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Delayed breast reconstruction using a combination of latissimus dorsi muscle flap and tissue expander with embodiment injection site

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Summary This article presents our experience in delayed breast reconstruction, using a combination of latissimus dorsi muscle flap (LDMF) and tissue expander with embodiment injection site, in a two-stage approach. A consecutive sample of 50 patients was studied. The average length of follow up was 4 years (range 12–72 months). In all patients the above two-stage approach was performed. The results are encouraging. Using LDMF and tissue expansion for delayed breast reconstruction has proven to be useful. This approach provides sufficient muscular coverage of the implant. The level of patient satisfaction is high. Major complications are rare. The minor complications are represented mainly by the dorsal seroma. The technique with LDMF has been improved substantially during the past few years. In our experience, it provides the plastic surgeon with an excellent, safe and consistently successful method for delayed breast reconstruction.

The musculocutaneous latissimus dorsi flap (LDF) has been a popular method for breast reconstruction since its first description by Mühlbauer and Olbrisch in 1977[1] and Bostwick et al. in 1978.[2] Other methods include tissue expansion, transverse rectus abdominis muscle flap (TRAM), deep inferior epigastric perforator flap (DIEP), superior gluteal artery perforator flap (SGAP), superior inferior epigastric artery flap (SIEA) and the gracilis flap. Even though results reported in the literature showed the free TRAM and DIEP flaps to be the best options for breast reconstruction, the use of the latissimus dorsi muscle flap (LDMF) must be revisited.[3–7] Despite the fact that oncological breast surgery has evolved from the radical mastectomy to the modified radical mastectomy and that the skin-sparing mastectomy is the latest evolution in surgical management of breast cancer, there is a group of mastectomy patients who need guidance and care for breast reconstruction because of their 'high-risk' chest wall. These are patients who have received radiotherapy, are heavy smokers, and have poor quality chest wall scarring with thin flaps. For such patients LDMF remains an attractive and useful alternative in the repertoire of different methods for breast reconstruction. Even though these risk factors are not major contraindications for free TRAM, DIEP or SGAP flaps, a free flap is a technically demanding

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procedure with which it is difficult to achieve a good aesthetic result. In nonspecialist centres for such patients, a free flap is usually a more difficult procedure with a high incidence of failure. Moreover, the LDMF can also be used when the TRAM flap (free or pedicled) or DIEP flap are contraindicated, when these two techniques are rejected by the patients or when the dorsal site is preferred. We present our experience using LDMF and tissue expansion in a two-stage approach.

Patients and methods

The medical records of 50 women who underwent delayed breast reconstructions at Iaso Hospital between December 1999 and December 2005 were reviewed to evaluate patient satisfaction with the postoperative results as well as the incidence of complications after surgery. Patient age ranged from 35 to 59 years. In 26 patients (52%) the tumour size was less than 20 mm and in 24 patients (48%) the tumour size was more than 20 mm. Seventeen cases (34%) were lobular cancer and 33 (66%) were ductal cancer. Seventeen cases (34%) had good grading, 22 (44%) moderate grading and 11 cases (22%) had poor grading. Twenty-nine (58%) patients had undergone modified radical mastectomy and 21 (42%) skin-sparing mastectomy. At the time of breast reconstruction, all patients presented without clinical evidence of metastasis. Thirty-six patients (72%) were smoking more than 10 cigarettes/day and 14 patients (28%) were not smoking. Twenty-seven patients (54%) had blood pressure measurements $>$16 mm Hg and 23 patients (46%) less than 16 mm Hg. Only one patient (2%) was suffering from diabetes mellitus. Thirty-nine patients (78%) received radiotherapy and 33 patients (66%) received chemotherapy. In 34 patients (68%) the reconstruction occurred in the left side and in 16 patients (32%) in the right side. In all patients, we used a combination of LDMF and tissue expansion in a two-stage approach.

