



# Delayed breast reconstruction with transverse latissimus dorsi myocutaneous flap using Becker expander implants in patients submitted to radiotherapy: A series of cases

Alexandre K. Dutra\*, Joel Abdala Junior, Ana Cibele Nagae Fernandes

Plastic Surgery Department, A.C. Camargo Cancer Center, Rua Bartolomeu de Gusmão 200 Ap 201B, 04111 020 São Paulo, Brazil

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## KEYWORDS

Breast;  
Reconstruction;  
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**Abstract** *Background:* Breast reconstruction with a latissimus dorsi myocutaneous flap associated with a breast implant is a well-established procedure. However, there are few published articles regarding latissimus association with expanders and radiotherapy. This study assess data of breast reconstructions using a latissimus dorsi myocutaneous flap associated with Becker expander implant (TLDMF/E) in patients submitted to radiotherapy.

*Methods:* This is a descriptive study consisting of a series of cases. Inclusion criteria were patients who underwent mastectomy, radiotherapy, and delayed LD MF/E breast reconstruction. A minimum 6-month follow-up period was established, and descriptive variables were analyzed.

*Results:* One hundred twenty-three patients were selected. The mean age of the patients was 45.1 years. Contralateral breast procedures were performed in 68 patients to achieve symmetry with substitution of the expander for an implant, with the majority of patients with an implant larger than the expander (74.0%). The nipple-areola complex was reconstructed in 77 patients (62.6%). In the donor site area, 116 patients (94.3%) had no complications. Minor complications were seroma in one patient and partial dehiscence in another patient. In the reconstructed breast, 11 patients (8.9%) had minor complications such as hematomas, partial necrosis of the native irradiated breast skin (3 cm or smaller), local infections, and partial exposition of the injection port. Major complications in the reconstructed breast were necrosis (larger than

\* Corresponding author.

E-mail addresses: [akdutra@uol.com.br](mailto:akdutra@uol.com.br) (A.K. Dutra), [joel.abdala@accamargo.org.br](mailto:joel.abdala@accamargo.org.br) (J.A. Junior), [ananagae@yahoo.com.br](mailto:ananagae@yahoo.com.br) (A.C.N. Fernandes).

3-5 cm) of the native irradiated breast skin in 5 patients (4.0%) who needed repair to avoid exposure of the expander. One patient needed expander removal due to a larger exposition.

**Conclusions:** Delayed breast reconstruction with TLDMF/E is a reliable option to selected patients with mastectomy and radiotherapy sequel.

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## Introduction

Mastectomy and radiotherapy still play a substantial role in breast cancer treatment. For women who face sequels after mastectomy, breast reconstruction enhances quality of life.<sup>1</sup> Breast reconstruction using a latissimus dorsi myocutaneous flap associated with a breast implant is a worldwide, well-established procedure that has been used for more than 40 years as a safe option to achieve an acceptable reconstructed breast mound.<sup>2-8</sup> Evaluations and technical details are well described in medical literature<sup>9,10</sup>; however, there are few published articles thus far regarding the association of latissimus with expanders and radiotherapy.

Breast reconstruction options must take into account stage of disease, in addition to radiotherapy sequel, breast form, pre-existing scars, breast size symmetry, body habits, patients' personal preference, and donor sites. A considerable number of breast reconstruction studies have assessed the outcomes of breast implants, expanders, and latissimus dorsi flaps.<sup>2-8</sup> Nevertheless, the reconstruction option of the most appropriate technique is often controversial, especially in the case of a radiotherapy sequel.<sup>11,12</sup> There is a paucity of data on breast reconstructions using a latissimus dorsi myocutaneous flap and its association with a Becker expander, particularly in repairing radiotherapy and mastectomy sequels.

The objective of this study is to assess data of breast reconstructions using the transverse latissimus dorsi myocutaneous flaps associated with Becker expander implant (TLDMF/E) in patients submitted to radiotherapy.

## Patients and methods

This is a descriptive study consisting of a series of cases, reporting all patients undergoing mastectomy, radiotherapy, and delayed LDMF/E breast reconstruction at A. C. Camargo Cancer Center between January 2009 and December 2016. All the patients were under the care of a single surgeon (A.K.D.).

Inclusion criteria were patients free of recurrence or metastasis submitted to simple mastectomy, modified radical mastectomy, radiotherapy, and TLDMF/E breast reconstructions. A minimum 6-month follow-up period was established.

