REVIEW ARTICLE
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Use of the serratus anterior fascia in immediate implant-based breast reconstruction

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ABSTRACT

Using the serratus anterior fascia may be a safe and effective option to recreate the lateral breast profile during subpectoral breast reconstruction, with minimal functional impact on the donor site. However, the literature is scarce when it comes to studies on this fascia flap in implant-based reconstruction. This article aimed to review the use of the serratus anterior fascia in immediate implant-based breast reconstruction, searching the electronic databases PubMed, Embase, Lilacs, and SciELO. The search was carried out by combining the following keywords: 'breast reconstruction' and 'serratus anterior fascia'. In the Pubmed and Embase databases, the search yielded a total of 12 and 15 articles, respectively, of which seven were selected according to the scope of this article. We found no studies on serratus anterior fascia and breast reconstruction in the Lilacs and SciELO databases. All works have results favorable for the use of the serratus anterior fascia flap and agree that this technique can be considered in the algorithm for the coverage of the inferolateral portion during subpectoral breast reconstruction.

KEYWORDS: serratus anterior fascia; breast reconstruction; breast implant; fascia; mastectomy.

INTRODUCTION

Breast cancer is the most commonly malignant neoplasm among women in most parts of the world, having 2.1 million new cases in 2018[1]. In Brazil, breast cancer is the most incident in women — after non-melanoma skin cancer —, with 74 thousand new cases estimated per year in the period from 2023 to 2025[2].

About 40% to 45% of patients diagnosed with breast cancer require mastectomy for local surgical control[3,4]. Breast reconstruction is part of the breast cancer treatment for patients undergoing mastectomy and minimizes mutilating sequelae, positively favoring their psychological health, sexuality, body image, and self-esteem[5].

Implant-based surgical techniques are the most used in immediate breast reconstruction in women with breast cancer undergoing mastectomy. The increased performance of skin and nipple-sparing mastectomies has favored single-stage reconstructions, without compromising oncological safety and providing better cosmetic results[6]. One of the benefits of immediate implant-based breast reconstruction is allowing rapid breast reshaping, preserving the patient's self-image, essential for their self-esteem and quality of life, in addition to helping reduce the number of surgical procedures and hospital visits[7,8].

Placing the implant below the pectoralis major muscle protects its integrity, reducing its visibility, palpability, and the occurrence of rippling[5,9]. In the subpectoral technique, the pectoralis major muscle covers about 2/3 of the implant. The options for complete prosthesis coverage, including the inferolateral portion, are total submuscular reconstruction, with the muscle flap and/or serratus anterior fascia, or the use of synthetic meshes and dermal matrices[10].

In breast surgery, the use of serratus fascia has been described in subfascial breast augmentation and in adipofascial tissue continuation with the pectoralis major muscle for coverage in breast reconstruction. However, few studies have reported its use in breast reconstruction[11]. The serratus anterior fascia flap in breast reconstruction can be a safe, effective, and fast option to recreate the lateral breast profile and prevent implant lateralization. The advantage of this flap is to be an autologous, well-vascularized tissue, which makes detaching the costal insertion of the serratus anterior muscle unnecessary, thus causing minimal impact on the morbidity and functionality of the donor site[11,12]. Despite its potential benefits, analytical studies evaluating the surgical results of using the serratus anterior fascia flap in breast reconstruction are scarce in the literature. This article aimed to review the use of the serratus anterior fascia in immediate implant-based breast reconstruction.

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METHODS

In order to systematize the search for articles in the literature, we used the PubMed, Embase, Lilacs, and SciELO electronic databases, combining the following keywords: 'breast reconstruction' and 'serratus anterior fascia'. The article selection sought to include the population of women undergoing implant-based breast reconstruction using the serratus anterior fascia in the reconstructive technique for implant coverage. The outcomes evaluated were postoperative results, surgical complications, and patient satisfaction.

We considered all types of articles published in English with the keywords present in the title, abstract, or both for the selection. Both authors reviewed the titles and abstracts independently. No time frame was set for the search. Based on this result, the articles were selected by title for abstract screening and subsequent inclusion in the bibliographic reference, after full-text screening. The articles chosen presented concepts and knowledge related to the use of the serratus anterior fascia in immediate implant-based breast reconstruction. We excluded abstract-only publications and duplicate articles.