A preoperative function test of the latissimus dorsi muscle (LDM) allows us to judge the integrity of the thoracodorsal vessels. The flap is raised with the patient in a lateral supine position. The upper arm is placed on an armrest in a slightly abducted position. This facilitates exposure of the muscle harvest. Inflation greatly aids dissection and haemostasis. We prefer a horizontal incision of 6—8 cm so that the scar will be under the brassiere strap. We recommend raising the muscle at the beginning of the operation. Dissection proceeds superficially to the muscle as distally as required using a light-fitted rack. Dissection deep to the muscle is in a relatively avascular plane and, when freed, the anterior border is delineated and mobilised followed by the more difficult medial border. Although the thoracodorsal vessels enter the LDM 6—8 cm below the cranial top and more at the medial margin, it is still necessary to inspect and preserve the thoracodorsal vessels. The thoracodorsal nerve is medial to the vessels and branches off from them below the auxiliary vein. The LDMF remains connected only to the thoracodorsal and the serratus collateral vessels. As a result, the entire muscle gains immense mobility. If needed, the tendinous insertion of the muscle attached to the humerus is transected completely while maintaining the integrity of the thoracodorsal nerve. The tendon is cut with scissors, sparing the neighbouring teres major muscle. In this way, the LDMF is elevated taking care to exclude the serratus anterior muscle. Once the flap is harvested, a tunnel is created to the mastectomy scar and the flap is mobilised anteriorly to the prepared anterior thoracic breast area. After placing one suction drain, the donor site is closed with running buried suture of Vicryl 2/0 and interrupted Nylon 4/0 sutures in a mattress way. After skin closure, the patient is moved into the supine position. Through the mastectomy incision, a pocket is created underneath the pectoralis major muscle (Fig. 1). In the next step, the anterior border of the LDMF is attached to the anterior serratus muscle. The pocket is left large enough to permit insertion of the expander but does not extend beyond the mid-auxiliary line. An anatomical textured tissue expander with an embodiment magnetic injection site is placed sub-muscularly inside the creative pocket and is parachuted into position (Fig. 2). Expansion to approximately 120 cc is commenced intraoperatively. To prevent seroma in the donor area, the drain in the back is left for at least 3 days (the range of time for the drain remaining in situ was 3—5 days, mean 4 days) and compression bandages are used over a period of 1—2 weeks. Expansion time ranged from 4 to 5 months (mean 4.5 months). A postoperative overcorrection of the desired breast size of 15—20% for a period of approximately 2 months is recommended.

During the second operative stage, the lateral edge of the mastectomy scar is opened to remove the expander and to place the final prosthesis. An anatomical cohesive silicone implant is preferred (textured). After removal of the expander a capsulotomy may be performed if this is judged to be necessary. Some combination of dissection and internal suturing and creation of a new fold may be necessary. A breast reduction or mastopexy or breast augmentation in the contralateral breast can be performed at this stage in order to achieve symmetry and a better overall aesthetic result. A nipple areola reconstruction can be performed at this stage or during a third stage under local anaesthesia.

In nine patients a very 'high-risk' chest wall existed. In these patients a radical mastectomy had been performed

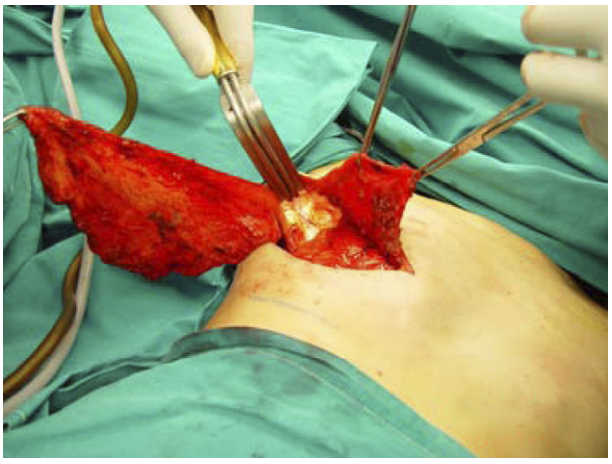

Figure 1 Through the mastectomy incision, a pocket is created underneath the pectoralis major muscle.

