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Editors

Fat Transfer in Plastic Surgery

Techniques, Technology and Safety

MOREMEDIA

Springer

Male Upper Arm Definition with Fat Transfer

42

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2.1 Male Upper Arm Definition with Fat Transfer

2.1.1 Anatomy of Human Arm: Muscular System

2.1.1.1 Upper Arm

hen the upper arm is discussed, the area between the oulder and elbow joint should be considered. There are ur muscles in this region. The biceps brachii, brachialis, d coracobrachialis muscles are located in the anterior gion, while the triceps brachii muscle is located in the pos- rior region. The three anterior compartment muscles, cluding the biceps brachii, coracobrachialis, and brachia- , are all innervated by the musculocutaneous nerve. Arterial supply to the anterior region of the upper arm is provided by the muscular branches of the brachial artery. To briefly describe these muscles:

42.1.1.2 M. Biceps Brachii

The biceps brachii muscle is a large and thick muscle. It has two heads, which are located in the ventral part of the upper arm, and consists of a short head (caput breve) and a long head (caput longum). Anatomically, the short head originates from the tip of the coracoid process and the long head originates from the supraglenoid tubercle (tuberculum supraglenoidale) of the glenoid/scapula. Both heads run distally and become a confluent muscle hub before tapering along the anterior aspect of the elbow and finally entering the radial tuberosity and forearm fascia via the bicipital aponeurosis [1]. The aponeurotic tendon, called lacertus fibrosus or aponeurosis bicipitalis, blends into the forearm fascia. It is the main supinator muscle of the forearm and facilitates the flexing of the arm and forearm. In particular, it provides some flexion of the arm, flexion, and outward rotation (supination) of the forearm. While performing this function, it is connected to the N. Musculocutaneous (C5–C6) nerve. Although liposuction alone causes this muscle to become prominent,

pplementary Information The online version contains supplementary terial available at https://doi.org/10.1007/978-3-031-10881-5_42.

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Di Giuseppe et al. (eds.), *Fat Transfer in Plastic Surgery*, https://doi.org/10.1007/978-3-031-10881-5_42

subcutaneous, sub-fascial and intramuscular fat injections can be applied during surgery. This application will increase muscle definition [1–6].

42.1.1.3 M. Triceps Brachii

The antagonist of the biceps muscle is the triceps brachii muscle, which has three heads. It is located in the posterior compartment of the upper arm. The long head originates from the infraglenoid tubercle. The medial and lateral heads originate from the humeral body. Distally, the heads converge on a tendon and enter the olecranon of the ulna. Its function is extension of the arm at the elbow and forearm extension, upper arm adduction, and shoulder stabilization. It is the strongest extensor muscle of the forearm.

42.1.1.4 The Deltoid Muscle

The deltoid muscle is a large triangular muscle located in the proximal upper extremity and is associated with the human shoulder girdle. Its base (or origin) attaches to the spine of the scapula and the lateral third of the clavicle. This U-shaped starting point reflects the entry point of the trapezius muscle. The apex (or insertion) attaches to the lateral side of the humeral body at a point known as the deltoid tuberosity.

The deltoid is divided into three different parts called anterior, lateral, and posterior. When all three parts contract at the same time, it helps the deltoid arm go past 15°. Since the pull direction of the deltoid muscle is parallel to the humeral axis, it cannot initiate abduction. During abduction, the anterior and posterior portions of the deltoid play an important role in stabilizing the arm, while the lateral head assists in raising the arm from 15° to 100°. Additional functions include ambulation. The anterior head of the deltoid works with the pectoralis major to flex the arm while walking. This is in contrast to the posterior part of the deltoid, which works with the latissimus dorsi to extend the arm during ambulation. The axillary nerve innervates the deltoid and both C5 and C6 contribute to the axillary nerve. The nerve originates from the posterior cord of the brachial plexus [7]. Beyond all these functional features, the deltoid muscle is at the starting point of masculinity. In order for the width and definition of the shoulders in the upper body to be aesthetically pleasing, fat transfer is primarily performed into the deltoid muscle.

42.2 Athletic Arm Appearance Expected in Men

The primary goal in the athletic male arm is to not make it look thinner, but to enhance the 3 main muscle groups (deltoid, biceps, and triceps) to prominence. Male patients desire a body structure having wide shoulders and prominent biceps and triceps muscles. Muscle structure, skin tone, and excess fat should be examined to evaluate whether the patient is suitable for the procedure; even if the fat structures on the arm are superficially located and skin retraction is good [8].

