The Scarless Latissimus Dorsi Flap for Full Muscle Coverage in Device-Based Immediate Breast Reconstruction: An Autologous Alternative to Acellular Dermal Matrix

Foot

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Background: Thin patients have fewer autologous options in postmastectomy reconstruction and are frequently limited to device-based techniques. The latissimus dorsi flap remains a viable option with which to provide autologous coverage, although for certain patients the donor scar can be a point of contention. The scarless latissimus dorsi flap is a way of mitigating these concerns. The authors present their 6-year single-surgeon experience with scarless latissimus dorsi flap reconstruction.

Methods: A retrospective review of scarless latissimus dorsi flap reconstruction was performed. Charts from 2003 to 2009 were queried for demographic characteristics, nonoperative therapies, and short- and long-term complications. Results were compared with historical data.

Results: Thirty-one patients with 52 flaps were identified. Fifty-one flaps were immediate reconstructions, with an average age of 47 years and body mass index of 22.8 kg/m^2. Thirteen patients were treated with chemotherapy and four were irradiated, two preoperatively. The single drain was removed on average at 21 days. Complications included three hematomas (5.8 percent), two capsular contractures (3.8 percent), and two infections (3.8 percent). Average time to secondary reconstruction was 143 days. There were five unplanned revisions (9.6 percent). There were no flap failures or tissue expander losses.

Conclusions: The scarless latissimus dorsi flap is an effective method for providing durable homogenous device coverage in the thinner patient (body mass index <24). With the advent of acellular dermal matrices, device coverage has been made simpler, but this comes at a cost. Coverage is thin, the matrix is not initially vascularized, and products are expensive. For these reasons, use of the scarless latissimus dorsi flap is an excellent alternative, particularly in the patient with a low body mass index. (*Plast. Reconstr. Surg.* 128: 1, 2011.)

CLINICAL QUESTION/LEVEL OF EVIDENCE: Therapeutic, IV.

For over a decade, the senior author (L.F.E.) has advocated use of the scarless latissimus dorsi flap for breast reconstruction in patients with a low body mass index who desire minimal scarring. These thinner patients lack the necessary volume in autologous donor sites because of deficiency in adipose tissue and thus require device-based reconstruction. The scarless latissimus dorsi flap allows for well-vascularized coverage of the entire device with flexibility to fill the expander at the time of immediate reconstruction based on the condition of the mastectomy flaps. Over the past 10 years, the senior author has observed minimal complications and good aesthetic outcomes using this flap. This study was

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designed to evaluate our experience in immediate breast reconstruction using the scarless latissimus dorsi flap.

The scarless latissimus dorsi flap is a variation of the latissimus dorsi flap in breast reconstruction.[1–4] It is termed "scarless" because there is no scar on the back. Initially, an endoscopic technique was used for muscle harvest through the chest incision. However, with experience, we found that 80 percent of the latissimus could be harvested with direct retraction without endoscopic equipment. The exposure does involve a 2- to 3-cm radial extension of a periareolar incision used for mastectomy, but this extension is routine for mastectomies performed at our institution. Extirpative surgeons feel this extension allows them better exposure of the breast and axilla for mastectomy and lymphatic assessment. For patients with ptosis, a vertical pattern is used, which affords latissimus exposure without any extensions of the scar.

The literature before 2005 is replete with descriptions of the latissimus dorsi flap being used in an independent autologous manner but always as a vehicle for healthy skin in conjunction with permanent implants or tissue expanders.[5–11] It was around this time that Breuing an Warren first described the use of acellular dermal matrixes as another option for complete coverage of an implant, albeit not vascularized.[12,13] With its ease of application and predictable result, acellular dermal matrixes ushered in an era of tissue expander reconstruction that relied on lower pole coverage from the acellular dermal matrix. The widespread use of acellular dermal matrixes in immediate reconstruction increased the need to reevaluate vascularized coverage of the expander implant, which can be achieved with the scarless latissimus dorsi flap. Although there are advantages and disadvantages to each technique, both can achieve an excellent result. However, for those who find it important to choose vascularized coverage over nonvascularized coverage, the scarless latissimus dorsi flap is an excellent option and perhaps an improved alternative to acellular dermal matrixes.