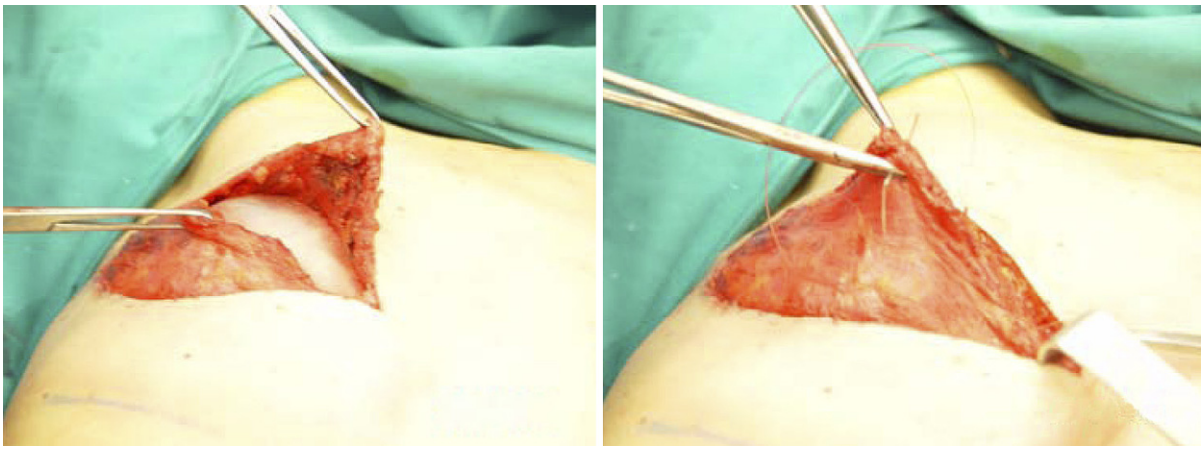

Figure 2 An anatomical textured tissue expander with an embodiment magnetic injection site is placed sub-muscularly inside the creative pocket and is parachuted into position.

and radiotherapy had been received. A major chest wall defect with thin mastectomy flaps adhered to underlying ribs existed. They had poor quality chest wall scarring and they were heavy smokers. In these patients a musculocutaneous LDF was performed. Additionally, in three of these nine patients, the musculocutaneous LDF was pre-expanded in the donor site area, in order to gain more skin.

Perioperative complications such as seroma that required puncture or drainage, and operative revisions for other reasons were recorded. Donor site morbidity including scarring was recorded. All patients were seen routinely 3, 6 and 12 months after breast reconstruction. The mean follow-up period was 4 years. All patients underwent a structured interview during the follow-up period to provide information on their personal view of the outcome of their breast reconstruction.

Results

A total of 50 consecutive patients were included in this study. Patient age ranged from 35 to 59 years (mean 47 years) (Table 1).

Complications were all minor (Table 2). Seroma was the most frequent complication after muscle harvest and occurred in 68% of the patients ($n = 34$). In 46% of the patients ($n = 23$), the seroma persisted after discharge. All the seromas were drained and treated conservatively. There was one episode of skin necrosis during the second-stage expander exchange. Despite the loss of an area of skin, the previously placed latissimus remained healthy, protecting the expander and resulting in a wound that healed ultimately with no expander loss. Postoperatively, five patients complained of impaired mobility of the shoulder region which required physiotherapy. Shoulder movement and muscle strength recovered within several weeks. After the second stage, two significant capsules developed (4%), one after 16 months and one after 20 months. We performed capsulotomy and implant exchange in these two patients. The first patient was treated 18 months and the second patient 21 months after the second stage.

In the donor site a hypertrophic scar was observed in 6% of the patients ($n = 3$), scar contraction in 4% ($n = 2$) and a painful scar in 2% of the patients ($n = 1$). No wound infection occurred (Table 3).

Table 1 Treatment of the contralateral breast

Breast reduction	26
Mastopexy	11
Augmentation	4
Total	41
Reconstruction of the nipple areola complex	43

Table 2 Complications

Complication	Incidence	
	n	%
Bleeding	0	0
Haematoma	0	0
Seroma	34	68
Minor wound dehiscence	2	4
Minor wound infection	1	2
Wound-edge necrosis	2	4
Partial flap necrosis	0	0
Flap necrosis	0	0
Expander loss	0	0
Capsule after the 1st stage	0	0
Capsule after the 2nd stage	2	4
Skin necrosis	1	2
Operative revisions	8	16
correction of breast shape	2	
scar revision	3	
nerve severing	3	

Table 3 Donor site morbidity

Morbidity	*n*	%
Hypertrophic scar	3	6
Scar contraction	2	4
Painful scar	1	2
Wound infection	0	0

A personal structured interview was performed on all patients (Table 4). The aesthetic results were rated as excellent by 18% of patients ($n = 9$). Ninety-two per cent of the patients ($n = 46$) answered that they do not feel restricted in their occupation, private life or in doing activities. Ten per cent of patients ($n = 5$) answered with an excellent response to the question 'How do you rate the sensitivity of the reconstructed breast area?' and 45 women (90%) would recommend this procedure to other women.