From an anatomical point of view, lipodystrophic arms contain a greater proportion of deeper than superficial fat in all their longitudinal sections and all their anatomical faces. It is known that the closer the sections are, the greater the amount of fat. They are regions with less thick adipose tissue on the anterior surface and distal third of the arm. In some cases, there is a specific lipodystrophic zone located in the posterior-outer region of the arm between the proximal and medial thirds. Liposuction of the lipodystrophic arms has certain limits because it is not always possible to circumferentially reduce the arms as patients may not be able to accept irregularities from retraction. We suggest that if the deltoid volume is enlarged by lipoinjection, the following effects will be achieved: restoration of the bideltoid width (making it wider than the bitrochanteric width) and great improvement in the contour of the upper limbs and optical effect of balance [9].

Arm shape is determined by the muscle structure and mass of each patient. In terms of underlying structure, three main muscles are responsible for arm shape: the deltoid, triceps, and biceps. More pronounced musculature in men is considered more athletic and healthy, but such a description can be considered a deformity in women. Slim folds and toned, smaller muscle mass are considered aesthetic for women. High-Definition Liposculpture has given both sexes an athletic appearance by shaping body fat with a multilayered and 3-dimensional shaping approach. This approach is based on creating concave and convex areas instead of flattening areas with liposuction alone. Fat is removed from some areas but grafted onto others to improve the anatomical architecture [8]. However, the general appearance of the arm is very different in men than in women. The two main muscle groups that lead to the emergence of athletic shape in male patients are the pectoral and deltoid muscle groups. The wide view of these two muscle groups causes the athletic/masculine V shape to form in the upper body. For this reason, the two main areas that should be considered before the abdominal region are the chest and arm regions. It should be kept in mind that shaping the abdominal region without shaping the upper body can cause artificial images to appear. The desired arm image to be obtained in men is to add definition to the deltoid, biceps, and triceps muscle groups using liposuction and to clarify the deltoid muscle with fat transfer.

42.3 Natural Shadows due to Muscles

Abduction, adduction, internal and external rotation, extension and flexion movements of the arm, and shadows due to muscle dynamics draw attention. In particular, the shadows

of the biceps and triceps muscles at the borders of the deltoid muscle and within the triceps muscle group can be easily determined. Under bright light, the naturally protruding muscles are bright, and the fatty areas in the natural spaces between these muscles are dark, i.e., shaded. In the natural position, the deltoid is the dominant muscle in the male arm. When the arm is extended, we observe that the triceps displaces slightly upwards and creates an upper dynamic zone together with the deltoid (Fig. 42.1).

Fig. 42.1 Abduction adduction, internal and external rotation, extension and flexion movements of the arm, and shadows due to muscle dynamics (**a**). In particular, the shadows of the biceps and triceps muscles at the borders of the deltoid muscle and within the triceps muscle group can be easily determined (**b**). The area marked with light blue in the picture is the dynamic zone formed by the triceps muscle (**c**, **d**). Care should be taken when using liposuction in this area and whole fat should not be removed

42.4 Preoperative Evaluation

Preoperative blood values should be measured and it should be checked whether they have any other problems. For this reason, hemoglobin, hematocrit, white blood cell count, creatinine, urea, and clotting time should be measured and evaluated preoperatively. If abnormalities are detected in these values, first the cause of the abnormality should be revealed and then it should be decided whether the patient is suitable

for surgery. Acetylsalicylic acid evaluation should be made for each patient to be applied and consultation with anesthesiologists should be made.

In addition to such a general evaluation, the BMI, skin quality, and muscle structure should be evaluated to determine patient suitability for this operation. Since the arms and trunk are often treated together in male patients, a BMI of 32 and below is more desirable.

42.5 Preoperative Drawing Techniques and Detection of Negative Spaces

Positive areas (dynamic zones) are formed by naturally protruding muscle groups in the body. Natural spaces covered with fat tissue around them are called negative spaces. While drawing, patients should be marked in the upright position before surgery. In men, the visible areas of extra fat are marked first with the arm at adduction; these areas are mostly in the posterior region. Depending on the patient's biotype (fat, lean, athletic), the area is marked for deep extraction or more superficial liposuction to create the triceps curvature. Visible extra fat on the inner or anterior part of the arm is also marked as needed in selected patients. After that, three muscles are marked: deltoids, biceps, and triceps.