PATIENTS AND METHODS

A retrospective review was performed on all patients who underwent postmastectomy reconstruction using the scarless latissimus dorsi flap between 2003 and 2009. All data collected represent a single surgeon's experience (L.F.E.). Patients who underwent scarless latissimus dorsi flap reconstruction were counseled preoperatively by the senior author regarding all options; however, those who sought scarless latissimus dorsi flap reconstruction were usually candidates with a low body mass index. The skin-sparing mastectomy and immediate breast reconstruction were planned with the extirpative surgeon, and patients were marked on the day before or just before surgery. Patient demographics, chemotherapy and radiation status, and complications were recorded. Outcomes, including expansion time and revision procedures, were identified. The case collection period was chosen to allow for a minimum 1-year follow-up.

Surgical Technique

The day before the scheduled operation, all patients are seen in the surgeon's clinic for a second interview and counseling. In a seated position, the scapular tip, chest midline, and inframammary fold are marked. Skin incisions depend on breast size, skin envelope (presence of ptosis), location of the tumor, and desired breast size. The circumareolar design with lateral horizontal extension is most commonly used. The lateral extension allows exposure of 80 percent of the latissimus muscle even in the thinnest of patients. In patients with ptosis, the lateral extension is exchanged for the vertical pattern extending to the inframammary fold. This vertical pattern allows for even wider exposure of the latissimus dissection once the mastectomy is complete. After the mastectomy, the wound is irrigated and hemostasis achieved. The skin is stapled and the patient is then placed in the lateral decubitus position (Fig. 1) with the arm flexed and adducted on a board. The patient is then prepared again from shoulder to iliac crest. F1

The table is rotated toward the surgeon so that the mastectomy defect is visualized. Using an assistant on the contralateral side of the table, continuous retraction is applied. The importance of effective retraction cannot be underestimated and is critical for visualization. Furthermore, extensive knowledge of the latissimus anatomy with prior dissections is mandatory. The soft tissues of the breast just lateral to the lateral border of the latissimus are marked in a line using methylene blue parallel to the axis of the body (Fig. 2). This marking facilitates reestablishment of the lateral breast border, a crucial aesthetic landmark. Using large and small Deaver retractors, the lateral border of the latissimus muscle is identified through the methylene blue mark and is exposed caudally and cephalad. The superficial surface of the muscle is then dissected to within 3.0 cm of the posterior midline. F2

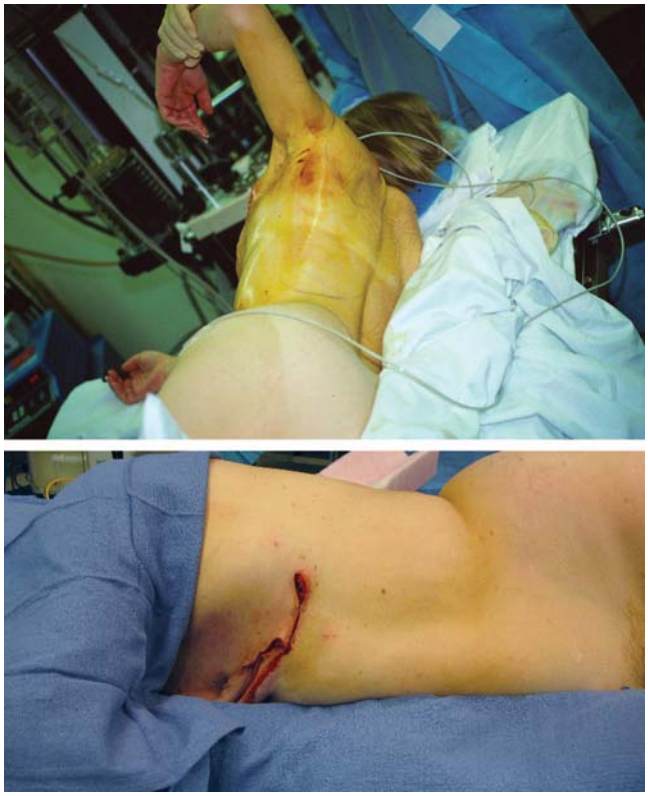

Fig. 1. Lateral decubitus position following completion of mastectomy, viewed from the foot of the bed (*above*) and from the surgeon's vantage point (*below*).

