Clinics of Surgery

Review Article

ISSN: 2638-1451 | Volume 11

The Latissimus Dorsi Flap in Breast Reconstruction: A Timeless Workhorse Through History and Innovation

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Received: 16 Sep 2024
Accepted: 09 Oct 2024
Published: 16 Oct 2024
J Short Name: COS

Citation:

Sampaio Goes J and D'Alessandro GS. The Latissimus Dorsi Flap in Breast Reconstruction: A Timeless Workhorse Through History and Innovation. Clin Surg. 2024; 11(2): 1-4

Keywords:

Latissimus dorsi; Myocutaneous flap; Breast reconstruction; Surgical technique; Oncological surgery

1. Summary

The latissimus dorsi myocutaneous flap (LDMF) is a pivotal surgical technique for breast reconstruction, celebrated for its reliable anatomy and minimal morbidity. Initially introduced by Iginio Tansini in 1896, the latissimus dorsi flap involved a dorsal skin flap for closing breast cancer surgeries. Despite early challenges, Tansini's insights into vascular anatomy established a foundation for its use. After a decline due to radical mastectomy approaches, the flap was revitalized in 1939 by Elliot Hutchins, who demonstrated its efficacy in restoring axillary lymphatic drainage. The LDMF regained popularity in the late 1970s for immediate breast reconstruction, often paired with silicone implants. Subsequent innovations, including fat grafting and robotic dissection techniques, have further enhanced its applications. While the transverse rectus abdominis myocutaneous (TRAM) flap has become a popular alternative, the LDMF remains a versatile and effective option in reconstructive surgery, consistently providing satisfactory aesthetic outcomes.

2. Introduction

The latissimus dorsi myocutaneous flap (LDMF) has proven to be a versatile technique, with widely described and predictable anatomy, providing a skin segment with consistent blood supply capable of producing satisfactory aesthetic results, with low morbidity [1-6]. At the University of Pavia in Italy, Iginio Tansini described a pioneering technique for the surgical treatment of breast cancer (BC) in 1896 [7]. In this surgery, the breast (skin and mammary gland), pectoral muscles, and ipsilateral axillary lymph nodes were resected, with the resection area closed using a skin flap from the dorsal region. However, Tansini reported complications, such as frequent necrosis of the distal third of the flap.

Dissatisfied with these findings, he observed that branches originating from the subscapular artery were important for flap perfusion, as they reached the skin through the latissimus dorsi muscle. Based on these anatomical findings, Tansini realized that, for the flap's complete viability, the muscle had to be included. In 1906, he published a new article describing, in addition to the radical surgical treatment of BC, new concepts such as the importance of axial vessels for flap perfusion, the role of perforating vessels in the perfusion of composite flaps, and, finally, the myocutaneous unit of the latissimus dorsi muscle [8].

Tansini's technique for BC treatment gained popularity in Europe between 1910 and 1920, with an English translation published in The Lancet in 1908 by Dr. Francesco Purpura [9]. After this period, the technique fell into disuse with the rise of Halsted's concept of surgical radicality for BC treatment, which discouraged any attempt at reconstruction of the resected area caused by oncological surgery [10].

A few decades later, in 1939, Elliot Hutchins observed that the latissimus dorsi muscle flap could restore axillary lymphatic drainage, preventing lymphedema resulting from radical mastectomies [11].

Later, Davis et al. and Darrell Campbell demonstrated the feasibility of using the latissimus dorsi muscle, combined with fascia lata grafts, with or without partial skin grafts, to correct large chest

wall deformities resulting from oncological resection [12, 13]. These studies were the embryo of a new era in the use of the latissimus dorsi flap.

German surgeon Neven Olivari is credited with reintroducing the latissimus dorsi myocutaneous flap (LDMF) into clinical practice, with a publication in 1976. He used the flap to treat oncological recurrences or thoracic complications resulting from locoregional radiotherapy [14].

The following year, McCraw et al. published an important conceptual study on myocutaneous flaps. The authors observed that muscles receive their blood supply segmentally through dominant vascular pedicles, and by identifying this pedicle, it became possible to dissect the muscle along its length, including the overlying skin segment, without compromising the perfusion of the entire complex. The authors conceptualized the pedicle's entry point into the muscle as the "axis of rotation," and the distance from this point to the flap's edge as the "arc of rotation" [15]. This study contributed to establishing more secure clinical use of myocutaneous flaps.

At the same time, Schneider, Hill, and Brown, as well as Muhlbauer and Olbrisch, were the first surgeons to reintroduce the LDMF for breast reconstruction (BR) after mastectomies, often combined with a silicone implant [16, 17]. Mendelson and Masson, reinforcing the concepts proposed by Schneider et al., demonstrated that the superior skin bridge of the LDMF could be completely divided, and the dominant vascular pedicle safely isolated, maintaining the perfusion of both the muscle flap and its overlying skin [16, 18].

