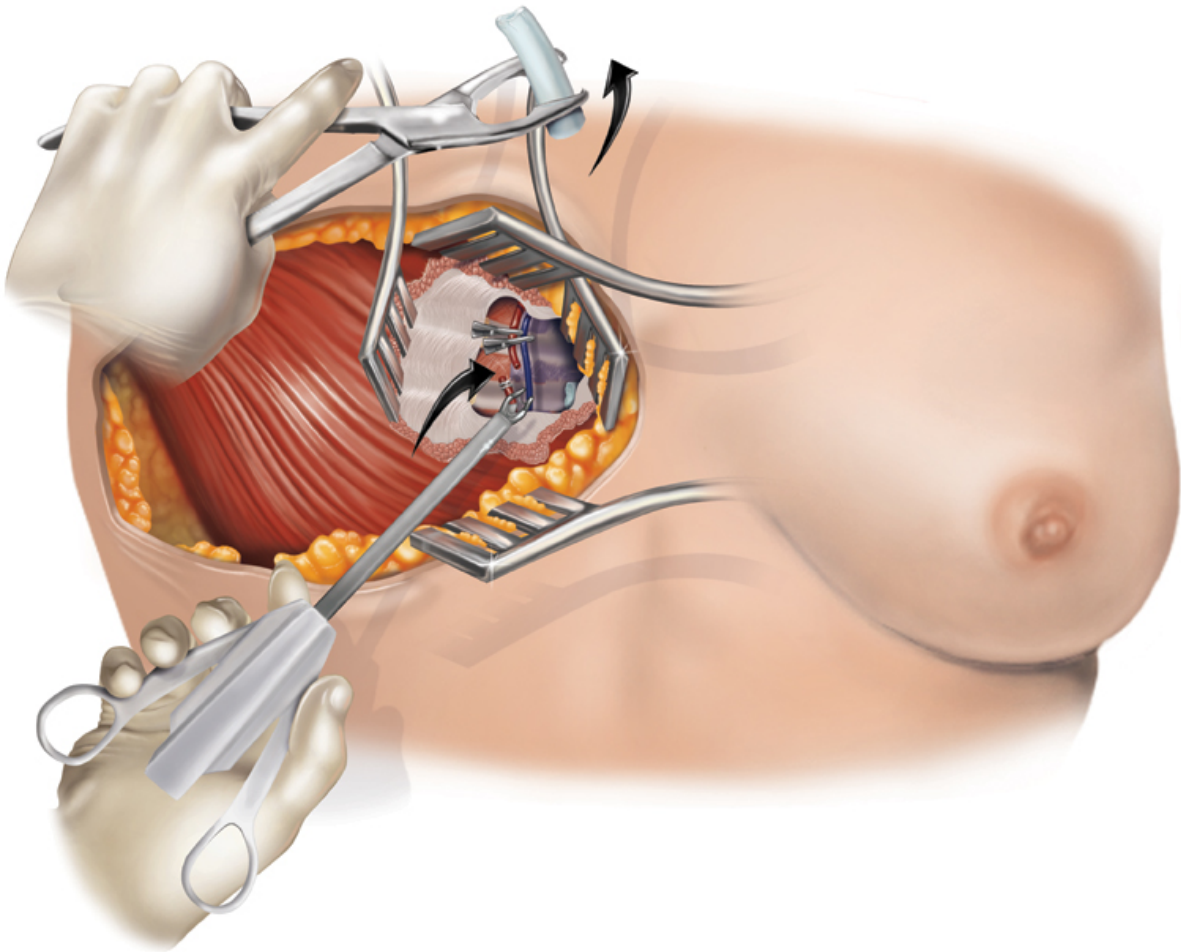
Figure 2-2

Figure 2-3

Once the recipient site is ready, the surgeon moves back to the donor site and ligates the vascular pedicle from the deep femoris artery and vein (Figure 1-5). An incision is made at the distal end of the musculotendinous junction of the gracilis muscle where it is identified and transected. This allows the surgeon to retrieve as much muscle as possible without further extending the existing incision (Figure 1-6). The gracilis is then transected from its origin and the

flap is freed where it is transferred to the chest wall and temporarily secured awaiting anastomosis.