In the Pubmed and Embase databases, the search yielded a total of 12 and 15 articles, respectively, of which seven were selected according to the scope of the review and eligibility criteria. Saint-Cyr et al.; Alani and Balalaa; Seth et al.; Bordoni et al.; Chan et al.; Cristofori et al.; and Tarallo et al.[11-17]. We found no studies on serratus fascia in the Lilacs and SciELO databases. Figure 1 shows the flowchart of article selection.

RESULTS AND DISCUSSION

Immediate implant-based breast reconstruction

Breast cancer is the most commonly malignant neoplasm among women in most parts of the world, having 2.1 million new cases in 2018[1]. In Brazil, breast cancer is the most incident in women — after non-melanoma skin cancer —, with 74 thousand new cases estimated per year in the period from 2023 to 2025[2]. Breast reconstruction is part of the breast cancer treatment for patients undergoing mastectomy and minimizes mutilating sequelae, positively favoring their psychological health, sexuality, body image, and self-esteem[5].

In 1963, Thomas Cronin and Frank Gerow were the first to report the use of silicone breast implants[18]. Historically, immediate implant-based reconstruction was performed with the placement of the implant in the subcutaneous plane; however, the technique was rejected due to the high rate of prosthesis displacement, flap necrosis, and capsular contracture[19]. In the 1980s, after Radovan's introduction to the use of tissue expanders, immediate breast reconstruction started to be performed; at first, in two stages[20]. The technological advancement of alloplastic materials and the introduction of conservative mastectomies contributed to single-stage breast reconstruction[21].

Currently, implant-based surgical techniques are the most used in immediate breast reconstruction among women with breast cancer[21]. Implant-based reconstructions show an upward trend of 11% per year. According to statistics from the American Society of Plastic Surgeons, 102,215 breast reconstructions were performed in 2016, of which, 83,149 used prostheses. This is due to the increasing performance of prophylactic mastectomies, as well as factors that improve the quality of reconstructions with prostheses, such as acellular dermal matrices, fat grafting, and nipple-sparing mastectomies[22]. The preference for prostheses is also related to the patient's choice for faster surgery with shorter recovery time, in addition to avoiding donor site morbidity, as occurs in autologous tissue reconstructions[23]. We emphasize that technological advances in prosthetic manufacturing and the current literature support the safety of breast implants[18].

In Brazil, women who undergo mutilating breast surgeries in the Brazilian public health system have the right to immediate breast reconstruction, as long as their medical condition allows its performance, as determined by Law 12,802/2013[24]. According to a study analyzing the pattern of surgeries performed in patients diagnosed with breast cancer in health facilities that are part of the Brazilian public health system from 2008 to 2014, Freitas-Júnior et al.[25] found an increased offer of breast reconstructions, both

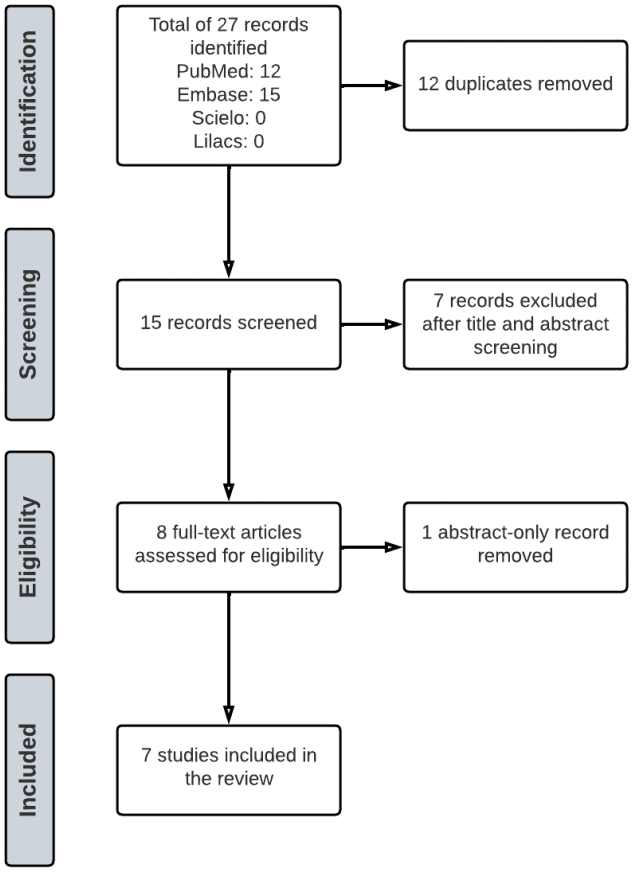

Figure 1. Flowchart of article selection.

flap- and implant-based. In 2008, women who underwent breast reconstructions represented 15% of mastectomized patients in the public health system, but this number increased significantly in 2013 and 2014 — 23.7% and 29.1%, respectively. Nevertheless, given the number of mastectomies performed, the offer of reconstructive surgery is still small[25].