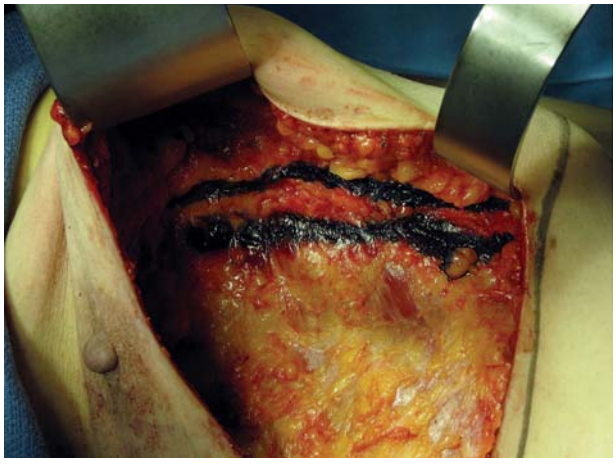

Fig. 2. Marking of the lateral breast soft tissue for future closure.

Attention is then turned to dissection of the superior border of the latissimus. At this point, the latissimus is overlying the scapular tip in a distinct layer superficial to the underlying teres major, which is attached to the scapula at its tip. The latissimus muscle overlies the teres major and has no origins or insertions on the scapula, thus allowing for easy differentiation between the two muscles (Fig. 3). Using continuous outward retraction on the latissimus, a plane between the latissimus and the teres major can be identified, allowing the surgeon's index finger to be placed under the latissimus and over the teres major. Using blunt dissection directed laterally, a deep plane is created from the medial border of the latissimus muscle to the lateral border. This effectively separates the latissimus from the teres major and the underlying serratus musculature. The retractor can now be placed deep to the latissimus muscle to separate it from the underlying tissues. F3

Approximately 80 percent of the muscle distal to the insertion is targeted and the exposure is completed to within 6.0 cm of the muscle border distally (Fig. 4). Elevation of the muscle is then completed by connecting the medial dissection that begins near the scapular tip with the inferior dissection. Great care is taken while elevating the medial border, as the segmental perforators may cause troublesome bleeding that is difficult to control or visualize. Slow and meticulous elevation with the cautery is important in this dissection. Once the muscle has been divided medially and F4

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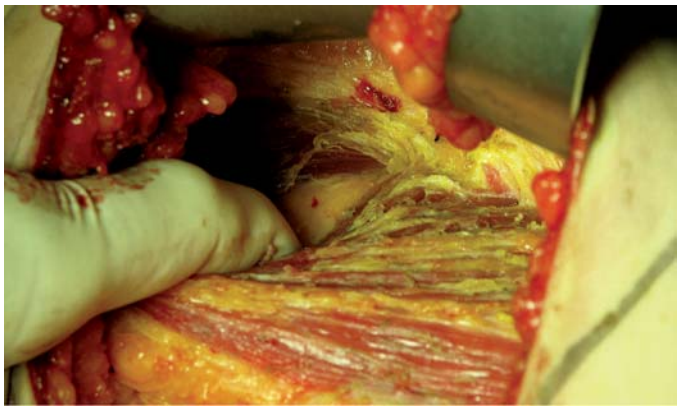

Fig. 3. Dissection of the latissimus muscle away from the teres major muscle near the scapular tip.

