



The evolution of autologous breast reconstruction

Domenico Costanzo MD¹ | Marco Klinger MD² | Andrea Lisa MD² |
Luca Maione MD² | Andrea Battistini MD² | Valeriano Vinci MD²

¹Humanitas University (Hunimed), Milan, Italy

²Reconstructive and Aesthetic Plastic Surgery School, Department of Medical Biotechnology and Translational Medicine BIOMETRA - Plastic Surgery Unit, Humanitas, Clinical and Research Hospital, University of Milan, Rozzano (Milan), Italy

Correspondence

Domenico Costanzo, Humanitas University (Hunimed), Milan, Italy.
Email: domenico.costanzo@mail.com

Abstract

With breast cancer (BC) becoming more treatable, breast reconstruction has become an integral part of BC treatment. Nowadays, implant-based breast reconstruction is more common. However, there is a growing interest in autologous breast reconstruction due to the increasing awareness of implant-related complications. This work provides a comprehensive overview of the evolution of autologous reconstruction techniques of the breast and the nipple-areolar complex (NAC).

KEYWORDS

AFG, breast cancer, DIEP, mastectomy, SGAP, TRAM

1 | INTRODUCTION

Breast reconstruction has become an integral part of breast cancer (BC) treatment in a pressing need to leave the least possible consequences from the aesthetic and psychosocial points of view when mastectomy cannot be avoided or at the time when more disfiguring surgeries were the sole available treatment for BC.¹

Nowadays, most reconstructions are implant-based.² There exist various types of implants with different shapes, textures, and fill materials for the plastic surgeons to choose from.³ Nevertheless, autologous breast reconstruction does not have the major disadvantages of implants (eg, capsular contracture and the risk of device failure); rather, it is characterized by long-lasting results, natural aging, responsiveness to change in body weight, and body contouring at the donor site.

This work provides a comprehensive overview of autologous reconstruction techniques of breast and nipple-areolar complex to date.

2 | AUTOLOGOUS BREAST RECONSTRUCTION

The first reported case of autologous breast reconstruction was by Verneuil in 1887 who used a pedicle-based off the opposite breast. Czerny followed in Verneuil's footsteps when he used a lipoma to reconstruct a lumpectomy defect.⁴

Tansini first performed a latissimus dorsi flap in 1906.⁴ This was originally described as a method to cover radical mastectomy defects. The flap was revisited in the 1970s as a mean to reconstruct the breast mound after mastectomy and other body areas. The latissimus dorsi consists of two triangular-shaped muscles supplied by the thoracodorsal artery. Newer techniques allow the latissimus dorsi to be harvested as a pedicled or free flap and as a muscular or myocutaneous flap with an overlying skin paddle. It can also be harvested along with any other flap based on the subscapular vascular system as a chimeric or subscapular "megaflap." Despite its size, it can be harvested without significant donor site morbidity. An implant can be placed immediately, or a tissue expander can be inserted with subsequent implant exchange once tissue expansion is complete. Alternatively, complete autogenous reconstruction may be performed in select patients. Due to its robust blood supply-based, today the latissimus dorsi may be the preferred reconstruction in heavy smokers, diabetics, and patients with vasculopathies and with a very noticeable defect, even if associated with radiotherapy.^{5,6}

In Tansini's time, most rejected breast reconstruction as they felt it was detrimental to cancer care.

Breast reconstruction started to be reconsidered only in the 50s, with surgeons such as Gilles performing tubed pedicled flaps.⁴ However, with the invention of silicone implants in the 1960s, autologous breast reconstruction was set aside in favor of prosthetic breast reconstruction.

Free flaps were not used until 1979 with Holmström's "The free abdominoplasty flap and its use in breast reconstruction [...]."⁷ However, autologous reconstruction really established itself after 1982, when Hartrampf published his method for pedicled transverse rectus abdominis myocutaneous (TRAM) flap.

Hartrampf described a vertically oriented rectus abdominis muscle with a horizontally oriented cutaneous paddle. This allowed the use of the lower abdominal skin and subcutaneous tissue as the breast "mound" while also providing a more aesthetic donor site closure. Others followed with the use of this technique. Since then, the TRAM flap has undergone modifications in technique to improve its blood supply.

Schelfan and Dinner⁸ studied anatomic dissections and showed that the primary source of circulation to the rectus abdominis muscle was actually from the deep inferior epigastric artery. This added to previous anatomic studies demonstrated by Milloy and colleagues in 1960.⁹ The anatomic contribution between the superior and inferior epigastric arteries was defined. As a result of these and similar studies, most surgeons now center the design of the TRAM flap slightly higher on the abdomen, just below the umbilicus.

Based on their anatomic dissections in the late 1980s, Moon, Taylor, and others¹⁰ suggest surgical delay of the TRAM flap in the attempt to improve flap viability. The improvement from delay becomes evident clinically after 1 week and is not further improved by extending the delay to 2 weeks. Surgical delay of a TRAM flap permits its use in those patients who are at higher risk of arterial and venous insufficiency.