The increased performance of skin and nipple-sparing mastectomies allowed the growing practice of single-stage direct-to-implant reconstructions, without compromising oncological safety and providing good cosmetic results[21]. The advantages of direct-to-implant reconstructions are lower number of surgeries; less exposure to anesthetic risk; fewer medical visits for expansion; in addition to immediate breast reshaping, which can reduce anxiety and improve self-image[8]. On the other hand, the disadvantage is that the quality of the flap or skin envelope available for coverage can limit the choice of implant volume. Yet, some findings indicate that the clinical results are comparable to two-stage reconstructions[26].

Conservative mastectomies

In 1894, Halsted revolutionized the treatment of breast cancer at the time by introducing radical mastectomy, considered the gold standard. Since then, the surgical approach has become less and less extensive. Subcutaneous mastectomy with preservation of the nipple-areola complex was first described by Freeman in the 1960s to treat a benign disease. However, the skin-sparing mastectomy technique became more popular after 1991, when Toth and Lappert described the technique as the use of minimal incisions and greater preservation of skin and inframammary fold, thus favoring the immediate reconstructive procedure[27].

Skin and nipple-sparing mastectomies are considered conservative mastectomies, defined by complete excision of breast tissue while preserving the skin envelope. The technique is safe for cancer treatment and comparable to conventional mastectomy and conservative surgery[28-30].

Moreover, preservation of the nipple-areola complex favors a better cosmetic result. Studies show that satisfaction with breast appearance and psychosocial well-being of patients undergoing nipple-sparing mastectomy and breast reconstruction is higher than preoperative satisfaction[9]. For women with large and ptotic breasts, pedicle and free nipple graft techniques can be used in nipple-sparing mastectomy[31].

Complications of conservative mastectomies with immediate reconstruction may include wound dehiscence, infection, implant loss, asymmetry, and capsular contracture, similar to conventional mastectomy. Nevertheless, the most common specific complications of the technique are flap and nipple necrosis. The rate of general complication is 22.3% and that of nipple necrosis is 5.9%. Among the factors associated with nipple necrosis, large breasts, ptosis, smoking, previous radiotherapy, periareolar incision, and comorbidities stand out[31].

Subpectoral implant placement

The prosthesis can be placed in the subpectoral or prepectoral position. Placing the implant below the pectoralis major muscle protects its integrity, reducing its visibility, palpability, and the occurrence of rippling. On the other hand, the disadvantage of subpectoral placement is related to muscle injuries, such as loss of strength and muscle spasms, causing animation deformity, in addition to being associated with greater postoperative pain compared to the prepectoral technique[5,9].

In order to create the total submuscular prosthesis pocket, the pectoralis major muscle is displaced until medially reaching the sternum insertions. Next, the pectoral muscle is sectioned at the nipple-areola complex level up to the lower extremity. Laterally, the serratus anterior muscle is detached from its costal insertions, allowing its displacement. These maneuvers allow the placement of the silicone prosthesis under the muscle flaps. The pocket with lateral coverage by the serratus muscle can result in flattening due to constant muscle pressure, interfering with the lateral breast profile[11].

In addition to the option of total submuscular reconstruction — a technique traditionally adopted for its low rate of complications, such as seroma, infection, and implant loss —, in which the implant is placed below the pectoralis major and serratus anterior muscles, subpectoral reconstruction can be performed using dermal matrices and synthetic meshes for inferolateral prosthesis coverage, helping delineate the inframammary profile[31].

Nonetheless, subpectoral reconstruction can be partial when the prosthesis is placed behind the pectoralis major muscle, thus leaving the inferolateral portion without coverage. Consequently, although it provides a better lateral outline, it has a risk of prosthesis lateralization. Preventing the skin suture from covering the prosthesis is also crucial to reduce the risk of implant exposure. Furthermore, the feasibility of this technique relies on having a viable dermal-fat flap[11].

Still, complete prosthesis coverage ensures greater implant protection and avoids its lateral migration. Alternatives to cover the inferolateral portion, besides the serratus anterior muscle, are synthetic meshes, acellular dermal matrices, dermal flaps, and serratus fascia. The problems of using mesh and dermal matrices are their high cost and complications such as seroma, while muscle flaps are associated with donor site morbidity. Therefore, using the serratus anterior fascia is a good option for covering the inferolateral portion, as it does not require detaching serratus muscle fibers and avoids additional costs with other alloplastic materials[9,11,32,33].