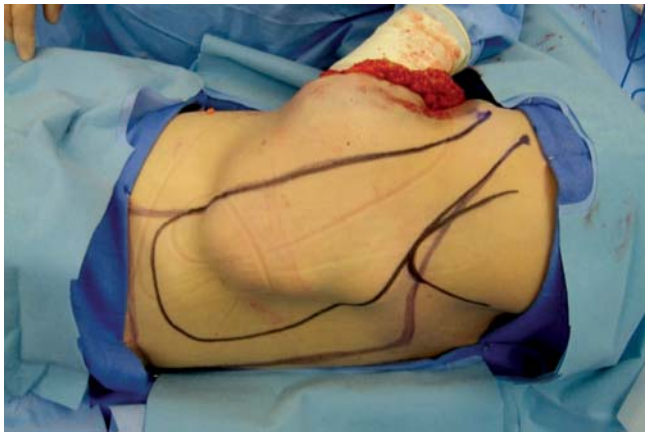

Fig. 4. Surgeon's hand demonstrating the superficial dissection of 80 percent of the latissimus muscle surface.

inferiorly, dissection continues toward the pedicle and humerus.

The retractor is now positioned over the insertion of the muscle as the surgeon applies traction caudal to the muscle with his or her contralateral hand. The neurovascular hilum, which is 10.0 cm distal to the insertion, is identified and visualized, and dissection is continued cephalad. Once the location of the neurovascular bundle into the muscle is identified and the muscle has been dissected more proximal to this hilum, the muscle can then be divided approximately 5.0 cm distal to the insertion of the muscle on the humerus. The thoracodorsal nerve is not divided, as this would lead to atrophy and thinning of the muscle over time. Because the muscle has been divided from its origin and insertion, unpleasant muscle action as detected by the patient is not a factor.

Division of the muscle proximally allows the muscle to drop 3 to 4 cm caudally and gives better range to cover the device. If one does not divide the muscle at this point, there is not enough length to reach inferomedially on the chest wall. This division is critical for full muscle coverage, which is one of the main points of using this technique. The latissimus is then transposed into the mastectomy defect and stapled to the chest wall to prevent twisting of the muscle during repositioning. A single drain is placed in the donor site, and the patient is turned supine and redraped.

Once supine, the orientation of the muscle is reaffirmed and the pectoralis muscle is elevated. The latissimus should easily reach the midline of the chest so that pairing it with the pectoralis muscle will give the underlying implant full muscle coverage. The methylene blue mark that denotes the lateral border of the breast is closed with several interrupted sutures, avoiding constriction of the pedicle. The latissimus is then inset along the inframammary line from the medial midline to the lateral border of the breast. An appropriate tissue expander is chosen and placed beneath the

pectoralis major and latissimus muscles. Once the expander is in place, the latissimus muscle is sutured to the pectoralis major muscle, giving full and complete muscle coverage. The expander is then filled based on both muscle and skin flap viability.

RESULTS

Between 2003 and 2009, a total of 52 breasts were reconstructed in 31 patients using the scarless latissimus dorsi flap in conjunction with a tissue expander. There were 10 unilateral reconstructions and 21 bilateral reconstructions (Fig. 5). The additional operative time for harvesting a single latissimus flap is 30 minutes. However, if the procedure is performed bilaterally, the additional time is 80 minutes, as three turns are required. An experienced team can minimize this time.

The average age was 47 years and the average body mass index was 22.8 kg/m^2. All patients but one had immediate reconstruction. Six patients had preoperative chemotherapy and seven had postoperative chemotherapy. Two patients had preoperative radiation therapy and two had postoperative radiation therapy. One donor-site drain was used for each reconstruction, and this was placed in the back with the understanding that fluid from the anterior operative site will naturally drain because the latissimus is not sutured to the lateral chest wall in a watertight fashion but with several interrupted sutures. We feel that it is beneficial, whenever possible, to avoid a drain in direct contact with an implant. The average time for drain removal was 21 days.

