The latissimus dorsi flap is a very reliable and versatile method, and is one of the best options for both immediate and delayed breast reconstructions.\textsuperscript{1–5} Despite the consensus regarding this procedure, its use has traditionally been limited by the desired size of the reconstructed breast. To overcome any shortfall in final volume, the flap is routinely augmented at the time of its harvest by the positioning of breast implants. Risks of infection, extrusion, rupture, capsular contracture, poor cosmetic outcomes following radiotherapy, and a recently suggested connection with anaplastic large-cell lymphoma are the main disadvantages of using implants.\textsuperscript{6–9}

The extended latissimus dorsi myocutaneous flap for autologous breast reconstruction was first introduced by Hokin in 1983, who took the whole muscle and the lumbar fascia with the largest possible skin paddle, avoiding the need for an implant to supply adequate breast volume, with 70 percent of flaps providing an excess of 400 cc.\textsuperscript{10} The surgical technique grew rapidly in popularity, and Delay et al. were among the pioneers reporting its advantages, disadvantages, and results in a consecutive sample of 100 patients.\textsuperscript{11} However, in this procedure, the increase in flap volume is correlated to greater donor-site morbidity, such as wound dehiscence, skin necrosis, and seroma formation, with often a contour and an aesthetic defect left to the dorsal donor area.\textsuperscript{12} Because of its relative cost, ease of use, low morbidity, and longevity, autologous fat transfer has recently become recognized as an essential and useful tool with which to achieve complete breast reconstruction. This flap...
is also able to improve the aesthetic outcomes of other methods of postmastectomy reconstruction such as the deep inferior epigastric perforator flap (DIEP), the thoracodorsal artery perforator flap, expander, and prosthesis.13–18 The compound latissimus dorsi myocutaneous flap provides suitable recipient tissue for fat transfer with a good blood supply and a reasonable volume of host tissue to inject into. The aim of this study is to present our experience with the use of the pedicled latissimus dorsi flap coupled with immediate intraoperative and, if needed, delayed fat grafting for total autologous breast reconstruction without implants.

PATIENTS AND METHODS

Between December of 2010 and May of 2013, 23 patients underwent total breast reconstruction with primary fat augmented latissimus dorsi pedicled flaps, in 21 cases for unilateral and in two cases for bilateral reconstruction. The mean patient age was 52.3 years (range, 39 to 68 years), and the mean body mass index was 24.77 kg/m² (range, 21.5 to 28.7 kg/m²). Indications for this technique were patients with small to moderate breast volume and with contraindications for abdominal free flaps, such as previous abdominoplasty, multiple abdominal scars, or previously harvested DIEP flap for the contralateral breast; and patients who reported a family history of deep venous thrombosis or pulmonary embolism with a positive thrombophilia screen. Patients’ records were reviewed retrospectively, evaluating the operative notes, complications, results, and follow-up.

Surgical Technique

In nipple-sparing mastectomy, skin-sparing mastectomy, or modified radical mastectomy, the planning of the latissimus dorsi flap included the largest transverse skin paddle (approximately 10 to 12 cm wide) allowing for easy closure of the donor site and for hiding of the scar in the bra. The bra strap area and inframammary crease were marked out with the patient in upright position. The transverse skin paddle was drawn on the back by the use of the pinch technique and was centered on the middle to lower bra strap area (Fig. 1). In unilateral reconstruction, the general surgeon and the plastic surgeon performed mastectomy and latissimus dorsi flap harvest procedures simultaneously with the patient in lateral decubitus position and the upper limb suspended at right angles, to give an adequate axillary access. The donor site was closed primarily over the flap and drains in the usual fashion, with fat harvested simultaneously (Fig. 2); then, the patient was turned to the supine position and the flap was rotated through the axilla to the anterior chest-wall area. In bilateral reconstruction, first, plastic surgeons harvested both flaps with the patient in the prone position and, second general surgeons carried out the mastectomy procedure simultaneous with fat harvest with the patient in the supine position. In both unilateral and bilateral reconstructions, once the skin paddle was isolated on the latissimus dorsi,
the outlined skin paddle, over the trapezius muscle, the iliac crest and the lateral back, leaving the thoracolumbar fascia on the back; the neurovascular pedicle was identified from below and the nerve was not divided. The donor area was closed in two layers using 2-0 Vicryl (Ethicon, Inc., Somerville, N.J.) simple stitches to the Scarpa fascia and 3-0 Vicryl Plus (Ethicon) continuous suture to the superficial dermis.

