Excess skin and fat of the upper arm is a common sequela of aging and weight loss in women, for which the specific operative strategy must correspond to the degree of deformity in each patient. For minimal deformities, there is a role for liposuction and/or resection and subsequent advancement of the skin around the axilla. For the vast majority of patients, arm skin reduction surgery is required from the axilla to elbow. Experience with severe deformities after massive weight loss (MWL) led to the design of the inclusive L-brachioplasty, so named for the L-shaped pattern of excision, with the long limb extending from the elbow to the axilla and the short limb extending perpendicularly through the axilla and along the lateral chest. Subsequent to its original development, the L-brachioplasty technique was adapted to treat deformities that accompany aging.

Over the past four years, modifications to the technique have improved the aesthetic results and reduced complication rates. These modifications include (1) improved geometric marking design, which expedites the operation and leaves a less conspicuous scar; (2) firm fixation of the posterior V-shaped advancement flap to the deltopectoral fascia, which secures the vertical and transverse reduction and minimizes distal scar drift; (3) excision site liposuction (ESL), which minimizes subcutaneous neurovasculature/
lymphatic injury and reduces bleeding; and (4) and barbed suture closure, which reduces operative time and the incidence of minor healing delays.

A well-performed L-brachioplasty addresses all areas of deformities, resulting in an attractive arm with minimal postsurgical distortion (such as scarring). With the patient’s arm abducted at 90 degrees, the resulting curvilinear scar passing across the axilla to the lateral chest resembles a reclining “L.” With the patient’s arm fully abducted, the scar nearly straightens, with only a short zigzag across the axilla.7,8

Suitable candidates for the L-brachioplasty are those who desire excision of their excess skin and fat on the arm and axilla. They must also be comfortable accepting a long scar, possible asymmetry, inadequate resections, delayed wound healing, and the general medical risks inherent in this operation. Poor candidates have excessive adiposity without skin laxity. Chronic arm swelling with lymphatic and/or venous incompetence would also seem to be a contraindication.

**OPERATIVE TECHNIQUE**

**Preoperative Markings**

Meticulous preoperative surgical markings permit expeditious intraoperative excision of the patient’s excess skin and fat, which will result in more symmetrical closures. Freehand markings should be made by the surgeon, followed by linear distance measurements to establish equal lengths for the anterior and posterior incision lines. With both sets of markings in place, there should be little need for intraoperative skin adjustments, such as those required for dog-ear corrections. Although “pinch-and-gather” techniques are reliable for determining the width of resection, heavy arms are difficult to estimate, so the author suggests planning an underresection. At the time of closure, if the resection proves to be inadequate, another perimeter centimeter excision can be performed along either resection line. A complete video presentation of the authors’ technique is available at www.aestheticsurgeryjournal.com.

The L-brachioplasty connects a hemielliptical skin excision of the medial arm to an elliptical excision of the lateral chest through the axilla. Drawing the anterior straight line of the hemiellipse at or slightly above the bicipital groove, and the curved line of the hemi-ellipse along the posterior arm leaves a swooping scar from axilla to elbow. The greatest fullness is thereby placed along the mid-posterior arm where it belongs.

There are six critical points for the preoperative marking (Figure 1A,B), which should be located with the patient’s arm abducted and the forearm flexed 90 degrees. The surgeon should initially place ink dots in the following locations: at the deltopectoral groove (point 1); at the widest portion of the midarm, slightly anterior to the bicipital groove (point 2); and at the termination of the brachioplasty, around the elbow or beyond (point 3). The straight or slightly bowed line connecting these points is the anterior incision line (Figure 1). The width of midarm excision is determined next by gathering and pinching the excess skin and fat posterior to point 2, then marking point 4 along the posterior margin of the arm. With the patient’s arm raised and the skin stretched, a straight line is drawn from the widest area on the posterior arm (point 4) to meet the anterior line termination at point 3. The adequacy of the width of this distal resection is adjusted by pinching and gathering. The proximal portion of the posterior incision line is then drawn by finding the critical point 5 that can be advanced to point 1. Pinch approximation of point 5 to point 1 advances the posterior axillary fold and tightens the posterior arm (Figure 1C). At this point in the marking, an incomplete hemiellipse is evident (Figure 1D). The anterior incision from point 1 to point 3 is equal in length to the curved posterior incision from elbow point 3 to the advancement point 5. With the arm extended, the posterior line continues across the axilla, remaining several centimeters away from the posterior axillary fold, to descend toward a tapered lateral chest mark (point 6) as the posterior incision line of the lateral chest. The length of this line (point 5 to point 6) will vary directly with the skin laxity and rolls of the lateral chest. A parallel line descends from point 1 through the axilla and posterior to the lateral pectoral fold to taper to point 6. The skin excision between these last two lines (point 5 to point 6 and point 1 to point 6) removes the excess skin of the axilla and lateral chest.