The following year, Bostwick et al. published a study with 44 BR cases in women who had undergone radical mastectomies. Among the cases described, 11 were performed with LDMF, with or without a silicone implant, and 5 were done using only the muscle flap, aiming to repair the pectoral muscles resected during radical oncological surgery [19].

Breast reconstruction with LDMF gained popularity in the late 1970s with further publications by Bostwick et al., showing consistent and aesthetically favorable surgical outcomes with single-stage BR after mastectomies, using LDMF with or without a silicone implant, thereby standardizing the technique [20, 21].

In 1978, Patrick Maxwell et al. described the use of the microsurgical LDMF [22]. After this first case for scalp reconstruction, the authors published further studies, expanding its use to other body areas [23]. In the same year, Serafin, Georgiade, and Given described two cases of late-stage BR using the contralateral microsurgical latissimus dorsi flap, anastomosing the flap's thoracodorsal vessels to the subscapular vessels [24]. Later, in 1989, Franklyn Elliott et al. described the microsurgical latissimus dorsi flap, sparing its medial portion. The authors proposed using the lateral portion of the muscle, nourished by the lateral branches of the thoracodorsal trunk [25].

From the 1980s onward, with the increasing use of LDMF in BR, new studies, analyses, and refinements were published. However, with Carl Hartrampf's 1982 publication [26], the transverse rectus abdominis myocutaneous (TRAM) flap replaced the LDMF as the first choice for BR using autologous tissue. This new technique eliminated the need for silicone implants, avoiding their drawbacks [27].

In 1983, Hokin and Silfverskiold first described BR using an extended LDMF without silicone implants. They used the entire latissimus dorsi muscle, lumbar fascia, and overlying skin for immediate and delayed BR [28]. In 1987, they published the results of the technique in 53 cases, 21 of which were immediate reconstructions. Seventy percent of the flaps had a volume greater than 400 ml, and the partial necrosis rate was 14.5% [29].

Along similar lines, aiming to eliminate the drawbacks of silicone implants in BR, Papp and McCraw proposed in 1994 to add dorsal subcutaneous tissue to the LDMF, aiming for BR without implants and with fewer dorsal aesthetic sequelae than the technique previously proposed by Hokin and Silfverskiold [30, 31]. Other publications with technical variations sought to add volume to the dorsal flap, always aiming for reconstruction with LDMF without silicone implants [32-37].

In 2007, Dennis Hammond systematized and popularized the LDMF dissected below the dorsal Scarpa fascia, incorporating the adipose tissue located below the dorsal fascia into the flap segment. The technique had lower complexity and provided an avascular dissection plane, as the dissection was carried out in loose areolar tissue. Thus, greater volume was added to the flap, providing better coverage for the silicone implant without major dorsal static sequelae [1, 38, 39]. By preserving the fascia and the superficial subcutaneous tissue layer in the dorsal region, the superficial plexus vessels and lymphatic drainage were preserved, reducing the incidence of seroma in the donor area [40].

Later, as an alternative to extended LDMF BR techniques, and aiming to further reduce dorsal sequelae, Santanelli di Pompeo et al [41]. published in 2014 a series of 21 cases where they performed immediate reconstruction after mastectomy using fat-grafted LDMF, achieving good aesthetic results with low complication rates [41].

In 1983, Argenta, Marks, and Grabb first described the use of a tissue expander in combination with LDMF. The authors treated a clinical case with extensive skin necrosis after mastectomy, and this approach allowed for the exchange of the expander for a silicone implant at a later stage [42]. A few years later, Summer Slavin demonstrated the usefulness of expanding the LDMF, both in the breast area and the dorsal area. When the donor area was inadequate, the LDMF was expanded on the back before transfer [43].

In 1995, Angrigiani et al. described the latissimus dorsi muscle perforator flap. This technique allows the use of a skin segment over the muscle without muscle dissection, by dissecting its perforating vessels [44]. In the same year, Eaves and Bostwick described the endoscopic dissection technique of LDMF with the possibility of using it for free transfer or as a pedicled flap [45]. Finally, in 2012, Selber et al [46]. described a series of cases in which they successfully performed robotic dissection of the LDMF [46].

3. Conclusion

The latissimus dorsi myocutaneous flap (LDMF) has evolved into a fundamental technique in breast reconstruction, demonstrating its versatility and effectiveness over the decades. From its pioneering use by Iginio Tansini to contemporary advancements in surgical techniques, the LDMF continues to provide reliable aesthetic outcomes with minimal complications. As innovations in fat grafting and robotic dissection enhance its application, the LDMF remains a critical option for surgeons seeking to optimize patient care in reconstructive surgery.

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