In case of nipple-sparing mastectomy, the skin paddle was totally deepithelialized, whereas in skin-sparing mastectomy and modified radical mastectomy, the exact defect was outlined on the planned skin paddle from the pattern imprint and the rest was deepithelialized, if needed. Fat tissue was harvested using the Coleman technique with a 2- to 3-mm cannula and a 10-ml syringe; it was centrifuged at 3000 rpm for 3 minutes and finally injected into the superficial and deep adipose layer of the latissimus dorsi flap skin paddle and muscle fascia with 1-ml syringes (Fig. 3). After fat expansion, the totally or partially deepithelialized latissimus dorsi skin paddle was secured to the lower edges of the breast pocket, under mild tension, and the distal muscle portion was folded onto itself, achieving extra bulk. Breast skin was redraped over the new mound, and a suction drain was positioned before skin closure (Fig. 4).

**RESULTS**

The mean operative time was 2.62 hours (range, 2.10 to 3.20 hours) for unilateral and 4.12 hours (range, 4.10 to 4.15 hours) for bilateral reconstructions. The mean size of the harvested

**Fig. 2.** In unilateral reconstruction, the general surgeon and the plastic surgeon performed mastectomy and latissimus dorsi flap harvest procedures simultaneously with the patient in the lateral decubitus position. The donor site was closed primarily over the flap and fat was harvested simultaneously.

**Fig. 3.** (Left) Fat tissue is harvested using the Coleman technique and injected into the superficial and deep adipose layer of the latissimus dorsi flap skin paddle and muscle fascia with 1-ml syringes. (Right) Fat-augmented latissimus dorsi flap.
skin paddle was 19.7 × 11.04 cm (range, 18 × 10 cm to 21 × 12 cm). Donor-site areas for fat harvest were the abdomen in 14 cases and the flanks in nine cases, with a mean harvested fat volume of 126 ml (range, 90 to 180 ml) and a mean injected fat volume of 101 ml (range, 60 to 150 ml).

Drain removal was performed when fluid output was less than or equal to 30 ml. In unilateral reconstruction, the patients were discharged to home on postoperative day 3 or 4, and the mean time to dorsal drain removal was 8.3 days (range, 5 to 13 days); whereas in bilateral cases, both patients were discharged on the sixth postoperative day and the mean time to dorsal drain removal was 9 days (range, 6 to 12 days). All flaps healed uneventfully and no seroma occurred in the donor site. All patients were evaluated by a multidisciplinary team (i.e., radiologist, plastic surgeon, and breast surgeon) and were monitored from primary surgery every 6 months by clinical examination and annually with ultrasonography and mammography. No patient experienced local recurrence or distant metastasis; no fat grafting–related complications were observed to either the recipient or the donor site, and none of the patients had any subjective functional impairment within an average follow-up of 18.30 months (range, 12 to 36 months).

Preoperative and postoperative photographs of a bilateral latissimus dorsi flap reconstruction are shown (Figs. 5 and 6). With a mean follow-up of 10 months, three patients required an additional session of fat transfer to correct irregularities located at the superior and medial aspects of the chest wall to improve breast shape, whereas two patients underwent two fat transfer sessions to enhance

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**Fig. 4.** Immediate result after breast skin has been redraped over the new mound that appears similar to implant placement.