Discussion

Breast reconstruction has become an integral part of breast cancer treatment and it is associated with an improvement in the quality of life of patients. Even though the microvascular TRAM and DIEP flaps appear to be the best treatment in autologous breast reconstruction,[3–7] these techniques may be contraindicated or are rejected by the patients. The preparation of a DIEP flap and generally the performance of microvascular procedures are considerably more demanding and not suitable for routine use. Prior surgery such as an open cholecystectomy or left internal mammary harvest may eliminate the use of a pedicle flap. Lack of sufficient abdominal soft tissue may provide an inadequate size match. Some colleagues reported that, after TRAM or DIEP procedure, they did not face severe problems such as a decreased ability of the patient to lift heavy objects, a poor aesthetic outcome in the donor area and chronic pains in the lower abdominal wall[8]; some other colleagues, however, agree with our experience in which we did have such problems.[6] Our experience also showed us that a properly performed cosmetic abdominoplasty, analogous to closing a DIEP flap defect, usually does not satisfy a breast cancer patient. These patients usually have suffered a stressful period due to their disease (mastectomy, radiotherapy, chemotherapy). In our country such patients will not easily accept an additional obvious scar on their belly. After a radical mastectomy, some patients are left with a major chest wall defect with thin mastectomy flaps adhered to underlying ribs. A degree of delayed healing may lead to considerable flap separation when the old scar is incised. Even in a situation in which there is obvious skin loss and the latissimus is used to incorporate a cutaneous paddle, poor healing around the edges of the flap may occur due to the poor vascularity of the recipient site. It is well documented that radiotherapy affects tissue healing with acute-phase subcutaneous haemorrhage and oedema, small-vessel occlusion, followed by late changes of small-vessel thrombosis, peri-ventitial fibrosis and endothelial proliferation and narrowing.[9] It has been shown, together with heavy smoking, that radiotherapy leads to a substantial increase in expander loss and complications.[10] The LDMF is an important alternative in patients who wish to undergo breast reconstruction. By using the LDMF to create a pocket, the incidence of capsular contracture and implant failure is reduced. In addition, a more natural appearance is obtained. The donor morbidity is minimal and recovery time is decreased compared with the TRAM flap. The concept of incorporating vascularised tissue into relatively avascular areas is well documented in reconstructive surgery, such as the use of free muscle flaps in the treatment of osteomyelitis.[11] The latissimus acts in a similar way, supplying a vascularised stent to the vulnerable chest wall flap. The muscle may also control tissue expansion and, to a degree, may distribute the pressure via the muscle through the tenuous skin. This equal distribution of pressure aids the overall shape of the reconstructed breast. The ability to create the chest wall pocket from a distant site is of equal importance, removing the need to create a fresh chest wall wound at a crucial stage. The indications for this procedure are: postradiotherapy, heavy smoker, poor chest wall scarring and lumpectomy defect.[12] A reduced donor site scar also adds to the indications. The latissimus is used as a stent for a poorly vascularised chest wall. The transferred latissimus can act as an excellent cosmetic cover in an attempt to camouflage the prosthesis.

Table 4 Patient satisfaction with reconstructed breasts

Response	*n*	%
1. Are you satisfied with the current result of your breast reconstruction?		
Excellent	9	18
Good	20	40
Adequate	11	22
Satisfactory	6	12
Poor	2	4
Unacceptable	2	4
2. Do you feel restricted in your occupation, your private life or in doing sports activities?		
Yes	4	8
No	46	92
3. How do you rate the sensitivity of the reconstructed breast area?		
Excellent	5	10
Good	7	14
Adequate	14	28
Satisfactory	15	30
Poor	5	10
Unacceptable	4	8
4. Would you repeat this type of breast reconstruction?		
Yes	44	88
No	6	12
5. Would you recommend breast reconstruction with the combination of LDMF and tissue expansion in a two-stage approach to other women?		
Yes	45	90
No	5	10