When the arms are fully raised, the equal lengths of the anterior and posterior incision lines of the upper arm and chest are confirmed as they are connected by a gentle zigzag across the axilla (Figure 1B and Figure 2). An inferiorly-based triangular flap of the proximal posterior upper arm, with point 5 at the apex, will be advanced across the axilla to point 1. Cross-hatching alignment lines are drawn and followed to align the closure after the skin resection (Figure 1B).

**L-Brachioplasty**

If brachioplasty is the only procedure being performed, the arms are prepped circumferentially while the patient is awake, and he or she is then dressed in a paper gown. The patient is placed in a supine position, and the arms are abducted about 80 degrees on arm boards. After the induction of deep sedation anesthesia, consisting of Propofol, Fentanyl, and Medazolam, the sleeves are split to expose the operative site and draping is completed (Figure 3). Arm intravenous infusion is avoided whenever possible, to prevent extravasations of fluid within the wound.

The width of resection is rechecked after the operative site has been exposed. Between 100 and 200 mL of saline with 1 mg of epinephrine and 30 mL of 1% xylocaine per liter are infused through a thin, multihole, blunt-tipped needle inserted into stab wound incisions within the resection pattern near points 1 and 3. If only ESL is being

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Figure 1. (A) The color-coded preoperative markings for the L-brachioplasty are shown. The ink dots placed at points 1 to 6 are marked sequentially in freehand, as described in the text. The dots are connected to create upper arm hemielliptical and lateral chest elliptical excisions. After the lines are drawn, the linear distances are measured and adjusted so that the distance from points 1 to 3 equals the distance from points 3 to 5, and the distance from points 5 to 6 equals the distance from points 1 to 6. (B) The patient’s outstretched arm demonstrates these relationships even more effectively. If the patient’s arm deformities are symmetrical, then these measured distances, as well as the width from points 2 to 4, will be the same or otherwise adjusted. (C) The advancement point 5 is dotted with a surgical marker, as it is found along the posterior incision line by pinch approximation to point 1, the deltopectoral groove. (D) Connecting point 4 to point 5 completes the descending limb of the hemiellipse.
Figure 2. With the markings completed, the effects of gravity when the arms are fully extended help to demonstrate that the approximation point 5 drops horizontal to point 1. This view better reveals the equal lengths of the anterior and posterior incisions on the arms and each lateral chest.

performed, infusion should be limited to the planned excision, so that the closure is not restricted by swollen tissue. The subcutaneous fat within the arm excision site is removed as completely as possible through liposuction (Figure 4). The authors prefer the preliminary application of ultrasonic energy, as it appears to better preserve neurovasculature than liposuction alone. After the ultrasound, the fatty emulsion is suctioned, leaving the skin thin, with a profound depression. More limited liposuction may then be performed as needed to reduce girth elsewhere.

The final check for the appropriateness of the width of resection is easily performed following ESL. If overresection was inadvertently planned, a narrow band on defatted arm skin can be retained. With anterior traction on the arm skin, the posterior arm incision is made through the skin, down to the superficial fascia. Once it has progressed through the fascia, the incision pops open and then is undermined to about 1 cm. The posterior incision is then continued across the axilla and along the lateral chest to the tapered end at point 6. The anterior straight line is similarly incised, undermined, and continued across the axilla, descending as the anterior incision of the lateral chest to the depth of the serratus fascia (Figure 5). If breast augmentation or spiral flap breast reshaping is scheduled, the posterior limb of the ellipse is not incised until the mastopexy/augmentation is complete because the advancement of skin in a breast augmentation reduces the need for lateral chest skin resection.