To mark the posterior sulcus (contraction mark) of the deltoid, the arm is abducted 90° and the forearm is flexed 90°. First, the deltoid boundaries are determined and the midline is marked from the shoulder to the elbow first. The negative space between the deltoid and biceps can be easily marked by backward rotation. If this negative space cannot be determined exactly, the patient is instructed to tighten and accentuate the biceps muscle. Thus, the negative space in between will show itself more comfortably. The center of the deltoid muscle and the upper 2/3 of the muscle are marked with a different color to show the area to be transferred. Approximately 100–150 cc of pure fat is injected directly into the muscle.

The anterior sulcus is then marked while the shoulder is in external rotation. Then, while the patient's upper arm is in full adduction, the patient is asked to contract the triceps muscle voluntarily and a second mark is placed on the deltoid posterior sulcus. A zone is created between the first deltoid narrowing mark and it is called the "dynamic zone." The bicipital groove is marked internally and externally. By marking the biceps muscle at 90° flexion of the elbow, a half-moon region and another dynamic region are drawn from the distal muscle tendon to the bend of the elbow [8].

In the midline, there is a tiny triangular negative area located on the midline at the lower border of the biceps triceps and deltoid. Aggressive liposuction in this area will help determine the classes of all these muscles. We know that there are medial and lateral bodies of the biceps. Superficial liposuction between the lower border of these bodies and the anterior surface of the elbow (cubital space) also supports the definition of the biceps muscle. Although this procedure is rare in my practice, I would like to share this information with my colleagues. Again, some intramuscular and superficial fat injection may be recommended to give volume to the biceps muscle. The triceps muscle consists of three trunks; when the patient is told to tighten the muscle, it is observed that the triceps moves slightly upwards.

At this stage, at the lower border of the muscle above the olecranon, a valuable negative area appears again and must be marked. Again, when the triceps muscle is contracted, the negative field shadow between the lateral and medial trunks can be identified and marked. Since the basic logic is to reveal what is naturally present, I do not recommend that any muscle body or negative area, which cannot be identified with the help of light and palpation, be relatively marked and struggled to be revealed during all these markings. It should be kept in mind that suitable candidates should be determined first for this operation (Fig. 42.2). It is easier to mark the arm in women than it is in men. Excess fat is marked when the patient's arm is in adduction. Some women may have fat deposits on the inside of the arm, which are marked with the arm on abduction. Next, with 90° arm abduction, 90° elbow flexion, and internal rotation of the shoulder, the posterior deltoid sulcus is marked and a triangular, "hollow" space is marked between the axillary posterior fold and the proximal posterior insertion of the deltoid muscle. In women, the triceps is not prominent, as the ideal female arm does not have significant muscle mass in that area. Women expect a straight and smooth arm appearance instead of convexity and prominence like that in the male arm.