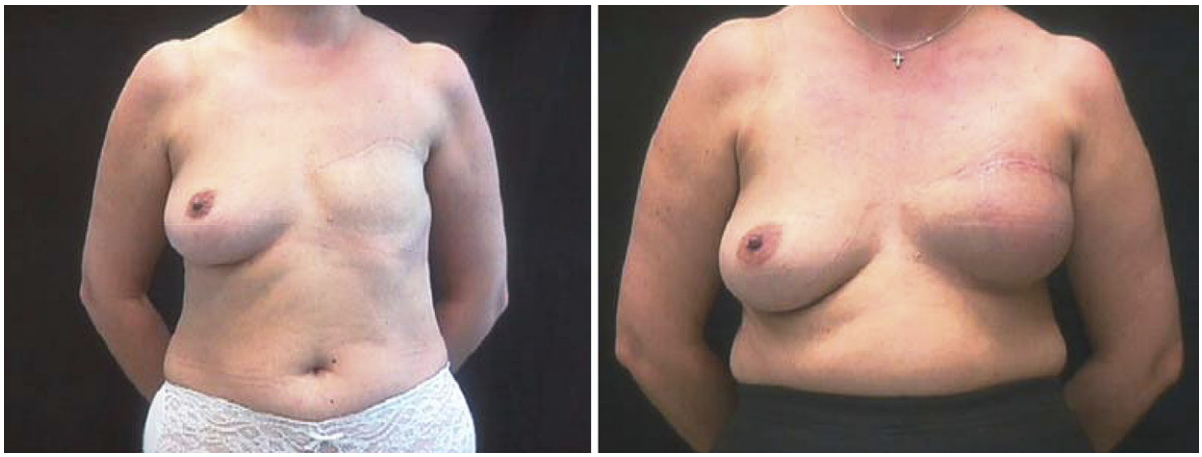

Figure 3 Preoperative view (left) and postoperative view (right) 4 months after the first stage. A tissue expander with an embodiment magnetic injection site is placed inside the pocket that was created using a LDMF.

A consecutive series of 50 LDMF and implant procedures was performed in our hospital by the authors without any flap loss or other major complications. The overall complication rate was low. The most important complication was a high incidence of seroma at the donor site, which occurred in 34 patients (68%). This phenomenon is well known and has been reported by others in as many as 79% of patients,[13] even though Titley et al. reported 0% incidence of seroma.[14] In accordance with others,[15] we advocate the preservation of the LDMF innervation to maintain muscle bulk and volume, even though there is still some debate about this issue in the literature. Tarantino et al., in a recent report, advised readers to routinely transect the nerve because of muscle spasm problems in 16% of cases.[16] In our series, postoperative abnormal muscle movements that required severing of the nerve were seen in three patients (6%). Trans-section of the tendinous insertion of the muscle on the humerus is performed routinely to reduce discomfort resulting from spontaneous muscle contractions and bulge formation below the axilla, as well as to improve the aesthetic outcome. Donor site morbidity is another issue for debate in breast reconstruction using autologous material. Forty-six of our patients (92%) denied they suffered any restrictions in their professional and private lives or in sports activities. Even though the low rate of complaints reported by our patients after the loss of LDMF function is in accordance with earlier results,[17] in another recent report patient-reported loss of shoulder force, limitation in shoulder function, discomfort, and impairment occurred in 31—51% of cases.[16] In our current study, donor site morbidity was very low compared with complications such as weakness of the abdominal wall or even formation of a hernia reported for the TRAM flap by others.[6,18,19] On the other hand, our low donor site morbidity is similar to the low DIEP donor site morbidity that Garvey et al. reported.[8] In our study the capsule contracture rate was lower (16% revision rate, 4% contracture rate) compared to earlier reported contracture rates after LDMF with expanders (8—16%) or implants (21—75%).[20,21] The capsule contracture rate after using LDMF with expanders is usually lower compared to LDMF with implants. The reason for infrequent symptomatic contractures is