Figure 1-5

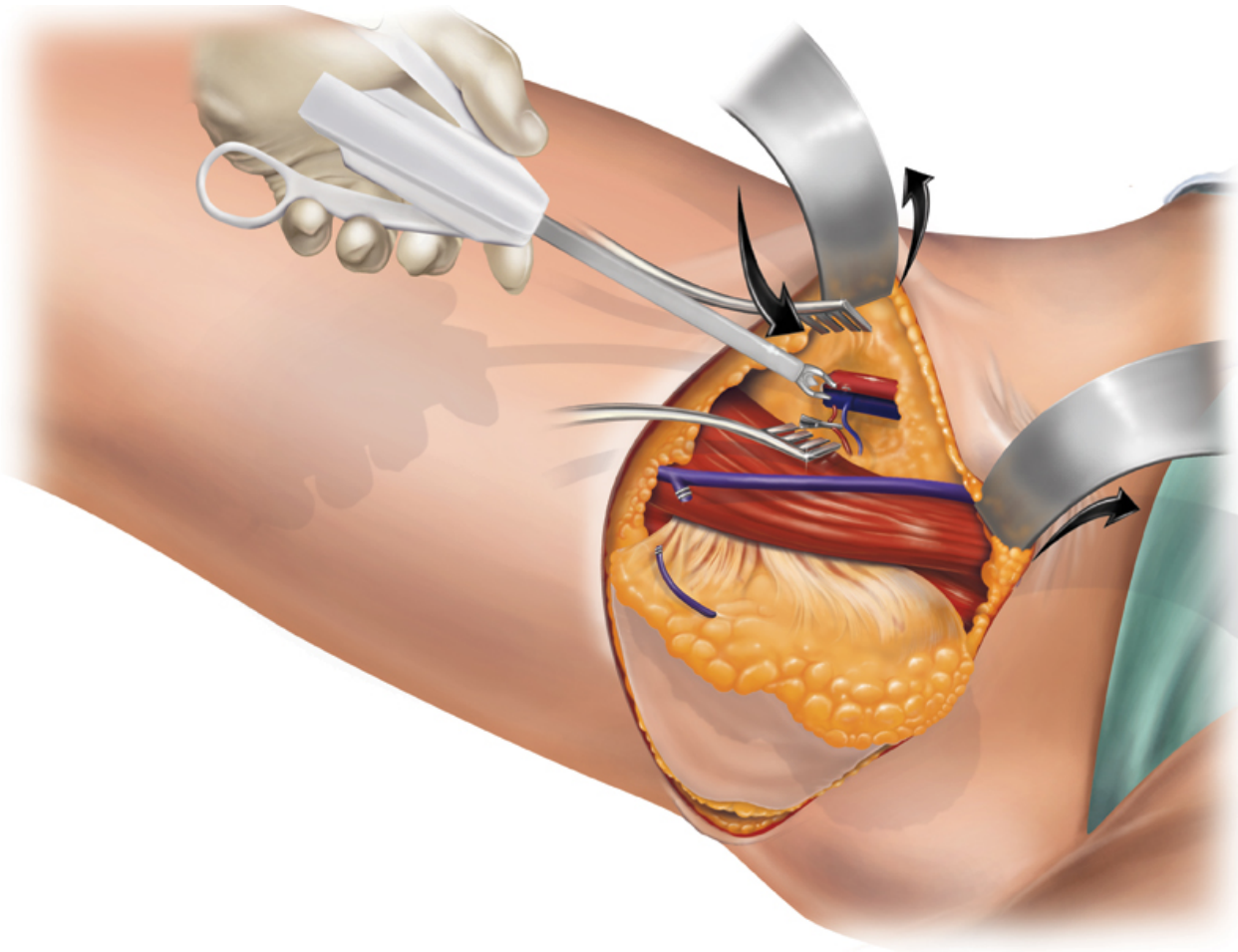