Exclusion criteria included breast-conserving surgeries, nipple-areolar complex preservation surgeries (envelope mastectomy), reconstructions with latissimus dorsi flap not associated with the Becker expander, and follow-up less than 6 months.

The descriptive variables analyzed were race, age, body mass index (BMI), risk factors (divided as three groups:

none, one or smoking addiction, two or one plus smoking addiction), Becker 35 expander volume, and volume and type of the silicone breast implant when changed in the second stage.

Complications were stratified into three groups, namely, flap, breast skin, and donor site, which were further divided as minor (seroma, dehiscence smaller than 1.5 cm, partial necrosis of flap or breast skin [3 cm or smaller], and local infection) and major (breast skin necrosis larger than 3 cm, gross local infection, and removal of the expander) complications.

The capsular contracture and the areas of skin island of the flap at donor site and in the reconstructed breast were also classified.

The TLDMF/E delayed breast reconstruction was indicated for irradiated patients who did not have enough available tissue at the mastectomy sequel to cover an implant or radiation-induced fibrosis in which a flap was required. The TLDMF/E was also indicated for patients with a larger amount of tissue required to repair the mastectomy sequel or could cause an anesthetic-related morbidity at the donor site.

The latissimus dorsi myocutaneous flap was the option for extremely thin patients or those who previously had undergone abdominoplasty or abdominal scars that could harm TRAM flap reconstruction, high-risk patients for TRAM flap reconstruction, and those who refused abdominal donor site. The transverse LDMF/E was offered as an option for some TRAM flap candidates who claimed for a faster surgery. Image exams (ultrasonography/magnetic resonance) were required for patients whose integrity of the thoracodorsal pedicle was doubtful during clinical exam.

The same surgical team performed operations in a standardized way (A.K.D. as a single surgeon). The peripheral limits of the muscle and the spindle-shaped skin island on the mid portion were marked transversely to midline at the back. Dimensions were defined according to the expander volume in addition to produce an easy donor site closure, and a final scar was placed exclusively in the bra line.

The length and the width of the skin island were noted in all patients, and a calculus of the length versus the width divided by two, resulted approximately in the dorsal skin island area in each patient. The skin area dimensions were noted again at the reconstructed breast approximately 30 days before the second surgery. The technique employed the entire surface of the muscle, transecting its tendinous insertion, partially, or totally on the humerus whenever possible (not possible in 51 patients who had severe axillary fibrosis involving the pedicle). All expanders were Becker 35-type placed under the latissimus dorsi flap and above the pectoralis major muscle. There was an immediate inflation of the expander saline camera achieving an

**Table 1** Patient clinical data.

| Data                             | Category                         | n                                 | %   |      |
|----------------------------------|----------------------------------|-----------------------------------|-----|------|
| Sociodemographic characteristics | Race                             | White                             | 81  | 65.9 |
|                                  |                                  | Non-white                         | 42  | 34.1 |
|                                  | Age (years)                      | 40 or under                       | 33  | 26.8 |
|                                  |                                  | 41-50                             | 76  | 61.8 |
|                                  |                                  | 51 or over                        | 14  | 11.4 |
|                                  | BMI                              | <26                               | 39  | 31.7 |
|                                  |                                  | 26 or over                        | 84  | 68.3 |
|                                  | Patient risk factor <sup>a</sup> | None                              | 18  | 14.6 |
|                                  |                                  | One or smoking addiction          | 85  | 69.1 |
|                                  |                                  | Two or one plus smoking addiction | 20  | 16.3 |
| Total                            |                                  | 123                               | 100 |      |

<sup>a</sup> Diabetes mellitus, hypertension, cardiovascular or pulmonary disease, or smoking addiction.

intraoperative tissue expansion that ranged from 50 to 200 ml (mean=75; SD=3.8), taking care for not compromising the vascular supply of the flap. The injection port was placed in a subcutaneous pocket, approximately 2 cm laterally distant from the anterior midline, created topographically anterior to the sternum or to the xiphoid process and ipsilateral to the breast reconstruction.<sup>13</sup>

The donor defect was closed and quilted to the underlying tissue.<sup>14</sup> A suction drain was placed with tubes inserted into the donor and the reconstructed sites.