By 1987, Hartrampf¹¹ had formulated a risk factor stratification to evaluate a patient for TRAM flap breast reconstruction. This looked at scores assigned to factors such as obesity, smoking, diabetes, previous abdominal surgeries, and other pertinent conditions. For high-risk patients, Hartrampf recommends the use of a double-pedicled TRAM flap. Paige and colleagues¹² looked at the overall morbidity in either uni- or double-pedicled TRAM flaps and found no significant difference.

The pedicled TRAM flap has certainly become the "workhorse" for autologous breast reconstruction.

Advantages of the TRAM flap are that it accomplishes reconstruction with autogenous tissue, leaves an acceptable donor scar, and serves as a simultaneous abdominoplasty. Disadvantages are a high tissue-to-blood supply ratio, protracted recovery with abdominal discomfort, potential for hernia from weakness from the abdominal wall, and limitations imposed by previous abdominal scars.¹³

The pedicled TRAM evolved to the free TRAM, as microsurgery was more common and the deep inferior epigastric artery was found to have improved blood supply when compared to the superior epigastric artery (the basis of the pedicled flap). This technique further evolved into the free ms-TRAM (muscle-sparing TRAM) and deep inferior epigastric perforator (DIEP) flap, in addition to utilizing other free flaps for breast reconstruction.^{4,6}

The DIEP flap allows for the ease of transfer of skin and fat from the abdomen for the reconstruction of a new breast without the sacrifice of rectus muscle or fascia.

Complications are infrequent and include partial or total flap loss, and fat necrosis of flap, fat necrosis of flaps, seroma formation at the abdominal donor site, and abdominal hernia.¹⁴

During the years, secondary flap options have been developed especially for patients in whom the abdominal tissue is not available or sufficient. These include flaps such as the SGAP (superior gluteal artery perforator), IGAP (inferior gluteal artery perforator), TUG (transverse upper gracilis), PAP (profunda artery perforator), ALT (anterolateral thigh perforator), and Ruben's flap (deep circumflex iliac vessels).¹⁵

Recently, autologous fat grafting (AFG) has been used as an option for primary breast reconstruction especially after lumpectomies (lipofilling)¹⁶; as an adjunct to autologous and implant-based breast reconstruction owing to its main role in the correction of breast contour deformities¹⁶⁻²¹; and as a treatment of postmastectomy pain due to its regenerative properties.²²⁻²⁴

3 | NIPPLE-AREOLA RECONSTRUCTION (NAR)

Nipple-areola reconstruction (NAR) constitutes a fundamental step to obtain aesthetically pleasing breasts and improve patients' satisfaction and health-related quality of life.

NAR began 40 years ago with the initial creation of both the nipple and areola from distant grafts. Subsequently, this approach transformed into a combination of local flaps for nipple reconstruction and distant grafts or tattooing for the areola.

Many of the earlier methods for nipple reconstruction are no longer used and have been relegated to historical significance including nipple banking due to spread of cancerous cells and nipple sharing due to insult on the contralateral nipple. All techniques, however, are hampered to some extent by loss of long-term nipple projection.

4 | DISCUSSION

The goal of breast reconstruction is to obtain aesthetically satisfying, symmetrical breasts in mastectomy patients. By achieving an acceptable appearance, breast reconstruction should improve patients' quality of life and offer no subsequent health risk.^{25,26}

In the present article, we recount the historical milestones of autologous breast reconstruction as a high interest is being generated with increasing awareness of implant-related complications.²⁷⁻³¹

CONFLICT OF INTEREST

The author declares that he has no conflict of interest.