**Fig. 5.** Patient 2. A 42-year-old woman underwent bilateral nipple-sparing mastectomy and immediate fat augmented latissimus dorsi flap reconstruction; preoperative and postoperative frontal views. She was not considered a good candidate to undergo DIEP flap bilateral reconstruction because of inadequate abdominal tissue.
DISCUSSION

The choice to undergo breast reconstruction is increasingly commonplace and has proven psychological benefits for many women.\(^1\) Many options for breast reconstruction exist, which are typically grouped into alloplastic, autologous, and a combination of both.

Type and timing of reconstruction is a multifactorial decision based on several factors that include size and shape of the native breast, location and type of cancer, the surgeon’s preference and experience, the patient’s demographic information, and whether adjuvant radiation therapy and/or chemotherapy is needed. Autologous microvascular reconstruction is recognized as the best choice for reconstructive options, affording the patient a natural, enduring breast that can be integrated with ease into her body image. In addition, the transferred tissue adjusts to changes in body weight and facilitates wound healing. Even if the DIEP flap still represents the criterion standard for autologous breast reconstruction,\(^2\),\(^3\) we suggest the latissimus dorsi flap coupled with immediate intraoperative and, if needed, delayed fat grafting as an alternative in patients who are not good candidates for abdominally

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Fig. 6. Patient 2. Preoperative and postoperative oblique views.

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Fig. 7. Patient 1. Preoperative and postoperative oblique views.

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Fig. 8. Patient 1. Preoperative and postoperative oblique views.
based flaps or for whom this technique is not an available option, or even as a primary option in patients with small to medium breasts. The latissimus dorsi flap, first described in the mid 1970s, has enjoyed a resurgence in popularity as a result of its relative simplicity combined with the very reliable and consistent vascularity of the flap. Despite these advantages, many surgeons continue to note problems in breast shape and implant-related complications. Moreover, a possible connection between prosthesis and a rare anaplastic large-cell lymphoma, often presenting as late seromas, has increased surgeon concern over seroma management, ranging from a conservative approach to implant removal and oncologic consultation to investigate other sites of disease.

Variations in the latissimus dorsi flap have been suggested to increase its volume and to avoid the use of an implant. The first so-called extended latissimus dorsi flap included lumbar fat extensions to the flap, and it further evolved to include the parascapular and scapular fat, in addition to lumbar

Fig. 7. Patient 4. A 51-year-old woman underwent left skin-sparing mastectomy followed by latissimus dorsi flap reconstruction, and immediate and delayed fat grafting. Preoperative and postoperative frontal views. Although she has adequate abdominal tissue for harvesting a DIEP flap, she reported a family history of deep venous thrombosis with positive thrombophilia screen and was considered not a good candidate to undergo the procedure.

Fig. 8. Patient 4. Preoperative and postoperative oblique views.
fat for additional volume.\textsuperscript{11,28,29} Using the extended latissimus dorsi flap, autologous tissue replacement of sufficient breast volume could be provided in many patients without implants, but with several limitations. Although major complications are rare, with only 1 percent total necrosis, donor-site wound problems such as dehiscence and necrosis occur in up to 30 percent of patients because of the impoverished blood supply of the local tissue, with seromas occurring in up to 79 percent of patients coupled with a possible contour defect left on the back.\textsuperscript{29–31} whereas the average is approximately 20 to 30 percent for common latissimus dorsi flap harvest.\textsuperscript{32,33} Even though in our case series five patients required an additional session of fat transfer, the same purpose of extended latissimus dorsi flap was achieved without complications in any of the patients. Latissimus dorsi flap harvest was

**Table 1. Patients and Operative Data**

<table>
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<tr>
<th>Patient</th>
<th>Skin Paddle Size (cm)</th>
<th>Mastectomy Weight (g)</th>
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<th>Fat Harvest (ml)</th>
<th>Fat Injection (ml)</th>
<th>Follow-Up (mo)</th>
<th>No. of Additional Fat Grafting Procedures (ml)</th>
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*Patient with bilateral reconstruction.
performed without additional subcutaneous tissue, saving the Scarpa fascia at the margin of the donor area defect. This allowed preservation of the blood supply and offered excellent strong tissues to available for a superficial tension-free wound closure.