Expander volumes were planned according to the opposite breast and each patient's preoperative photograph. The final expander volume was compared to the mastectomy specimen weights (in natura). The final skin island dimensions and a calculus of its area were also noted just before the second surgery. The senior author (A.K.D.) evaluated each patient for the grade of capsular contracture as described by Spear and Baker<sup>15</sup> during clinical evaluation, according to the follow-up after the second surgery.

Statistical analysis was performed with SPSS software, version 24.0 (Chicago, IL). Descriptive analysis was carried out; data of the characteristics of various categorical variables were presented as frequencies and percentages, and data of quantitative variables were presented as measures of central tendency (mean and median) and dispersion measures (standard deviation).

## Results

Five out of 132 initially selected patients were excluded under the criteria adopted. Another four patients either died or did not come back to follow-up. Information of each patient about clinical data, technique, and clinical outcome was retrospectively collected from 123 patients ( $n=123$ ) (Table 1).

The age of patients at the time of breast reconstruction ranged from 27 to 74 years (mean=45.1; SD=7.8). Sixteen of them underwent a simple mastectomy (13%), and 107 underwent a modified radical mastectomy (87%).

One hundred eight patients (88%) stayed for two days in hospital, and eleven patients (9%) stayed for three days (only two patients stayed for one day and another two patients for four days). No patient required a blood transfusion or intensive care. The mean time between mastectomy



**Figure 1** A 42-year-old patient with post left-sided mastectomy and radiotherapy sequel with a left transverse latissimus dorsi musculocutaneous flap associated with Becker 35 expander /685cc - Frontal view during expansion period.

and radiotherapy was 12 months (SD=4.6). The mean and median daily-fractionated radiotherapy dose was 50.4 Gy (range 44-52 Gy), and the follow-up ranged from 6 to 84 months, with a median of 34 months.

The nipple-areola complex was reconstructed in 77 patients (62.6%). Contralateral breast procedures were performed in 68 patients to achieve symmetry. Our preference to the nipple-areola complex reconstruction was a nipple graft (with the contralateral nipple as a donor area) and an areolar tattooing. Seventy-seven patients submitted to a second stage breast reconstruction surgery (Figures 1-14) had the Becker expander implant replaced by a conventional natural-shaped (Mentor CPG 323) or a round high-profile silicone implant with textured surface to obtain better symmetry. This second-stage surgery was performed between 6 and 13 months (mean=7, SD=5.7) after LDMF/E reconstruction (Table 2).

Becker 35 expander volumes ranged from 460 to 865 (mode=565), and hyperexpansion was not used in our routine. The total reconstructed breast volume was reached in one to four postoperative expander sessions, which initiated approximately 30 days (mode=35) after the first stage of

**Table 2** Reconstruction data and clinical outcome of transverse latissimus dorsi myocutaneous flap associated with Becker expander in patients submitted to radiotherapy.

| Data   | Category                    | <i>n</i>   | %          |
|--|-----------------------------|------------|------------|
| Becker expander volume   | 460 cc                      | 16         | 13.0       |
|  | 565 cc                      | 79         | 64.2       |
|  | 865 cc                      | 28         | 22.8       |
| Volume of silicone breast implant (Mentor CPG 323 or round high profile) at second stage of reconstruction | 440-475                     | 8          | 6.5        |
|  | 495-555                     | 66         | 53.7       |
|  | 600-650                     | 36         | 29.2       |
|  | 685-700                     | 13         | 10.6       |
| Complications: flap, breast skin and/or donor site   | None                        | 105        | 85.4       |
|  | Minor <sup>a</sup>          | 13         | 10.6       |
|  | Major <sup>b</sup>          | 4          | 3.2        |
|  | Becker exposition - failure | 1          | 0.8        |
| Classification of capsular contracture after prosthetic breast reconstruction <sup>15</sup>                | IA or IB                    | 119        | 96.8       |
|  | II                          | 3          | 2.4        |
|  | III                         | 1          | 0.8        |
|  | IV                          | 0          | 0          |
| Areas of skin island of the flap at donor site   | 52.5-60 cm <sup>2</sup>     | 81         | 65.9       |
|  | 61-77.5 cm <sup>2</sup>     | 42         | 34.1       |
| Areas of skin island of the flap at the reconstructed breast   | 52.5-60 cm <sup>2</sup>     | 61         | 49.6       |
|  | 61-77.5 cm <sup>2</sup>     | 62         | 50.4       |
|  | <b>Total</b>                | <b>123</b> | <b>100</b> |

<sup>a</sup> Seromas, dehiscence (approximately 1.5 cm) at the reconstructed breast or at the donor site, partial flap or breast skin necrosis (3 cm or smaller)/local infection.