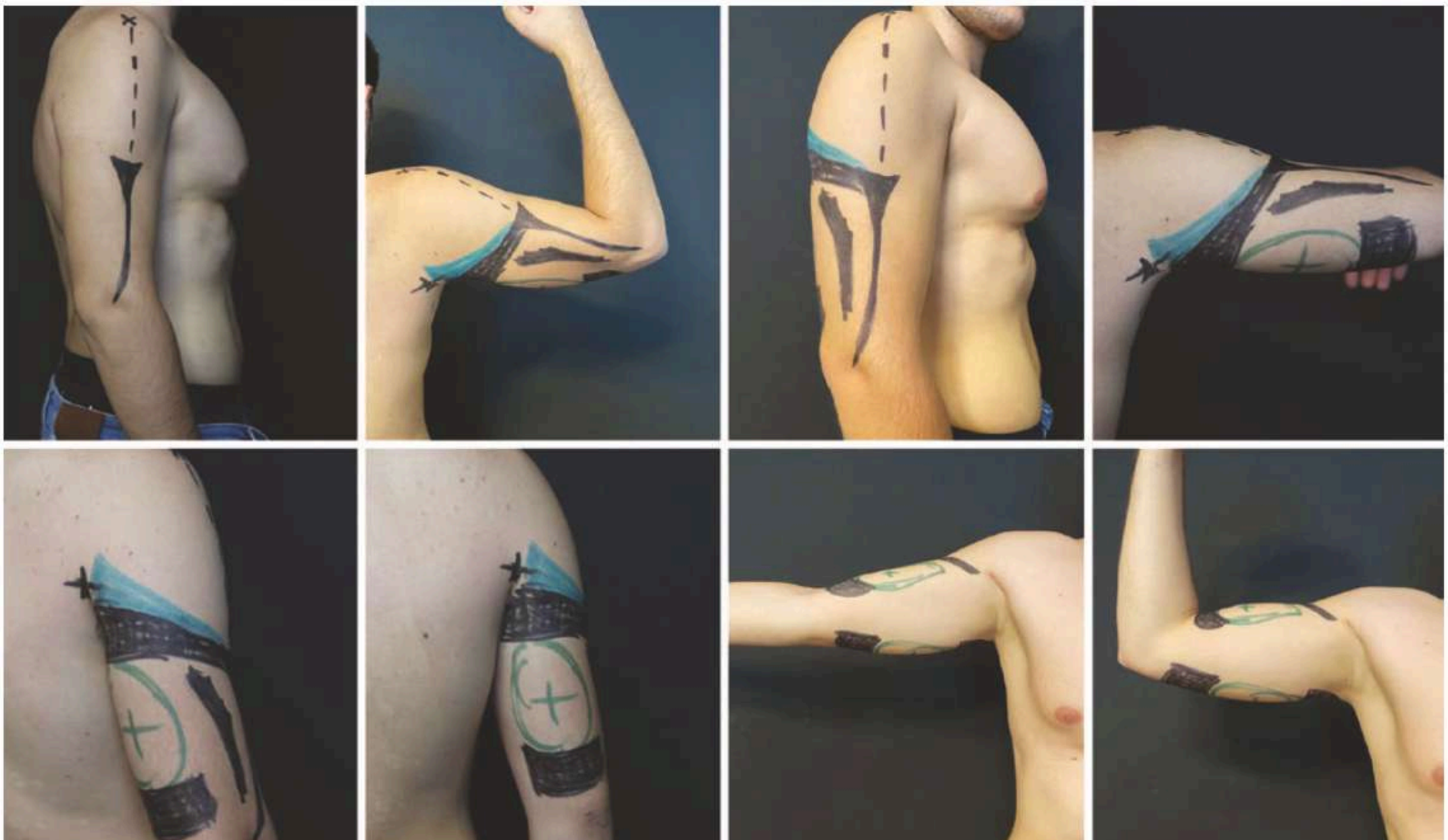

Fig. 42.2 The arm drawing stages of men shown before the operation. Black color indicates the frame, which is the negative zones. Negative spaces include the bicipital groove (inner and outer), the tricipital tendon, and the posterior margin of the triceps in the proximal and distal parts. The green color indicates the areas where fat injection can be made

42.6 Liposuction Technique

The liposuction technique has been developed over the years and has become today's modern liposuction technique. This technique was developed with inspiration from blind sharp excisional procedures. The first attempt at liposuction was made in 1921 by Dujarrier, who operated on a dancer's knees and calves. Injury to the femoral artery resulted in amputation of the leg [10]. Charles Dujarrier, a French surgeon, first experimented with the first shaping procedure of the inner thigh fat deposits in 1929, inserting a sharp curette under the skin through a small skin incision [11].

But the results were not as expected. This technique was abandoned as it resulted in excessive bleeding. The French researcher, Ives Gerard Illouz, introduced the first modern liposuction technique in 1977. In this technique he developed, he used blunt cannulas and a strong suction system. This technique was called dry liposuction because no liquid was injected into the targeted fat layers prior to suction. Further development of the wet liposuction tech-

nique introduced by Gregory Hetter of Las Vegas involved the addition of epinephrine as a vasoconstrictor to the soaking solution [12].

Recently, the development of power-assisted liposuction has further expanded and improved this procedure, increasing the popularity and use of liposuction.