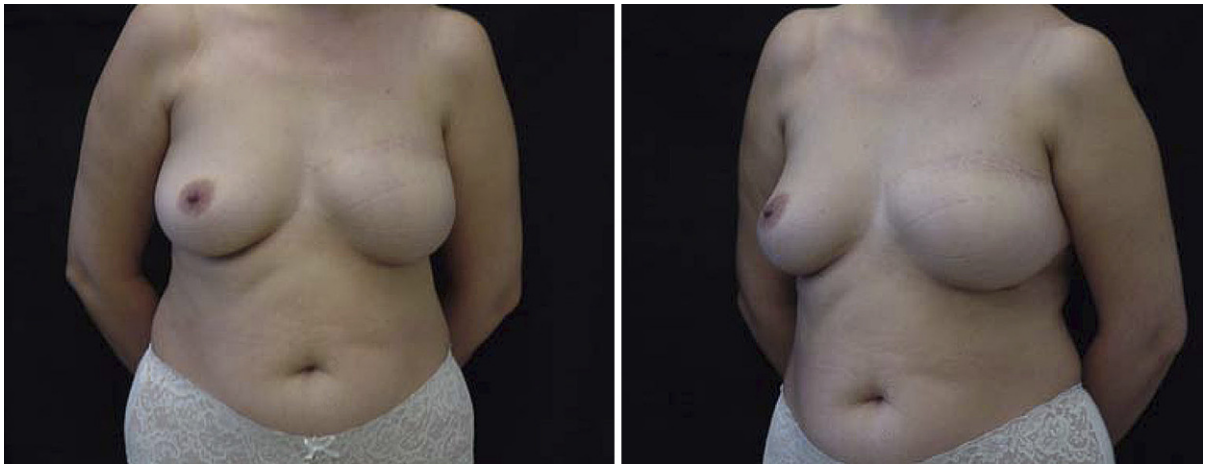

Figure 4 Postoperative view 1 month after the second stage. The expander has been replaced with an anatomical cohesive-textured silicone implant.

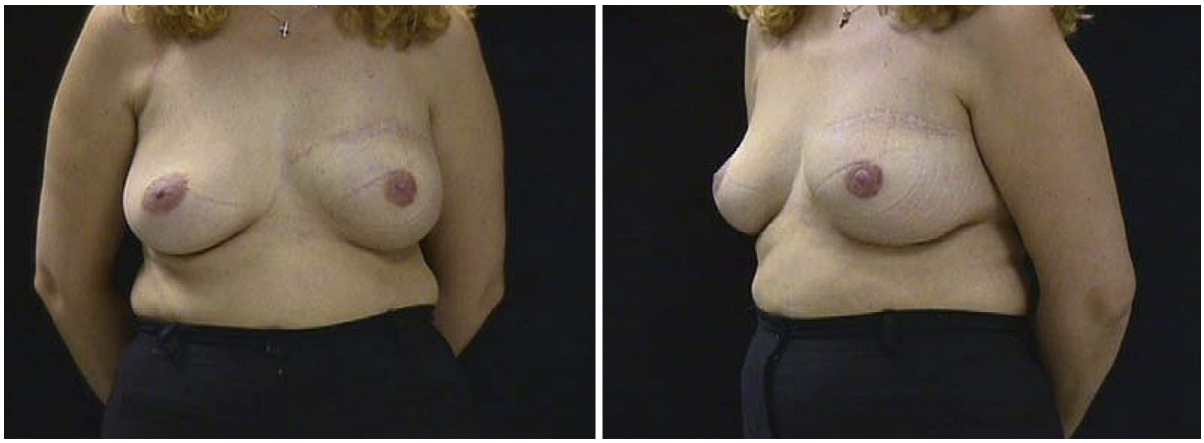

Figure 5 Postoperative view 2 years after the nipple areola complex reconstruction. Final result.

probably because of the gradually maturing capsule of the expander, in which the final implant is placed. Moreover, the equal distribution of pressure that the expander provides may contribute to the low capsule contracture rate. Finally, the fact that after removal of the expander a capsulotomy may be performed, if this is judged to be necessary, may also contribute to the low capsule contracture rate. In our patients we did not face any serious problems of late implant malposition or migration. As previously mentioned, we had postoperative abnormal muscle movements that required severing of the nerve in three patients. One of the advantages of this technique is that an oversized pocket is created due to the overexpansion. In this way you limit the possibilities of implant malposition or migration. Of course in our series we may not have had such problems because of the effect of time: our maximum follow up was only 6 years (mean 4 years). Tarantino et al. in a recent report with a minimal follow up of 10 years (mean 15 years) showed that most significant implant-related problems as capsule contractures occurred after 7.5 years.[16] He reported an implant-related revision rate of 50% with a definitive implant removal rate of 10%. The effect of time has a significant role on the incidence of implant-related problems. A great advantage in autologous breast reconstruction is that implant-related problems as capsule contracture do not exist. On the other hand, implant outcomes with the latissimus reconstruction are similar to those with cosmetic breast augmentation. All of us perform cosmetic breast augmentations with great frequency despite the possible implant-related problems and despite the possible need for repeated operations in the patient's lifetime. Only two patients (4%) stated that the final aesthetic result was unacceptable. One of the two patients who rated the aesthetic result as unacceptable was a 59-year-old obese woman. The patient developed severe seroma after the first stage resulting in delayed healing. Postoperative convalescence was protracted by an extended in-hospital stay (16 days). The other patient experienced recurrent, severe capsular fibrosis. Only 8% of the patients ($n = 4$) reported feeling restricted in their life, one in her professional life, one in her private life and two when participating in sports. Two of these four patients rated their problems in these areas as substantial. The last two patients were active skiers, who complained of impeded shoulder mobility. The acceptance of the change in the sensitivity of the reconstructed breast was high; only four patients (8%) rated this factor as unacceptable.