<sup>b</sup> Breast skin necrosis (larger than 3 cm)/local infection.

**Figure 2** Frontal pre-operative view.**Figure 3** Donor-site in detail. Size of the skin flap pad 17 × 9 cm.

the breast reconstruction surgery. The reconstructed breast expansions increased the latissimus dorsi skin area covering the Becker expander; hence, the final dimensions became larger than the skin area planned on the back. Comparing the skin dimensions of the flap planned at the donor site to the skin area of the reconstructed breast after expansions, an enhancement in measures between 1.5 and 3 cm was observed. These enhancements could be the ways to obtain a larger final silicone implant volume at the second stage of breast reconstruction surgery. The majority of patients (91

or 74.0%) had the silicone implant volume larger than the Becker volume (Table 2).

Considering the donor site area, no complications were observed in 116 patients (94.3%). Minor complications (observed) were seroma in one patient and partial dehiscence in another patient ( $n=2$ ). There were no hematomas, necrosis, infection, contour deformity, lumbar hernia, and skin retractions. Chronic pain was not mentioned at the



**Figure 4** Postoperative view 11 months after second stage breast reconstruction surgery. Becker expander was substituted by an anatomical shaped high projection silicone implant (volume = 620cc). The nipple reconstruction was performed with the contralateral nipple as a donor area - Frontal view.



**Figure 5** Left lateral view.

donor site. We could not evaluate cosmetic outcomes of the dorsal scar (Table 2).

Regarding the reconstructed breast, minor complications were found in 11 patients (8.9%), such as hematomas, partial necrosis of the native irradiated breast skin (3 cm or smaller), local infections, and partial exposition of the injection port. There was no flap loss, no distortion, or expander exposition. Major complications observed were necrosis larger than 3-5 cm of the native irradiated breast skin in 5 patients (4.0%) who needed outpatient repair to avoid exposure of the Becker expander; however, one of these patients needed to have the expander removed due to a larger exposition (Table 2).

Regarding capsular contracture, most reconstructions (113 patients, 91.9%) were classified as Baker IA or IB<sup>15</sup> (Table 2).



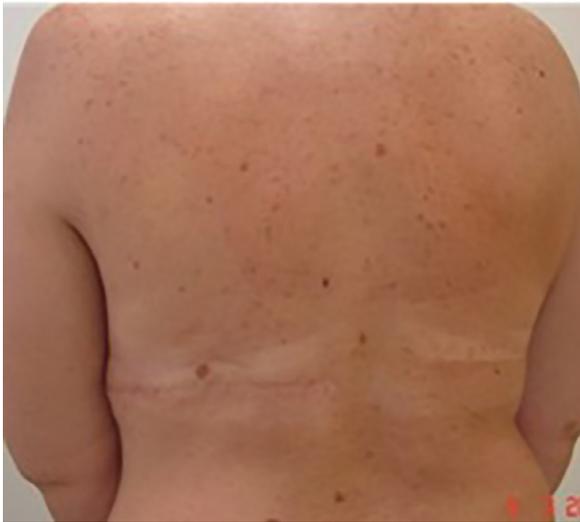
**Figure 6** Right lateral view.



**Figure 7** A 36-year-old patient with post left-sided mastectomy and radiotherapy sequel - Patient yearned for bigger breasts - Frontal view.



**Figure 8** Frontal view with left transverse latissimus dorsi musculocutaneous flap associated with Becker 35 expander/565cc during the expansion period.



**Figure 9** Donor-site in detail. Size of skin flap pad  $16 \times 9$  cm.



**Figure 11** Left lateral view.



**Figure 10** Postoperative view 13 months after second stage breast reconstruction surgery. Becker expander was substituted by an anatomical shaped high projection silicone implant (volume = 555cc). The contralateral augmentation mammoplasty and the nipple reconstruction are concluded. The nipple reconstruction was performed with the contralateral nipple as a donor area - Frontal view.



**Figure 12** A 48-year-old patient with post left-sided mastectomy, radiotherapy sequel, and transverse latissimus dorsi musculocutaneous flap associated with Becker expander. The patient did not want to have right breast mammoplasty - Frontal view.