Postoperative complications occurred in seven of 52 reconstructions (13 percent) and included three hematomas (5.8 percent), two occurrences of severe capsular contracture (3.8 percent), and two superficial skin infections (3.8 percent) successfully treated with 7 days of antibiotics (Table 1). There were no deep soft-tissue infections and none of the devices required removal. Most complications were managed conservatively; however, five patients (9.6 percent) did require unplanned minor revisions, three for lateral chest wall debulking. The bulk laterally from the passage of the latissimus to the chest is often noted by the surgeon and the patient, especially in the first 3 months after surgery. This unwanted bulk usually resolves with muscle atrophy. If not, suction-assisted lipectomy can be used to resolve it at the time of nipple reconstruction. All 31 patients and 52 breasts underwent successful replacement of expanders with permanent implants. Average follow-up was 3.6 years (range, 1.1 to 7 years).

The average time for secondary reconstruction was 143 days. The secondary procedure typically included exchange of the expander for a permanent gel implant, nipple reconstruction, and autologous fat grafting, which is increasingly a standard component of the secondary procedure. Two breasts (no radiation exposure) developed capsular contracture, which required two corrective procedures but ultimately resulted in a soft breast. The patients with preoperative and

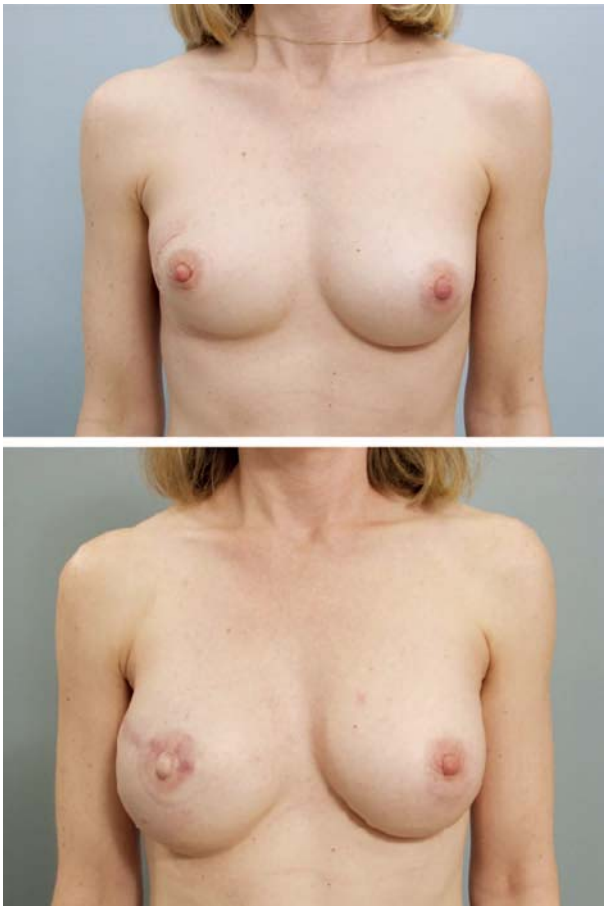

Fig. 5. (*Above*) Preoperative view of a patient with unilateral breast cancer. (*Below*) Eighteen-month postoperative view shows right scarless latissimus device-based reconstruction with contralateral breast augmentation.

Table 1. Complications Incurred during 52 Scarless Latissimus Dorsi Flap Reconstructions

Complication	Incidence (%)
Hematoma	3 (5.8)
Seroma	3 (5.8)
Capsular contracture	2 (3.8)
Soft-tissue infection	2 (3.8)
Total	10 (19.2)

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postoperative irradiation did not have capsular contracture. Three breasts underwent lateral debulking with suction-assisted lipectomy because of aesthetic concerns. In this series, there was no compromise of flap viability, expander migration, extrusion, or deep tissue infection.

The donor site on the back is essentially undetectable (Fig. 6). The often-discussed winging of the scapula with latissimus harvest was not observed. However, a small indentation beneath the scapular tip can be noted because of a lack of bulk of the latissimus once it is transferred. Long-term results have been excellent (Fig. 7). Preservation of the lateral breast aesthetic line was achieved in all of these patients despite the fact that the muscle has not been transferred high in the axilla, as advocated by some surgeons.[14] Using methylene blue markings to accurately reconstruct this lateral aesthetic breast line is a direct and essential part of the procedure, which yields excellent long-term results and profiles in this location without the high passage of the flap.