The skin resection begins with thick full-thickness skin and subcutaneous tissue resection from the chest and continues through the thin axillary tissues over the clavpectoral fascia (Figure 6). Distal traction of the arm skin proceeds like an avulsion removal, assisted by scalpel cuts to the dermis (Figure 7A,B). Little bleeding is encountered, as the arm skin is removed like a full-thickness skin graft. Superficial veins, lymphatics, and sensory nerves can be seen within a latticework bed of connective tissue nearly empty of adipose. Bleeding should be minimal.

The proximal posterior triangular flap is advanced to the deltoid fascia at the groove with several 2-0 braided absorbable sutures (Figure 8). This is the anchoring stitch that keeps the scar from drifting distally. Care should be taken to avoid thinning the advancement flap, as the tip vascularity is already marginal and the temporary fullness will recontour to a natural axillary hollow. With the preoperative hatch marks as a guide, the incisions are then aligned with towel clamps. Additional skin can be resected along the wound edge if the closure is too loose. New hatch marks are drawn, and the towel clamps are removed.

Although any continuous horizontal running, 2-0 gauge, long-lasting absorbable suture could approximate the subcutaneous fascia, the author prefers 0 or
Figure 4. Excision site liposuction is the radical removal of fat under the skin to be resected. Three-step ultrasonic-assisted lipoplasty is preferred by the surgeon (DJH). The illustration inset shows adequate thinning, as determined by a pinch test.

Figure 5. The excision site is depressed by radical fat removal following three-step excision site liposuction. The perimeter incision is made first along the posterior arm and chest and then along the anterior arm and chest.

Figure 6. Starting from the lower chest, the skin and fat excision proceeds across the clavipectoral fascia. Full-thickness chest wall adipose is attached to the skin resection.
Figure 7. (A) This illustration demonstrates the planned chest and arm excision, which is removed from proximal to distal with an avulsion-like technique over the arm after the perimeter incision is complete. (B) Proximal to distal avulsion of arm skin is shown intraoperatively, aided by a scalpel. The lymphatics are probably best spared by this direction of the skin avulsion. Little adipose remains on the undersurface of the skin resection, while the bed is mostly defatted neurovasculature.
Figure 8. The first step in the closure is the advancement of the subcutaneous fascia of point 5 (now the tip of the posterior triangular flap) to point 1 in the deltoid muscular fascia with interrupted 2-0 gauge absorbable sutures.

1 PDO double-armed barbed Quill SRS (Angiotech Pharmaceuticals, Vancouver, Canada). The thin subcutaneous fascia of the arm causes pull-through of vertical sutures, and large horizontal bites that do not catch the dermis, while dimpling the skin, provide a secure purchase. The 1 barbed PDO comes on a 38-mm tapered needle that is passed through as a running horizontal mattress, starting from the center of the wound and advancing distally (to the elbow) and proximally (to the deltopectoral groove). To begin the closure, two horizontal bites are taken away from the center, with each needle and the Quill suture pulled taut (Figure 9A,B). After passing the suture on either side of the wound, the barbed suture is then synched and secured to the appropriate tension (Figure 9C,D). As the suturing proceeds, the barbs prevent the closure from slipping. Thus, there is no segmental slippage, as may occur with other running sutures. At the end of the wound, the barbed suture is returned back for several throws, forming a “J.” The dermal dimpling caused by the horizontal suture pull of the subcutaneous fascia to the dermis will disappear over several postoperative months. A second continuous barbed intradermal suture closure follows, using 3-0 Monoderm Quill SRS (Figure 9E,F). Dermal glue or taping completes the closure. As there is no undermining of the skin, no drains are placed. Furthermore, suction drains may be contraindicated in the arms since negative pressure may encourage the opening of damaged lymphatics.

The operative time for each arm is approximately 40 minutes. The incisions are covered with sponge dressing and then wrapped in ACE bandages (BD, Franklin Lakes, New Jersey) with the hands elevated. The sponges and bandages are removed and replaced with tightly fitting elastic sleeves five days postoperatively. The two-month (Figure 10) and 18-month (Figure 11) results of two demonstrative patients show the primary healing and the predicted, symmetrical scar location.