Currently, we can talk about four different liposuction techniques, which include Aspiration-Assisted Lipectomy (AAL), Laser-Assisted Lipectomy (LAL), Power-Assisted Lipectomy (PAL), and Ultrasound-Assisted Lipectomy (UAL). The most commonly used procedure in liposuction surgeries is UAL (trade name: VASER®).

Aspiration-assisted lipectomy (AAL) technique uses negative pressure to remove fat from a syringe applied to a small volume, blunt-tipped aspiration cannula. While applying this technique, aspiration from the superficial layer should be avoided to prevent pitting, hyperpigmentation, and contour irregularities. The superficial fat layer contains vertical fibers. It should not be forgotten that if it is damaged, it may cause contour deformities [13–15].

In laser-assisted lipectomy (LAL) technique, it is performed with a much smaller incision compared to UAL. LAL is performed by inserting a laser fiber through a small incision [16]. Complications of LAL are very rare. Only one study reported a complication rate of 0.93%, including skin burns and local infection. From this point of view, it is a technique with very few complications.

In the power-assisted lipectomy (PAL) technique, an external power source is used. Liposuction is performed with the help of an electric vacuum pump [16]. Thanks to this power aid, the surgeon spends less effort. In this way, it is a technique that is advantageous for tissue removal in large volumes and in dense fibrous areas [15, 17]. In addition, liposuction complications should always be considered.

In the ultrasound-assisted lipectomy (UAL) technique, ultrasound energy is used. UAL transmitting ultrasound energy is used to emulsify the fat before the fat is removed. Especially with this technique, it can be advantageous in the fibrous areas, such as the back, chest, and upper side because these areas are more difficult to target using standard liposuction. It should be noted that larger incisions are required in the UAL technique. In addition, it should always be considered that there is a risk of thermal injury to the subcutaneous tissues due to the exothermic energy caused by ultrasound.

The general principle of UAL is to melt fat homogeneously by emitting sound waves specific for fat cells. It helps apply superficial liposuction and reduce complication rates, especially in areas where fat tissue is superficial (i.e., arms). General complications of liposuction can be listed in two groups as short-term complications and long-term complications. Short-term complications include wound infection, seroma hematoma, edema, ecchymosis, paresthesia, fat embolism, pulmonary embolism, and skin necrosis, while long-term complications include contour deformity, hyperpigmentation, hypertrophic scarring, and lymphedema [15]. However, complications observed, especially in arm liposuction, are noted as seroma hematoma, the friction burns at liposuction cannula port sites, and numbness in the early period, while fibrosis, inadequate definition, and very rarely cystization following fat transfer in the late period attract attention.

The patients are operated under general anesthesia. In some cases, if only the arm is to be intervened, it can also be done under local anesthesia. However, general anesthesia is mostly preferred because the technique requires intramuscular fat injection.

Liposuction can be performed under local anesthesia with or without sedation, or general anesthesia. Each modality has its advantages, disadvantages, inherent risks, and suitability for the unique demands of each operation and patient. The cannula may be a short and curved 1.5–2.5-mm-diameter infusion cannula with holes along the shaft. The oozing cannula is connected via tubing to either a syringe or a pressurized infusion pump system. The fluid is supplied by a constant fan movement, starting from the deep fat layers in the horizontal planes and advancing superficially. Because the cannula is constantly in motion, there is no need to monitor the return of blood to the tubing syringe.

When shaping the arm, the operation should be started in the probe position. Two small incisions to be made just above the elbow with the deepest point of the posterior axillary line are sufficient to work from behind. As in all liposuction applications, surgery begins with tumescent fluid infiltration. The solution used is prepared before the operation and contains 1 mg of adrenaline and 1 ampoule of 10% lidocaine in each 1000 cc RL.

After infiltration of the tumescent solution, skin protected ports are fixed with 4–0 silk to the incisions made from the elbow and posterior axillary region to prevent the friction burns at liposuction cannula port sites. The operation should be started in the prone position. Then, the fat melting phase is started with the ultrasonic system. In the Vaser® system we are using, the fat is melted by operating at 100% energy level in C mode with a five-ring 3.7-mm-thick probe. Using the probe at a deep level throughout the melting process will reduce the risk of possible complications. It is technically safe to melt all desired layers from the deep to the surface by applying passive hand pressure. As in liposuction, it would be more appropriate to start the process of melting fat from negative areas first and then move on to areas with excess fat tissue (if any). It is worth emphasizing that there is no need for liposuction in men, especially on the triceps and deltoid muscles unless there is a need to stretch for volumization. After the fat is melted by ultrasound, liposuction can be applied with cannulas of 3–5 mm in diameter and three

straight or reverse triangle holes depending on the surgeon's experience. While these processes pass, the nurses prepare pure fat grafts in 50 cc luer lock injectors (these processes will be explained in detail in the next section).