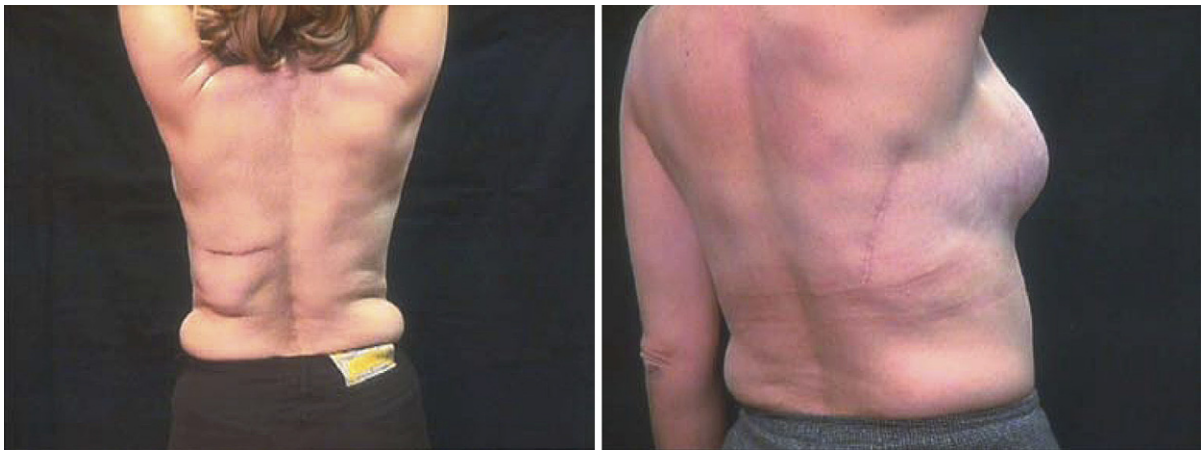

Figure 6 Postoperative result after LDMF harvest (left) and musculocutaneous LDF harvest (right).

Forty-four patients (88%) stated that they would repeat this type of reconstruction. The small number of women ($n = 6$, 12%) unwilling to repeat the procedure expressed dissatisfaction with the cosmetic result, the scar or had back complaints. Forty-five patients (90%) would recommend this type of reconstruction to other women. Our study reports a high subjective patient satisfaction of 80%. Patient satisfaction may differ from surgeon satisfaction as the patient may measure success differently; however, we must take into consideration that breast reconstruction is an aesthetic operation. Our experience showed us that in aesthetic plastic surgery it is the opinion of the patient that counts. We must always operate for the satisfaction of the patient even though the patient is not the professional and her opinion is always subjective.

In conclusion, the LDMF for breast reconstruction has now been available for approximately 30 years.[22] In the hands of the experienced plastic surgeon, the LDMF is a safe technique with excellent results.[20] We use a two-stage approach, with the combination of LDMF and an expander with an embodiment injection site, with acceptable aesthetic results (Figs. 3–6). We have found this approach to be an effective method of providing breast reconstruction. It is a successful approach, because it provides sufficient muscular coverage of the implant. This procedure provides a good aesthetic result in a procedure with minimal complication rate, donor site morbidity and decreased recovery time. Patient satisfaction is high. Breast reconstruction with the combination of LDMF (musculous or musculocutaneous) and an expander with an embodiment injection site provide the plastic surgeon with an outstanding, highly successful procedure that can be recommended as an additional valuable approach in breast reconstruction.

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