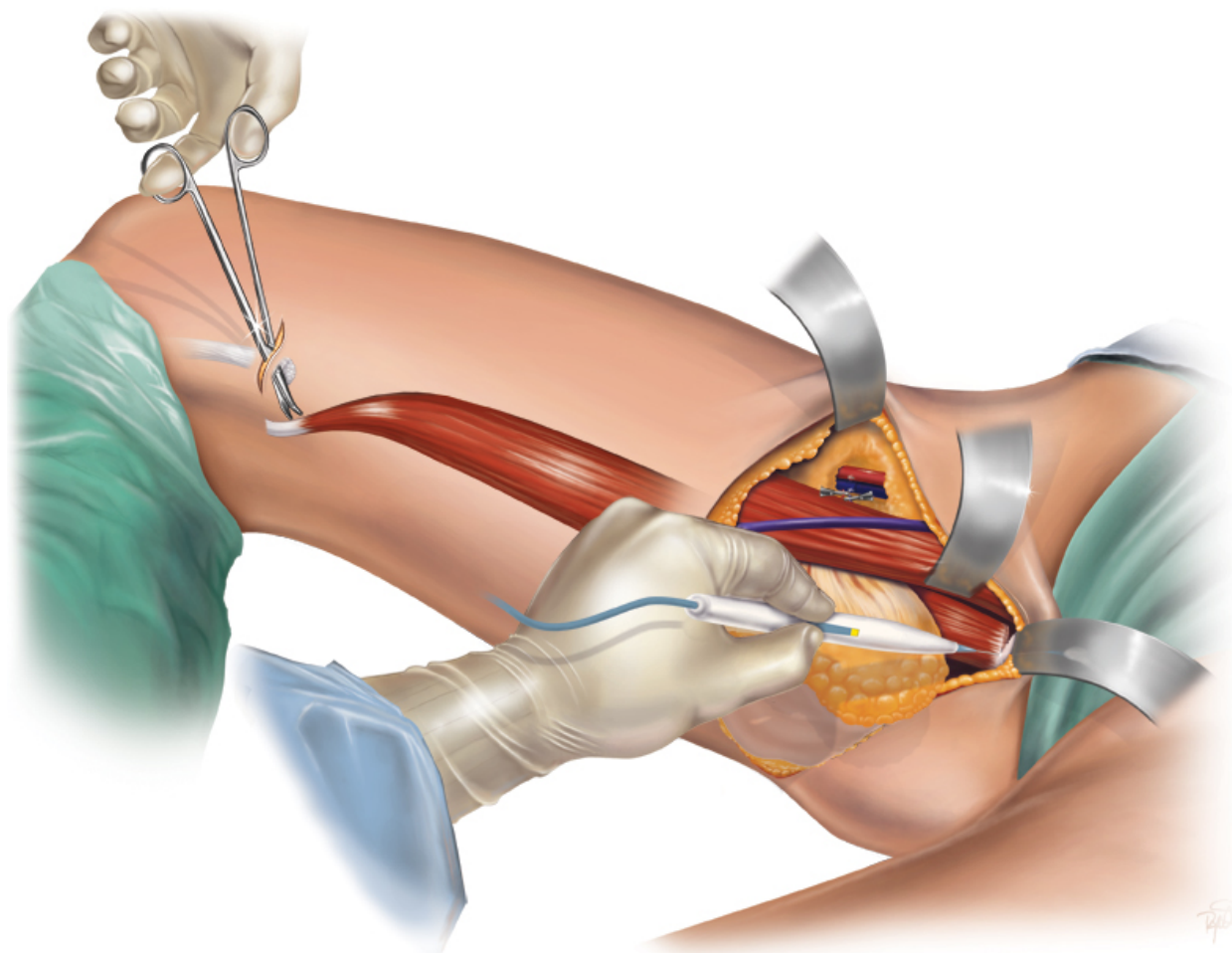