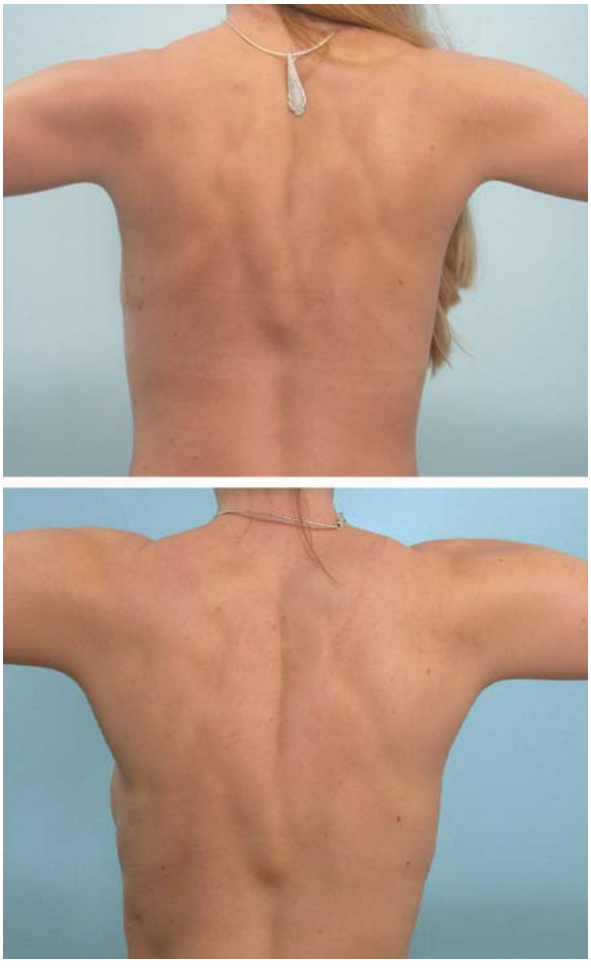

Fig. 6. (*Above*) Preoperative view of the back. (*Below*) Postoperative view of the back 1 year after harvest of the left latissimus muscle. Notice a slight indentation along the scapular border.

DISCUSSION

For patients who lack subcutaneous tissue for a transverse rectus abdominis musculocutaneous flap, a latissimus dorsi flap in combination with an expander continues to offer an excellent solution. The latissimus dorsi flap offers vascularized coverage to the underlying device, which is a reassuring element to reconstructive surgeons who are performing immediate breast reconstruction. Plastic surgeons are always searching for "protection" in the event of overlying skin loss. Although many patients can be reconstructed using merely a subcutaneous expander or implant, many surgeons prefer the assurance of well-vascularized coverage of the implant in the deeper plane. Furthermore, there are concerns about the incidence of capsular contracture if an implant is placed subcutaneously.[15] Finally, the position of the implant is perhaps not as reliable when placed subcutaneously without lateral and inferior elements to establish and hold the inframammary and lateral mammary line. All of these problems have led to a search for material that can be easily used to protect against and even prevent implant extrusion because of overlying skin necrosis, capsular contracture, or malposition of the implant. The latissimus dorsi has long been used to solve these problems but almost always with a scar on the back. Using the described technique, the latissimus can be harvested in an adequate size to provide, in conjunction with the pectoralis major muscle, total well-vascularized coverage of the underlying tissue expander or implant.

In the past, the serratus anterior muscle when coupled with the pectoralis major muscle has been used to achieve full muscular coverage of the device.[16–18] However, the serratus anterior muscle is applied tightly to the chest wall, is difficult to dissect en bloc, and provides unreliable coverage to the device inferolaterally because of its thinness and lack of bulk in many thin patients—especially in the junction between the pectoralis and serratus musculature. The coverage is at best tight, preventing a more rapid expansion of the device at the initial operation.[19] Although there is additional time and expense with this technique, the added dimensions of the latissimus muscle give significant benefits when coupled with the pectoralis muscle over the use of the serratus muscle with the pectoralis muscle.