The serratus anterior fascia in breast reconstruction

In 1986, Wintsch and Helaly were the first to describe the use of the serratus fascia in a wrist reconstruction technique; later, its use was reported in the reconstruction of other body parts, such as wrist, forearm, leg, and back of the hand. In breast surgery,

the use of serratus fascia has been described in subfascial breast augmentation and in adipofascial tissue continuation of the pectoralis major muscle coverage in breast reconstruction. However, few studies have reported the use of the serratus anterior fascia flap in breast reconstruction[11]. Figure 2 illustrates the elevation of the serratus anterior muscle fascia.

The use of the serratus anterior fascia flap allows recreating the lateral breast profile and prevents the lateralization of the prosthesis or tissue expander, without needing to detach muscle fibers from the rib cage. The advantage of this flap is to be an autologous, well-vascularized tissue, in addition to making the costal detachment of the serratus anterior muscle unnecessary; it also has a low complication rate, with minimal donor site damage. Therefore, this technique provides safe, effective, technically easy, and fast inferolateral coverage of the submuscular prosthesis pocket with a high satisfaction rate[11,12,16].

In 2010, the use of serratus fascia in breast reconstruction was initially described by Saint-Cyr et al. after a retrospective study involving 22 patients with a mean follow-up time of 197 days. The authors concluded that the use of the serratus fascia is a safe, effective, and inexpensive method for lateral coverage of the tissue expander and reconstruction of the lateral breast profile, providing good cosmetic results with minimal complications. They also considered patients without comorbidities, history of radiotherapy, or axillary dissection, as well as those with a moderate body mass index, ideal for the technique. Yet, the authors reported some technical limitations when using serratus fascia, such as fascia damage by iatrogenesis, caused by axillary dissection, radiotherapy, or extensive oncologic resection of the lateral chest wall; anatomical variations, such as very small or thin fascias; and patient-inherent factors, such as smoking, diabetes, and low body mass index, which can be associated with attenuated fascias[11].

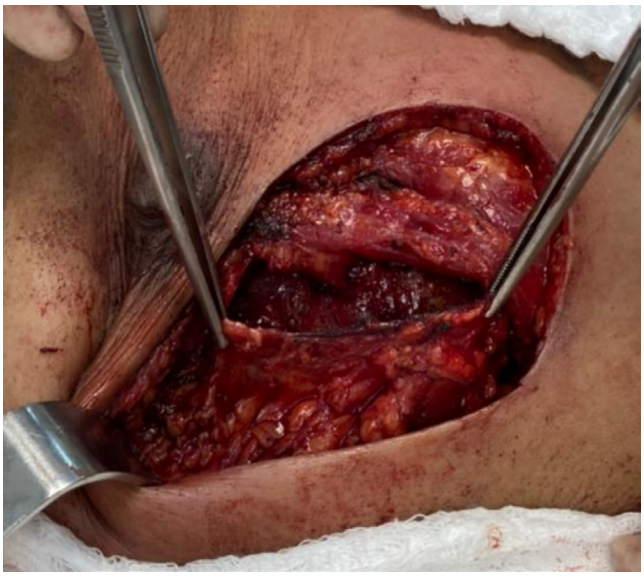

Figure 2. Image of the elevation of the serratus anterior muscle fascia.

Also, in a prospective study evaluating the musculofascial coverage — using the pectoralis major muscle, serratus anterior fascia, and superficial pectoralis major fascia — of the tissue expander in 59 patients who underwent immediate breast reconstruction, Alani et al. concluded that the fascia flap is an effective well-vascularized, autologous tissue option that prevents lateral displacement of the expander without needing to use another muscle flap or synthetic matrices[13].

The largest study on the use of serratus fascia in breast reconstruction was performed by Seth et al.[14]. It compared the use of serratus fascia (n=177) and serratus anterior muscle (n=375) for inferolateral coverage of the tissue expander. The authors revealed that elevation of the serratus fascia is a viable and safe alternative for inferolateral prosthesis coverage, with no differences in complication rates when compared to the serratus anterior muscle. In addition, they found that the fascia allowed for greater expander fill volumes and a lower number of expansions than the technique using the serratus muscle ($p<0.01$). The authors declared that fascial tissue is thinner and more pliable than muscle tissue, thus creating a larger potential space for expansion[14].