Figure 1-6

A venous coupler is utilized for the joining of the veins while the artery is sutured with 9-0 nylon (Figure 2-4). Once the recipient vessels are joined with the donor vessels, the flap is left to allow for adequate blood perfusion while the donor site at the upper leg is closed with a running barbed Quill suture (Figure 1-7).

Figure 2-4

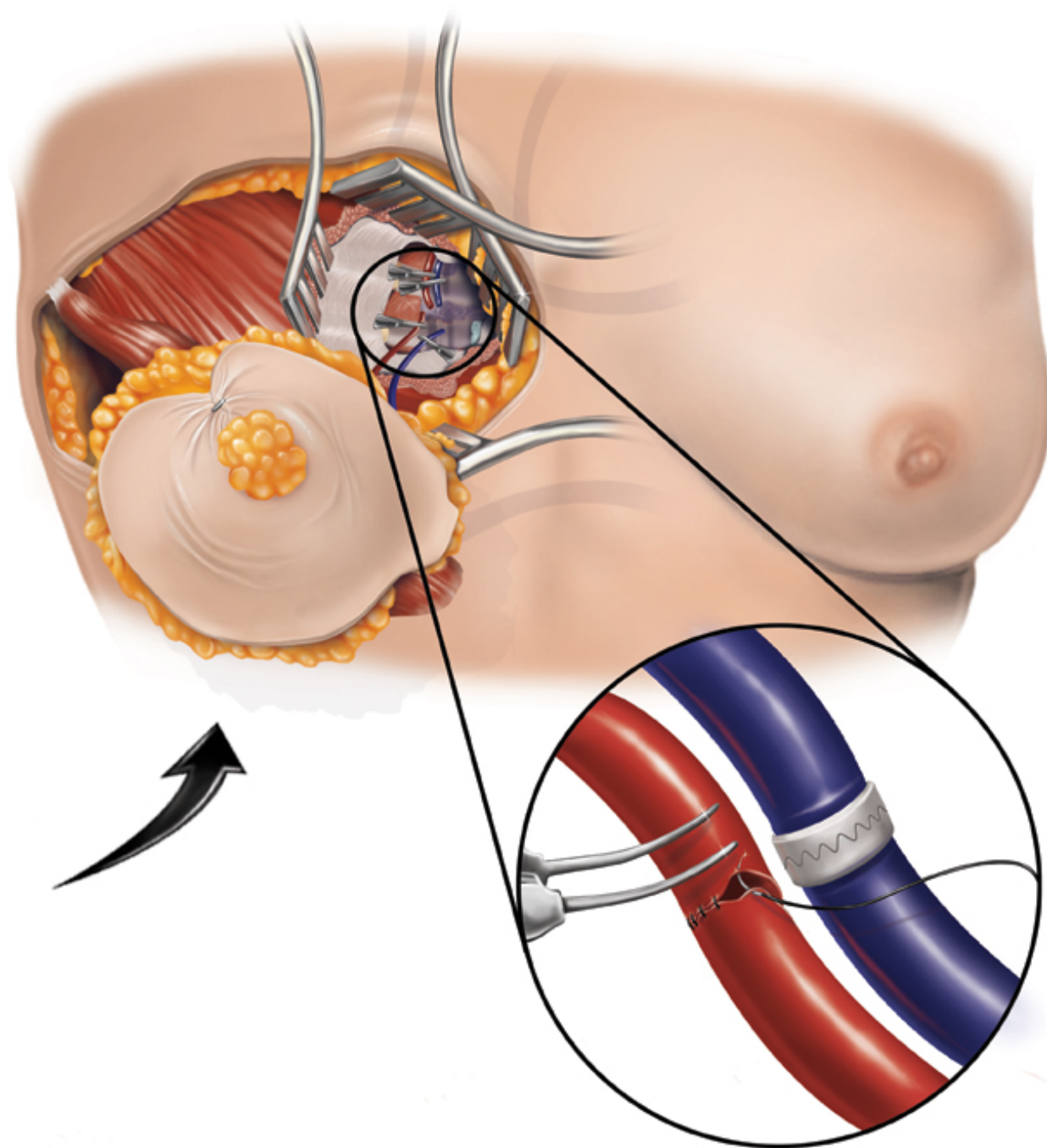
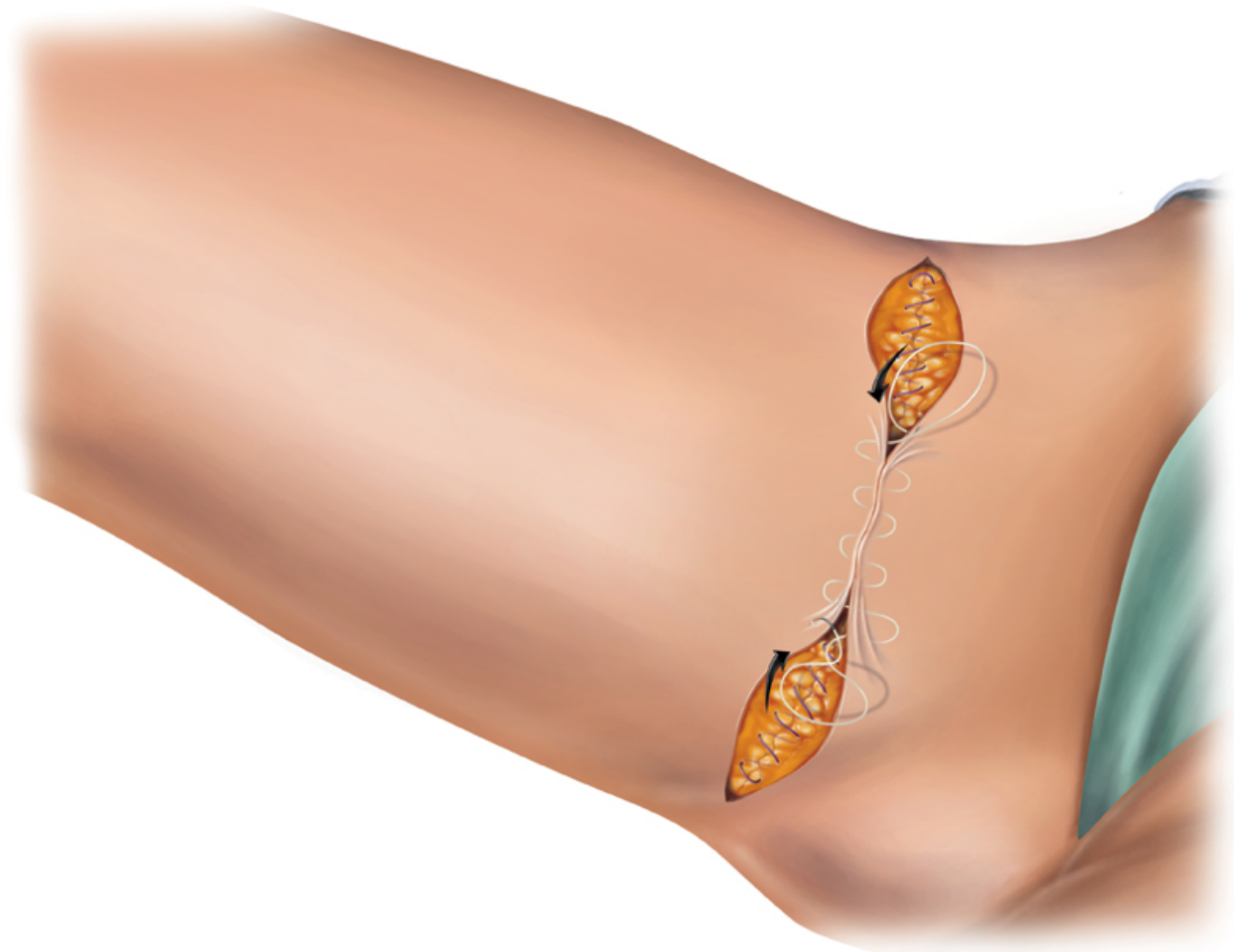
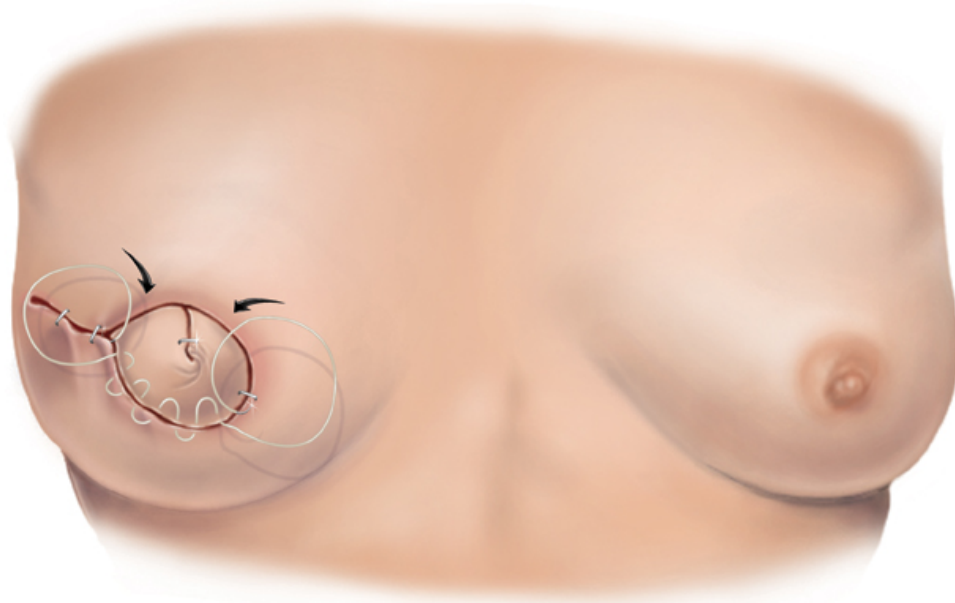