ORCID

Domenico Costanzo  <https://orcid.org/0000-0002-5867-4409>

Marco Klinger  <https://orcid.org/0000-0001-8417-0186>

Andrea Battistini  <https://orcid.org/0000-0002-8837-268X>

REFERENCES

- Costanzo D. Oncologic breast surgery: an historical perspective. *Breast J*. 2019;26:1-3.
- 2018 National Plastic Surgery Statistics. American Society of Plastic Surgeons. 2018.
- Vinci V, Domenico C, Luca M, et al. The evolution of breast prostheses. *Breast J*. 2020. <https://doi.org/10.1111/tbj.13954>
- Rozen WM, Rajkomar AKS, Anavekar NS, Ashton MW. Post-mastectomy breast reconstruction: a history in evolution. *Clin Breast Cancer*. 2009;9(3):145-154.
- Kim PS, Gottlieb JR, Harris GD, Nagle DJ, Lewis VL. The dorsal thoracic fascia: anatomic significance with clinical applications in reconstructive microsurgery. *Plast Reconstr Surg*. 1987;79(1):72-80.
- Rowell AR, Eisenberg N, Davies DM, Ian Taylor G. The anatomy of the thoracodorsal artery within the latissimus dorsi muscle. *Br J Plast Surg*. 1986;39(2):206-209.
- Hartrampf CR, Schefflan M, Black PW, Robbins T. Breast reconstruction with a transverse abdominal island flap. *Plast Reconstr Surg*. 1982;69(2):216-225.
- Schefflan M, Dinner MI. The transverse lower rectus abdominis operation for breast reconstruction. *Plast Reconstr Surg*. 1983;72:819.
- Millroy FJ, Anson BJ, McAfee DK. The rectus abdominis muscle and the epigastric arteries. *Surg Gynecol Obstet*. 1960;110:293-302.
- Moon HK, Taylor GI. The vascular anatomy of rectus abdominis musculotaneous flaps based on the deep superior epigastric system. *Plast Reconstr Surg*. 1988;82:815-832.
- Hartrampf CR Jr. Breast reconstruction with a transverse abdominal island flap. A retrospective evaluation of 335 patients. *Perspect Plast Surg*. 1987;1:123.
- Paige KT, Bostwick J III, Trimble Bried J, Jones G. A comparison of morbidity from bilateral, unipedicled and unilateral, unipedicled TRAM flap breast reconstruction. *Plast Reconstr Surg*. 1998;101:1819-1827.
- Uroskie TW, Colen LB. History of breast reconstruction. *Semin Plast Surg*. 2004;18(2):65-69.
- Lo Tempio MM, Gerald GL, Allen RJ. Breast Reconstruction with DIEP and S/IGAP. Breast Reconstruction - Current Techniques. 2012. Marzia Salgarello, IntechOpen.
- Rose J, Breast PY, Flaps RF. *StatPearls [Internet]*. Treasure Island, FL: StatPearls Publishing; 2019.
- Khouri R, Del Vecchio D. Breast reconstruction and augmentation using pre-expansion and autologous fat transplantation. *Clin Plast Surg*. 2009;36(2):269-280.
- Kanchwala SK, Glatt BS, Conant EF, Bucky LP. Autologous fat grafting to the reconstructed breast: the management of acquired contour deformities. *Plast Reconstr Surg*. 2009;124(02):409-418.
- Cavaggioli F, Forcellini D, Vinci V, Cornegliani G, Klinger F, Klinger M. Employment of needles: a different technique for fat placement. *Plast Reconstr Surg*. 2012;130(2):373e-374e.
- Klinger M, Cavaggioli F, Giannasi S, et al. The prevalence of tuberous/constricted breast deformity in population and in breast augmentation and reduction mammoplasty patients. *Aesth Plastic Surg*. 2016;40(4):492-496.
- Klinger M, Klinger F, Giannasi S, et al. Stenotic malformation and its reconstructive surgical correction: a new concept from minor deformity to tuberous breast. *Aesthetic Plast Surg*. 2017;41(5):1068-1077.
- Herly M, Ørholt M, Larsen A, et al. Efficacy of breast reconstruction with fat grafting: a systematic review and meta-analysis. *J Plast Reconstr Aesthet Surg*. 2018;71(12):1740-1750.
- Cavaggioli F, Maione L, Forcellini D, Klinger F, Klinger M. Autologous fat graft in postmastectomy pain syndrome. *Plast Reconstr Surg*. 2011;128(2):349-352.
- Carelli S, Colli M, Vinci V, Cavaggioli F, Klinger M, Gorio A. Mechanical activation of adipose tissue and derived mesenchymal stem cells: novel anti-inflammatory properties. *Int J Mol Sci*. 2018;19(1):267.
- Lisa AVE, Murolo M, Maione L, et al. Autologous fat grafting efficacy in treating PostMastectomy pain syndrome: a prospective multicenter trial of two Senonetwork Italia breast centers. *Breast J*. 2020. <https://doi.org/10.1111/tbj.13923>
- Serletti JM, Moran SL. The combined use of the TRAM and expanders/implants in breast reconstruction. *Ann Plast Surg*. 1998;40(5):510-514.
- Macadam SA, Bovill ES, Buchel EW, Lennox PA. Evidence-based medicine: autologous breast reconstruction. *Plast Reconstr Surg*. 2017;139(1):204e-229e.
- Brunner C, Teymouri HR, Eder M, et al. How risky are silicone gel-filled breast implants? Current standpoints and alternatives. *Munch Med Wschr*. 1998;140:257-259.
- Alderman AK, Wilkins EG, Kim HM, Lowery JC. Complications in postmastectomy breast reconstruction: two-year results of the Michigan Breast Reconstruction Outcome Study. *Plast Reconstr Surg*. 2002;109:2265-2274.
- Cordeiro PG, McCarthy CM. A single surgeon's 12-year experience with tissue expander/implant breast reconstruction: part I. A prospective analysis of early complications. *Plast Reconstr Surg*. 2006;118:825-831.
- Cordeiro PG, McCarthy CM. A single surgeon's 12-year experience with tissue expander/implant breast reconstruction: part II. An analysis of long-term complications, aesthetic outcomes, and patient satisfaction. *Plast Reconstr Surg*. 2006;118:832-839.
- Loch-Wilkinson A, Beath KJ, Knight RJW, et al. Breast implant-associated anaplastic large cell lymphoma in Australia and New Zealand: high-surface-area textured implants are associated with increased risk. *Plast Reconstr Surg*. 2017;140:645-654.

How to cite this article: Costanzo D, Klinger M, Lisa A, Maione L, Battistini A, Vinci V. The evolution of autologous breast reconstruction. *Breast J*. 2020;26:2223-2225. <https://doi.org/10.1111/tbj.14025>