Now, acellular dermal matrix has been introduced, which has been used extensively over the

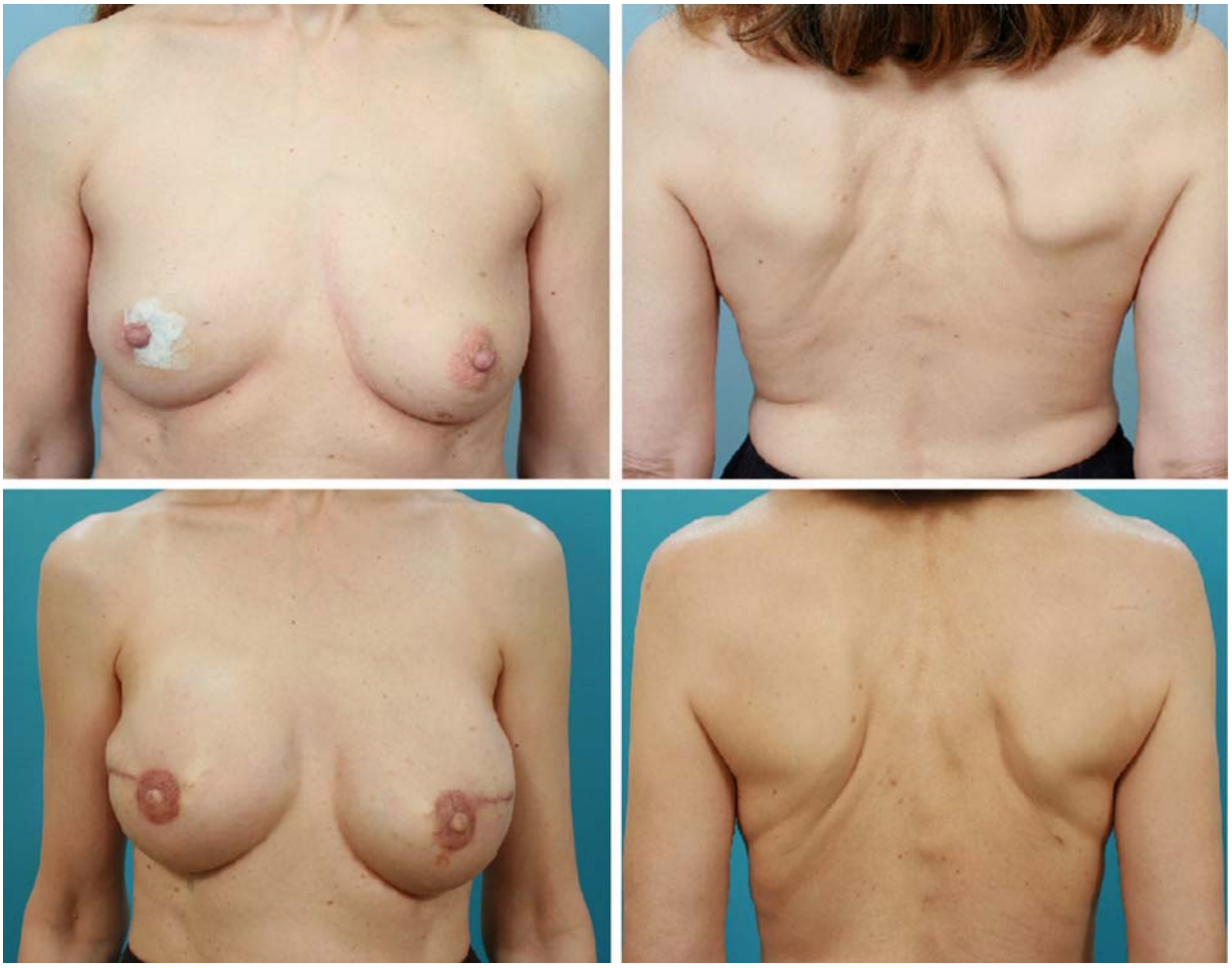

Fig. 7. (*Above, left*) Preoperative view of the breasts before bilateral mastectomies. (*Above, right*) Preoperative view of the back. (*Below, left*) One-year postoperative view following bilateral scarless latissimus dorsi flap reconstruction. (*Below, right*) One-year postoperative view of the back following bilateral scarless latissimus dorsi flap reconstruction.