Figure 1-7

Once the flap has displayed adequate blood perfusion, it can be laid within the thorax for reconstruction of the breast mound. The flap is secured to the fascia of the pectoralis major to fashion the breast mound medially. This allows for proper configuration of the vessels for prevention of vessel kinks or twisting that precipitate threatening clotting states. The mastectomy flaps are elevated and draped over the now secured breast mound, stapled into place, and sutured once again utilizing the quill suture (Figure 2-5).

Figure 2-5

III. Methods

Investigating possible opportunities for a thesis I based my decision on a couple of factors. Up to this point, much of my artistic attention has been paid towards the realm of two-dimensional illustration. With little desire to pursue three-dimensional media, I made the decision to take a traditional two-dimensional approach in exhibiting my thesis project as digital paintings, which allowed for a multitude of different uses. I soon discovered that Dr. Vega and his team were in need of such a project to help illustrate and educate their patients on free flap breast reconstruction. These illustrations would accompany an article written by Dr. Vega and

published by the *Journal of Plastic and Reconstructive Surgery*, as well as allow for web-based patient education within Dr. Vega's personal business website.

Free Flap Breast Reconstruction via autologous tissue is a complicated and involved procedure that spans five to six hours in the operating room. During that allotted operating time the surgeon performs a multitude of different tasks on the patient. Like an artist working a whole canvas at once, the surgeon frequently jumps from one point of the patient to another. Any layperson trying to observe this procedure would find it very difficult to follow. The challenge at hand was to take such a complicated situation and break it down into ten to twelve easy-to-follow steps that a pre- or post-operative patient could observe and understand without having to decipher medical literature or terminology.

To solve this problem, I decided that the best and most efficient way to convey this information was to create digital paintings from direct surgical observation that would highlight the important aspects of the procedure for the patient. These included: donor site flap shape, incision through dissection, as well as recipient site dissection through inset of the new breast. Twenty hours of direct surgical observation were spent in studying the procedure, as well as Dr. Vega's surgical techniques. Understanding instrumentation and equipment was essential as I was to illustrate the actions of these instruments in my presentation. Direct surgical photography was utilized to capture the important steps of the procedure for artistic reference during developmental and final rendering. Photographs were very helpful in providing an authentic reference for tissue identification, pigment, and dynamics. A sketchbook was utilized to capture surgeon position relative to the patient and intra-operative hand positions.

Comfortable with the surgical content, the next step led me to create final sketches sequentially portraying desirable steps of the procedure. It was important to view each illustration from the patient's perspective. With a lack of direct medical knowledge, each illustration had to be simple enough for the layperson to understand but retain enough information to explain certain anatomical aspects of the surgery.

In finalizing each sketch, a problem of readability surfaced. With a goal in mind to describe the procedure verbatim it dawned on me that the patient might become confused if the illustrations portrayed a jump from the medial thigh to the thorax and back again in the middle of the sequence. The question of perspective also arose as surgical perspective of the thorax might confuse the reader due to the lack of information present to distinguish what is being viewed. The final decision was to focus on each portion of the procedure as its own sequence: one showing the medial thigh from orientation to closure and another showing the thorax, post-mastectomy, from incision, flap inset, to closure. This would place some responsibility with the surgeon to explain this process but viewing the sequence on the stance of viewer understandability it made sense. To alleviate the issues surrounding the perspective of the thorax, I decided to illustrate the sequence from an anatomical anterior view displaying the patient native left breast for reference. This allows the viewer to retain enough information from the illustrations in understanding where on the body the surgical action is taking place.

Final renderings of the illustrations took place within Adobe Photoshop CS3 with scanned sketches as a template. The digital paintings took four to five hours to complete a piece.

The final exhibit was to be displayed on two thirty-by-forty inch boards set on foam core. The medial thigh procedure was placed on the first board (Figure 3-1) while flap inset in the thorax was placed on the second board (Figure 3-2). The exhibits were to be hung side-by-side with readability from viewer left to right. The final layout was done in Adobe InDesign CS3.

Attention was emphasized on the artwork therefore the layout was simplified. I did not include many design elements, as they would have distracted the viewer's attention from the information within the artwork. Keeping the text to a minimum, I included leader lines identifying each anatomical structure. Minimal text in this case was the best option to allow for the artwork to describe the surgical procedure to the viewer.