Bordoni et al.[12] analyzed 29 patients submitted to bilateral mastectomy and immediate breast reconstruction with placement of the tissue expander below the pectoralis major and serratus anterior muscle on one side and below the pectoralis major muscle and serratus fascia on the other, identifying lower postoperative pain levels and reduced seroma drainage on the fascia side, with statistical difference[12].

Chan et al.[15] evaluated 51 patients undergoing nipple-sparing mastectomy and direct-to-implant breast reconstruction, using only autologous flaps for coverage: pectoralis major muscle and serratus anterior fascia. They also reported that the serratus anterior fascia flap is a versatile, safe, and inexpensive option for inferolateral prosthesis coverage, especially in women with small and medium-sized breasts[15].

Cristofori et al. evidenced the effectiveness, safety, and lower complication rate, in addition to satisfaction with the result, of the serratus fascia flap (n=59) compared to the classical submuscular technique (n=64) in implant-based breast reconstructions[16]. Moreover, Tarallo et al. found good inferolateral coverage when evaluating soft tissue thickness by ultrasound in 20 breast reconstructions using the serratus fascia in the prosthesis coverage technique[17]. Table 1 summarizes the articles analyzed on serratus fascia and breast reconstruction.

CONCLUSIONS

Studies on immediate breast reconstruction involve heterogeneous populations and various surgical techniques.

Table 1. Summary of the articles.

Reference	Study design	Patients (n)	Population	Mean follow-up	Results	Level of evidence
Tarallo et al.[17]	P	18	Patients who underwent two-stage breast reconstruction with inferolateral coverage by serratus fascia from November/2018 to October/2019.	17.45 months	The serratus fascia provides good inferolateral coverage according to the thickness measurements of soft tissues over the prosthesis detected by ultrasound.	IV
Cristofori et al.[16]	R	123	Patients submitted to immediate implant-based breast reconstruction using the serratus anterior fascia flap or the classical technique between November/2012 and February/2015.	43.9 months	The modified serratus anterior fascia flap is a simple, safe, effective, and inexpensive autologous technique for immediate implant-based breast reconstruction.	III
Chan et al.[15]	R	51	Women with immediate implant-based breast reconstruction after nipple-sparing mastectomy from 2012 to 2016.	28.9 months	The serratus anterior fascia flap can provide autologous coverage in integrated mastectomy and implant-based breast reconstruction, especially in small and medium-sized breasts.	III
Seth et al.[14]	R	552	Women with serratus anterior fascia or muscle elevation in immediate reconstruction with tissue expander after mastectomy in a 10-year period in a single facility.	43.8 months	No differences in complications were found among patients with serratus muscle or serratus fascia. Serratus fascia elevation is a safe and viable alternative for inferolateral coverage during prosthetic breast reconstruction.	III
Bordoni et al.[12]	P	29	Women undergoing bilateral mastectomy and immediate two-stage implant-based breast reconstruction from January/2014 to January/2015.	20 months	The early postoperative pain score reported by patients was significantly lower with the fascial coverage.	III
Alani, Balalaa et al.[13]	P	59	Patients who had immediate breast reconstruction after mastectomy with the placement of a temporary tissue expander in the first stage, covered by a musculofascial layer composed of pectoralis major muscle, serratus anterior fascia, and superficial pectoral fascia for 3 years in a single center.	31 months	Serratus anterior fascia and superficial pectoral fascia flaps can be effectively used as a layer of autologous tissue to cover the inferolateral portion of the tissue expander in immediate breast reconstruction after mastectomy.	IV
Saint-Cyr et al.[11]	R	22	Patients who had immediate breast reconstruction with tissue expander after mastectomy using the serratus fascia.	197 days	The serratus anterior fascia flap is a versatile and safe option, providing vascularized coverage of the lateral prosthesis in expander-based breast reconstruction.	IV

P: prospective; R: retrospective; n: absolute number.

The literature is scarce when it comes to studies on the use of the serratus fascia in implant-based reconstruction. However, given the available data, the results of all studies agree that the serratus fascia flap technique can be considered in the algorithm for the coverage of the inferolateral portion in immediate implant-based breast reconstruction using the subpectoral technique. The evidence suggests that using the serratus fascia is simple, effective, and safe, in addition to favoring lower morbidity compared to the serratus anterior muscle flap.

AUTHORS' CONTRIBUTIONS

LSPR: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft. JVB: Conceptualization, Methodology, Formal analysis, Supervision, Writing – review & editing.

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