## Discussion

The latissimus dorsi myocutaneous flap associated with Becker 35 expander implant provides a reliable and consistent reconstruction in patients submitted to radiotherapy. Historically, the latissimus dorsi flap was commonly associated with an implant or an expander (not so common) to achieve a reconstructed breast mound.<sup>2-10</sup>

Several authors have evaluated implant types, capsular contracture degree plus flaps in breast reconstructions. The option of the latissimus dorsi flap plus an expander seems to reduce capsular contracture degree.<sup>16,17</sup>

Capsular contracture is a multifactorial subject that involves sensitivity of patients to irradiation, inflammatory re-

sponse, bacterial infection, position of implant, and type of elastomers, among many other factors. Our patients showed a low incidence of this complication and also with low Baker grade, particularly considering the selection of irradiated patients, although analysis was for a short period of time.

Degradation of appearance after a long postoperative period was observed by many authors.<sup>2,4,11,16</sup> In fact, patient satisfaction rates slightly deteriorated with time.<sup>7</sup> Muscular atrophy of the flap and the subcutaneous tissue can also occur in the long term, hence causing loss of volume, especially in thin patients.<sup>18</sup> In these patients, the usage of autologous tissues to correct the insufficient volume is preferred, and the first choice is fat grafting as described by Coleman<sup>19</sup> with reliable results. Additionally, the usage of



**Figure 13** Postoperative lateral view 6 months after breast reconstruction surgery. Becker 35 expander/685cc was maintained.



**Figure 14** Donor-site in detail. Size of the skin flap pad 15 × 7 cm.

fat grafting in irradiated area improve the skin quality with the formation of a new subcutaneous tissue.<sup>20</sup>

The capsular contracture of the reconstructed breast and its failure to undergo natural ptosis as the patient ages may play a role in these dynamic changes of the satisfaction rate. Certainly, these facts represent disadvantages to the technique. However, these negative radiotherapy effects are more intense in cases of immediate breast reconstructions, as the latissimus dorsi flap and the implant may receive radiotherapy doses as part of cancer treatment when adjuvant radiotherapy is indicated.<sup>6,7</sup>

Radiotherapy increases the risks of necrosis/infection, implant exposure, capsular contracture rates and grades, and the incidence of poor cosmetic outcome. Performing the flap after radiation occurs in the breast area allows the transposition of a healthy tissue that can be expanded to replace the tissues that suffered radiation damage. The Becker expander contributed to improve our results, as its

silicone portion gave an initial volume and provided a well-distributed tissue tension and it was softer than a total saline expander.

Irradiation should not be an absolute contraindication for breast reconstructions based on an implant/expander, especially when a myocutaneous flap is used.<sup>19-26</sup> Our results reinforce the possibility of using the Becker expander even in adverse radiation sequels.

Our study proposes a novel sequence of procedures with the Becker expander as the first stage to the final reconstruction result. The application of this methodology was particularly successful in patients with irradiation sequel or the necessity of a large breast/volume reconstruction. It was an approach to reduce tissue tensions, avoiding flap ischemia and improving breast volume planning. In addition, it was also a way to obtain a better final volume definition, as we could establish the optimum expander volume before replacing it to the silicone implant in the second stage of the breast reconstruction.

Another positive result observed in our series was the lack of blood transfusions or intensive care as mentioned in other studies with TRAM flaps or endoscopic flaps.<sup>27,28</sup> We also found a short hospitalization period, with a median of 2 days. These lines of evidence empower the discussion of the options to perform breast reconstructions.

This series of cases found a low complication ratio, and no expanders were removed as a result of minor complications as seromas or partial necrosis. Nevertheless, outpatient procedures were necessary to restore the integrity of the skin in patients who had these types of complications.

The use of implants or Becker expanders to structure a breast mound with an irradiated tissue being part of its covering implies a potential risk of necrosis or even its exposition, which are disadvantages of our technique.

## Conclusions

Delayed breast reconstruction with TLDMF/E is a reliable option for patients with previous mastectomy and radiotherapy sequel with a low complication ratio. It is especially appropriate when a large breast volume is desired.

## Funding

None.

## Conflict of interest

The authors have no conflict of interest and no financial or any kind of relation with other people or organizations that may inappropriately influence the study.

## Ethical approval

This study follows the recommendations of the Helsinki protocol. The study protocol - EC42/17 - was approved by the Institutional Ethics Committee of A.C. Camargo Cancer Center - Antônio Prudente Foundation, São Paulo, Brazil.

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