Figure 3-1

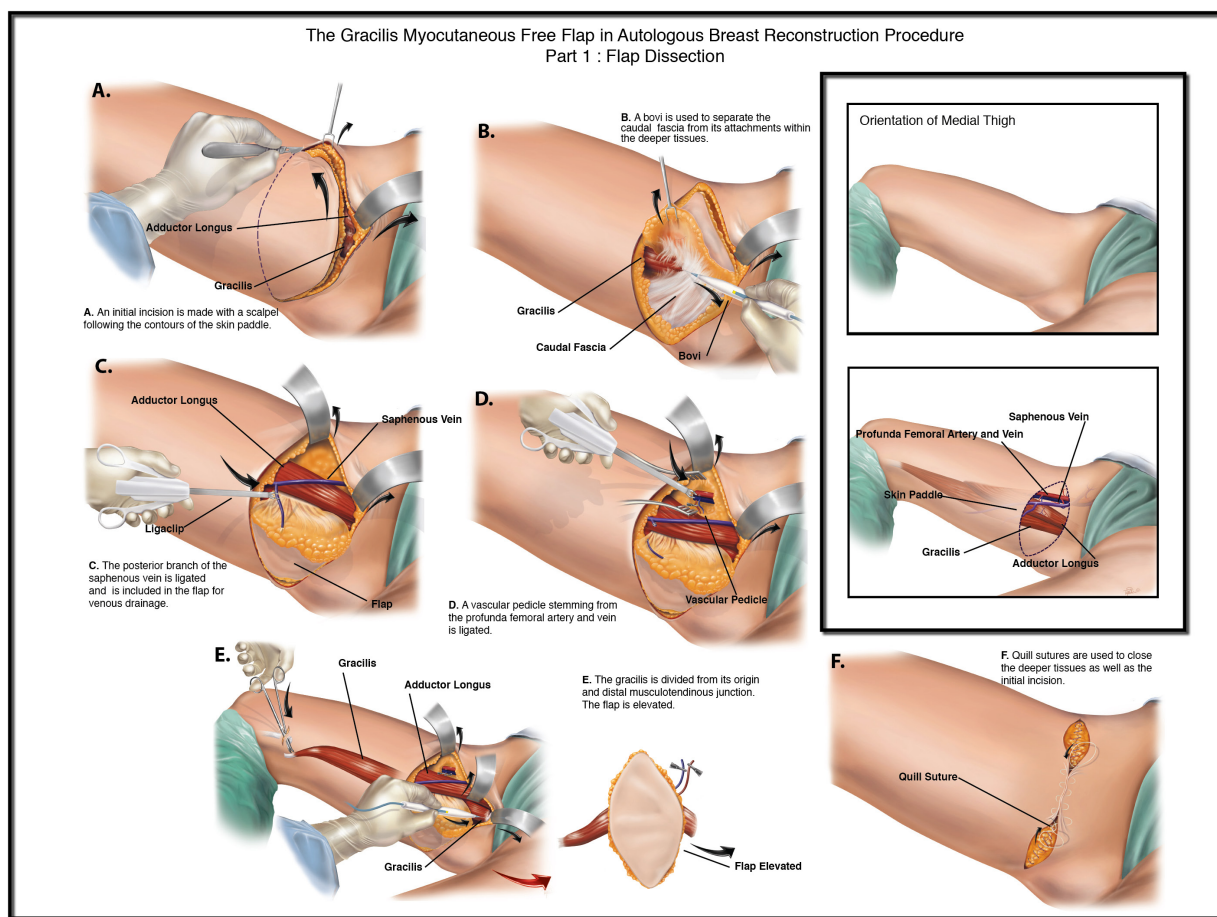
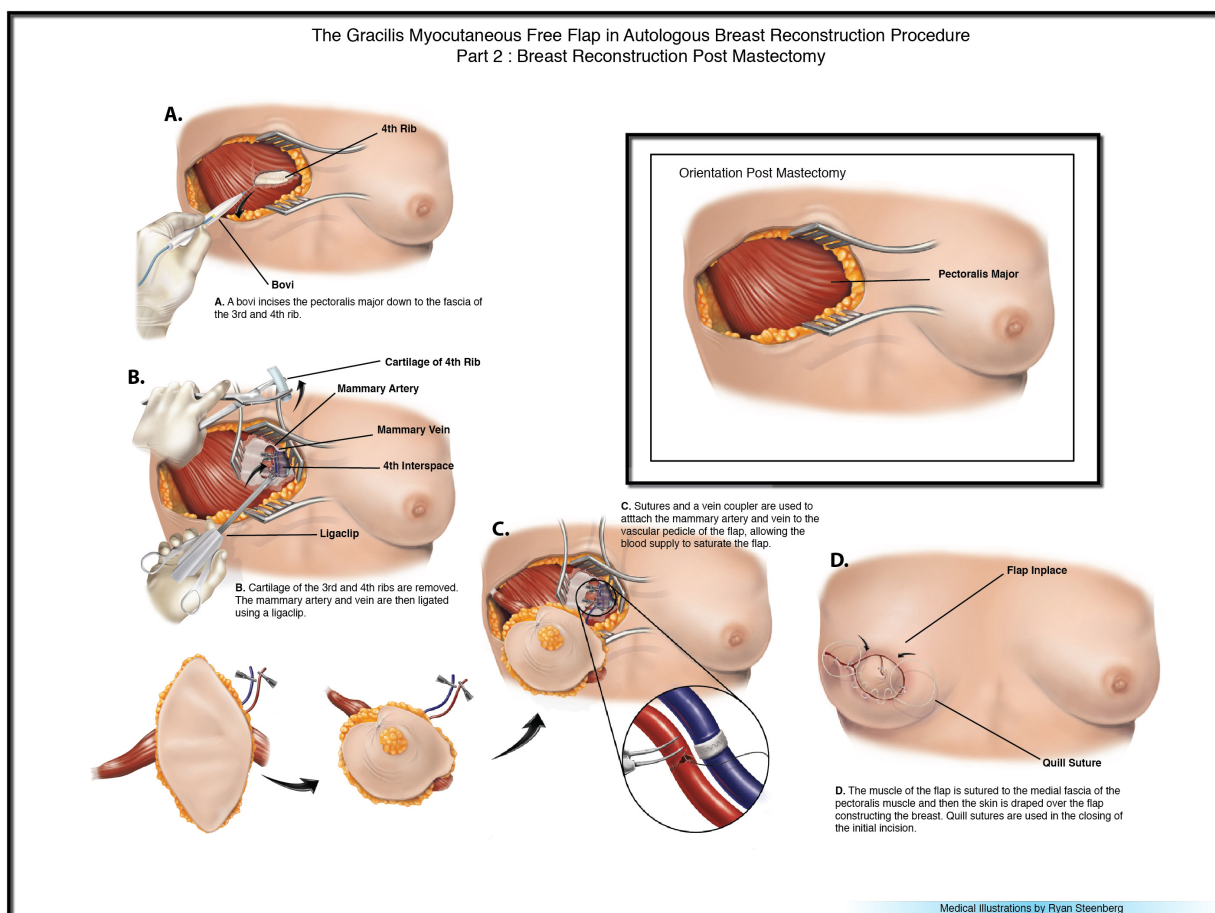