Then, an average of 100–150 cc of pure fat is injected into the deltoid muscle by entering through the posterior axillary incision while still in the prone position with a 2.4-mm-diameter, three-straight hole cannula. In the application done as a bolus injection, the cannula is entered into the muscle and is slowly pulled back and the entire fat injection process is completed from the end point. Incisions used for fat grafting are always closed with 5–0 rapid vicryl. If there is not enough volume in the triceps muscle, sub-fascial and subcutaneous fat injection, ranging from 30 to 60 cc in total, can be performed from the posterior axillary incision, especially to the region of the lateral head.

If fat grafting is applied in the biceps muscle, it will be easier to reach the intramuscular and sub-fascia with this 2-mm additional incision by opening the arm medial as an additional incision instead of the anterior axillary incision in the Spin position. Here again, 30–60 cc fat can be applied, mostly at the medial head (Fig. 42.3).

Fig. 42.3 The fat collected as a result of liposuction

42.7 Preparation of the Fat and Safe Intramuscular Injection

Fats removed from the body by liposuction are collected in closed systems (Fig. 42.3). Here, it is important to note that, when using an ultrasonic device (Vaser®) with a small bracket open, only 100% C mode energy level is need. We observe that fat cells are alive in MRI examinations of patients with a history of 1–5 years [18, 19].

The fats collected in the closed system are transferred to 50 cc injectors after separating them from the liquid part with their own weight and gravity effect without using a special system (Fig. 42.4).

Decantation is done for the fat to be grafted. Fat grafting can be done with a curved, 2.4-mm cannula. To increase the volume, 50–150 mL of fat is injected intramuscularly into the middle fascicle of the deltoid. This is done through a posterior axillary incision, by inserting a 2.4-mm curved cannula. Figure 42.5 shows preoperative (Fig. 42.5a, b, e, f) and after liposuction arm contouring and fat grafting in male patients in need of deltoid sulcus recreation (Fig. 42.5c, d, g, h). In the preoperative view, the maximum width of the scapular arch is bitrochanteric, while the postoperative maximum width is bideltoid. The more pronounced lateral curvature and triceps recess should be noted.

In the patient in the prone position, 100–150 cc fat transfer is performed using a posterior axillary incision, with a 2.4-mm-diameter and 16-cm-angled cannula, into the deltoid muscle pole. At this stage, the most important part is that the

Fig. 42.4 The fats collected in the closed system transferred to 50 cc injectors after separating them from the liquid part with their own weight and gravity effect without using a special system. A 1 cc acrylic syringe is preferred for small volume fat grafting. The air bubble inside the syringe must be removed so that the amount of the injected volume can be accurately recorded. Also, 10–50 cc syringes can be used for large volume fat grafting

Fig. 42.5 Preoperative (**a**, **b**, **e**, and **f**) and immediate postoperative images (**c**, **d**, **g**, and **h**) of male patients. All patients underwent the arm shaping procedure described in the main text. Postoperative images show changes in shape and volume and include curved posterior areas at the proximal and distal ends

fat is injected intramuscularly (never subcutaneously) in the form of a bolus. The injection must be completed by coming back in the same direction after it enters the muscle once with the cannula and reaches the extreme point (Video 42.1). Although the injection is intramuscular, the incisions that are used for fat injection are closed with 4/0 or 5/0 rapid vicryl as a general principle.

42.8 Postoperative Care

After the liposuction application, a 10–14 days compression garment is placed on the arm that is shaped by the liposuction method, extending beyond the elbow. At the same time, an active postoperative treatment regimen, which includes infrared and local heating pads as well as a lymphatic drainage massage, should be implemented. A massage is performed to drain excess fluids from the elbow incision left open from the surgery. Patients can fully move their arms after 1 day. If necessary, physical therapy can also be applied to patients. It is recommended that patients do stretching exercises following surgery. These exercises can be given according to the patient between 1 and 6 months. In postoperative care, it is sufficient to use standard corsets with moderate pressure for 7–10 days and to use the recommended drug treatments after general liposuction procedures. While the fat-injected incision is sutured, the incision near the elbow is left open for drainage. Postoperative manual massages are an important and recommended part of this drainage. After intramuscular fat injections, I recommend patients to stay away from active sports for 6–12 weeks in which they will use the relevant muscle.