Latissimus dorsi flap planning required the largest transverse skin paddle, with a mean size of 11.04 cm (range, 10 to 12 cm), to harvest the most autologous tissue available either for primary volume or for further volume expansion by means of immediate fat grafting. From our experience, a larger skin paddle results in higher tension applied to the deep layers, correlating to less serum collection and no seroma formation. Thus, closing the donor area without excess/loose tissue potentially reduces dead space and avoids donor-site wound problems.

As the perforator flap concept has gained acceptance on the reconstructive ladder, the latissimus dorsi flap evolved to the thoracodorsal artery perforator flap, which spares the latissimus dorsi muscle, resulting in less donor-site morbidity and with shoulder function preservation, a lower incidence of seroma formation, and no need for suction drainage. Although it had grown rapidly in popularity, the thoracodorsal artery perforator flap does not replace the latissimus dorsi flap in our practice, and no different indications for breast reconstruction are suggested. As reported previously in the literature,34,35 our main concerns are the inconsistent perforator size, quality, quantity, and location, which necessitate tedious and meticulous dissection, requiring more experience and skill to perform this procedure safely and quickly and to promptly convert a thoracodorsal artery perforator flap to a muscle-sparing latissimus dorsi flap if needed.

Conflicting reports regarding upper limb disability following unilateral and bilateral latissimus dorsi flap harvest are present in the literature. The severity of donor-site morbidity varies, according to the patient sample investigated (e.g., regarding sex, age, body habitus), type and site of the reconstruction evaluated (breast versus lower limbs versus head and neck), and the different associated procedures. Several studies have shown that latissimus dorsi muscle harvest for breast reconstruction has little effect on shoulder mobility36,37 and, as reported by Glassey et al., no significant range-of-motion loss at 1 year in a prospective review of 22 patients.38 Others have demonstrated some weakness, pain, and functional difficulties in the early postoperative follow-up.39,40

From the current case series, the latissimus dorsi flap provides suitable recipient tissues for fat transfer, with a rich blood supply and a reasonable volume to inject into, achieving a total autologous breast reconstruction. To allow immediate autologous volume augmentation and inferior breast pole shaping, intraoperative fat transfer can be performed safely in the superficial and deep adipose layer of the latissimus dorsi flap skin paddle and muscle fascia. From the results, it was possible to add an extra fat volume of approximately 100 cc preferentially into the lower portion of the skin paddle, to increase projection of the reconstructed breast, with an immediate result similar to implant placement (Fig. 4). If the desired breast volume is not achieved during the first operation or irregularities are still present at the superior and medial aspects of the chest wall, further delayed sessions of fat grafting can be performed under local anesthesia with sedation, and the patient can be discharged home safely and quickly. The preservation of the thoracodorsal nerve combined with muscle reinsertion to the inframammary fold is recommended to preserve muscle tropism, thus maintaining bulk and avoiding volume decrease in the reconstructed breast during the first year after surgery.

Given that the back scar is an inevitable price to pay for this procedure, the horizontal scar could be considered more aesthetically acceptable by the patients than an oblique one because it lies under the bra or bikini strap posteriorly. The use of autologous fat grafting has already been described as a very useful and reliable technique for primary reconstruction and a valid tool for correcting postoperative contour deformities.12–17

In our case series, all patients underwent immediate reconstruction; although further studies are needed, we believe that the immediate latissimus dorsi flap volume augmentation and contouring with fat grafting can be performed safely also in delayed reconstructions such as latissimus dorsi flap reconstruction with prosthesis. To the best of our knowledge, this is the first literature report where fat transfer is used to achieve immediate latissimus dorsi flap volume augmentation for breast reconstruction.

CONCLUSION

The pedicled latissimus dorsi flap coupled with intraoperative fat grafting is an alternative for total autologous immediate breast reconstruction, using easy and time-tested techniques and avoiding implant-related complications when abdominal tissues are not available.

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REFERENCES