Figure 3-2



IV. Conclusions

The project yielded a successful final result. I was able to break down and render a very intricate procedure for the purposes of visual representation and educational delivery. A goal of providing a sequential and coherent presentation was achieved as Dr. Vega found the boards and illustrations useful. He went on to use the illustrations in a published installment in the Plastic and Reconstructive Surgery Journal in 2009. The decisions of altering the event sequence, containing the processes from dissection to closure of both the thorax and lower extremity as their own boards deemed worthy as the boards presented in a coherent manner. The value of such a presentation in clearly illustrating this significant procedure is immeasurable as without a clear display the layperson would be left perplexed. In any future investigation of this same procedure I would also render the surgeons process in the shaping of the flap as I found containment of the gracilis muscle in the flap to be somewhat of interest.

References

- Hartrampf, C., Schefflan, M., & Black, P. (1982, February). Breast Reconstruction with a Transverse Abdominal Island Flap. *Plastic Reconstructive Surgery*.
- Schoeller, M.D., M.Sc., Huemer, M.D., & Wechselberger, M.D., M.Sc. (2007, November). The Transverse Musculocutaneous Gracilis Flap for Breast Reconstruction: Guidelines for Flap and Patient Selection. *The Journal of Plastic and Reconstructive Surgery*.
- Vega, S. J., M.D., Sandeen, S. N., M.D., Bossert, R. P., M.D., Perrone, A., M.D., M.B.A., Pharm.D., & Ortiz, L., B.S. (2009, November). The Gracilis Myocutaneous Free Flap in Autologous Breast Reconstruction. *The Journal of Plastic and Reconstructive Surgery*.
- Buntic, R. F., M.D., Horton, K. M., M.D., Brooks, D. B., M.D., & Ghazi, A. A., M.D. (2011, May). Transverse Upper Gracilis Flap as an Alternative to Abdominal Tissue Breast Reconstruction: Technique and Modifications. *The Journal of Plastic and Reconstructive Surgery*.