42.9 Outcomes

When the techniques described above are carefully applied by experienced surgeons for the upper arm liposuction surgery, the results are satisfactory for the patients. A few cases before and after surgery are shown in Fig. 42.6. Yet another case is shown in Fig. 42.7a, b. In order to get good results during the arm contouring process, the negative and positive zones drawn on the arm and contoured should be determined so that they have a natural appearance (Fig. 42.7c, d).

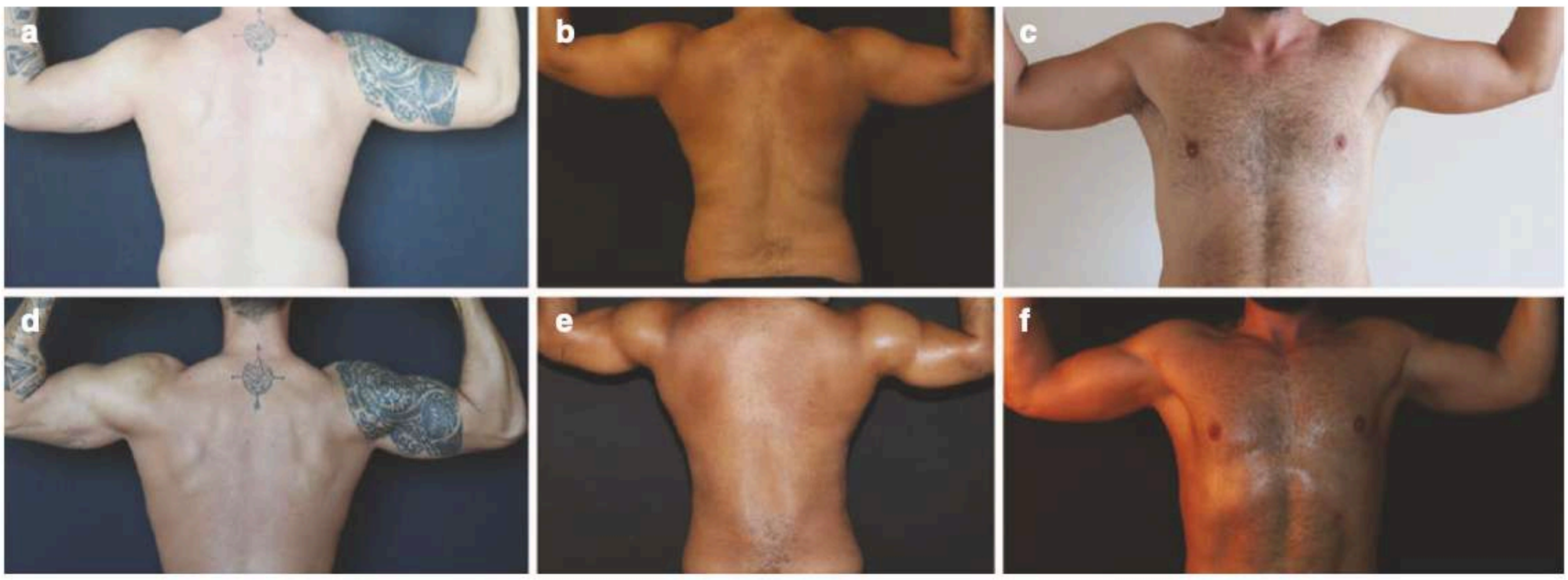

Fig. 42.6 Before photos for different patients (**a**–**c**) and after photos, respectively (**d**–**f**), for arm shaping in male patients. The deltoid definition and muscular appearance in the postoperative images are striking

Fig. 42.7 The before (**a**) and after view (**b**) of a patient who underwent arm shaping. While planning the arm contouring, the negative and positive zones drawn on the arm and contoured (**c**) should be determined so that they have a natural appearance (**d**)

Conflict of Interest None.

Funding None.

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