Since implementing the modified technique described herein, the authors’ complications rates have been reduced and satisfaction has improved. The markings are more precise, leading to expeditious surgery. The anchoring to deltopectoral fascia is more secure with less distal drifting of the axillary scar. The excision site liposuction reduces swelling, numbness and seromas. The barbed suture closure is faster and more secure with less minor wound separations. There were 13 women and two men, treated over the past four years. Over the past 30 arms, only one seroma was aspirated on one occasion. There have been no lymphoceles. Whereas seromas are localized collections of serous tissue fluid, lymphoceles are localized collections of lymph due to injury to larger lymphatic vessels. Lymphoceles rapidly form a fibrotic wall and usually need excisions and possible ligation of vessels to correct. Appreciable swelling has concluded in all patients within one month. Incision dehiscence was limited to less than 1 cm in five patients. Tip necrosis of the V-advancement flap occurred in about 10% of the cases, leaving small wounds in the axilla to heal secondarily. Minor secondary skin reduction was performed in two patients.

Complete maturation of the scars takes over two years, so revisions of primarily healed scars are rare. No patients in the series of 30 described above have expressed regret over their scar. There were no contractures across the axilla in this latest group of patients, and they were very appreciative of the reduced hair and hollow.

CONCLUSIONS

The original L-brachioplasty technique is commonly employed for patients with arm deformity resulting from MWL. With our improved understanding of the aesthetics and the four modifications described herein, the authors have improved their results and lowered their complication rates. We have gone beyond the concept of arm reduction surgery and are now able to offer patients a procedure that sculpts the region more specifically, offering an improved aesthetic result. Specifically, with this procedure, the authors recommend leaving a small amount of extra tissue, rather than compromise shape or hazard serious complications. With the improvement in shape, scar placement, and reduced complications, this L-brachioplasty technique can take its place as the optimal cosmetic operation for moderate to severe skin and fat redundancy of the upper arm.

Disclosures

The authors declared no conflicts of interests with respect to the authorship and/or publication of this article.
Figure 9. (A) The two-layer skin closure commences with the barbed Quill SRS suture. Precise alignment and crosshatch markings should be placed and followed prior to suturing. The subcutaneous fascia is closed with horizontal running 0 barbed PDO Quill suture. Shorter interval vertical passes are employed in the thicker subcutaneous tissues of the chest. (B) Unlike illustration A, which shows for clarity a completed run of barbed sutures without synching, the intraoperative photograph demonstrates that after the first four throws, the suture is synched to approximate the skin edges and then precisely synched after every other pass of the needle. (C) The anchor advancement of the posterior flap to the deltopectoral fascia with 2-0 Vicryl has been completed. The first four horizontal bites of the double-armed 0 PDO barbed suture are being placed. (D) The two ends of the PDO Quill suture have been pulled and synched to securely approximate the fragile subcutaneous fascia. (E) An illustration of the final closure, with the widely spaced 0 PDO and the shorter intradermal 3-0 Monoderm suture at the completion of the procedure. The PDO closure is secured with a J-shaped return and bury of the end in the suture line. (F) The periodic dimpling of the dermis near the suture line is indicative of a secure closure and will fade over time. The topical adhesive is applied at this point, followed by a lightly pressured dressing.
Figure 10. (A, C, E) This 58-year-old woman presented at 145 pounds, having lost 150 pounds eight years prior. Her preoperative markings are shown in the frontal and posterior views. In addition to the excision lines, there was limited cosmetic liposuction of the posterior arm. (B, D, F) Five weeks after L-brachioplasty seen in Figures 1-3, 5-7, and 9. The patient’s healing was uncomplicated, leaving symmetrical curvilinear scars from the height of the axilla to the posterior border of the arm. At this point in early follow-up, the smaller axillary hollow is maturing as the overall swelling reduces.

Figure 11. (A, C, E) This 53-year-old woman presented at 165 pounds, having previously lost 135 pounds. (B, D, F) Eighteen months after a total body lift, including an L-brachioplasty. Her results approach the aesthetic ideal described in the text, with minimal visibility of the scars.
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