past 5 years. Acellular dermal matrix offered many potential advantages such as the ability to give a type of incorporated coverage of the lower pole of the implant without muscle transposition. This is not vascularized coverage and has to become vascularized through the surrounding tissues. It does not bring in new blood supply but instead must "live off " the surrounding tissue. Acellular dermal matrix can stabilize the pocket inferiorly and laterally and may have some effect in preventing capsular contracture.[20,21]

The short- and long-term results in patients who have undergone implant-based reconstruction using acellular dermal matrixes have become a popular topic of debate as concerns for infections and seromas arise. Chun et al. found an increase in the seroma rate (14 percent versus 2.57 percent) and the infection rate (8.9 percent versus 2.1 percent) when an acellular dermal matrix was used.[22] Lanier et al. described similar difficulties with acellular dermal matrix, citing a 25 percent unplanned reoperation rate.[23] In another recent study, Antony et al. published an infection and seroma rate of 7.2 percent.[24] These rates are considerably higher than published rates for completely autologous submuscular coverage. Delay et al. reported a 2.0 percent infection rate in a series of 100 latissimus dorsi flaps (with skin islands) for breast reconstruction.[10] In our series, we found a 3.8 percent superficial infection rate and no deep tissue infections, which could cause loss of expander or implant.

When comparing acellular dermal matrix to the scarless latissimus dorsi flap, there are questions of time, cost, and appearance. This operative time is undoubtedly longer than the time taken to sew in acellular dermal matrix; how-

ever, with the latissimus dorsi flap, one now has vascularized coverage.

Cost has been discussed extensively since the introduction of acellular dermal matrix. Although the cost is well known, the products are increasingly accepted by insurance companies because of their value in breast reconstruction. Certainly, the operative time is going to be longer with the scarless latissimus dorsi flap, but if complications are reduced because of the vascularized coverage of devices, it is worthwhile.

Finally, the clinical result of the breast reconstruction using the scarless latissimus dorsi flap is one of the most important elements to the patient. We have attempted to evaluate this over the past 6 years but have been unable to find that there is a significant difference in the clinical aesthetic result of the breast reconstruction regardless of whether acellular dermal matrix or the scarless latissimus is used. The latissimus muscle thins significantly with expansion, and at the time of exchange from the expander to the implant, the muscle seems attenuated. However, once the expander is removed, the muscle returns immediately to its preexpansion thickness because the internal tension of the tissue expander has been removed. A nice thick coverage of muscle is then noted over the entire implant. Furthermore, this thick coverage is quite helpful in nipple reconstruction. The thinness of the acellular dermal matrix under the skin is similar to that of the latissimus; however, the thickening of acellular dermal matrix is not observed at the time of tissue expander removal. Nonetheless, the aesthetic feel of the latissimus reconstruction cannot be significantly differentiated from that of the acellular dermal matrix reconstruction.

SUMMARY

The scarless latissimus dorsi flap is an important reconstructive option, for patients with a low body mass index without adequate subcutaneous tissue for completely autologous reconstruction and for any patient who prefers not to have autologous tissue transfer from the abdomen or another location. In addition, it may be that the scarless latissimus dorsi flap avoids the untoward effects seen with acellular dermal matrix. The scarless latissimus approach provides stable, well-vascularized coverage when paired with the pectoralis major muscle, which allows for precise contouring of the expander pocket, excellent reassembly of the lateral aesthetic line of the breast, a protective muscular and vascularized layer for the implant, reduced occurrence of significant postoperative capsular contracture, and long-term stabilization of the implant in the pocket.

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AUTHOR QUERIES

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