

## **A New Algorithm for Brachioplasty**

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### **ABSTRACT**

Brachial deformities have been treated over years by different techniques. Many authors tried to establish algorithms for such problem. 60 brachioplasties were done from 2004 to 2009. The technique was chosen according to a new algorithm established in Ain Shams University. Circumferential liposuction was done for patients with excess fat only. Semilunar axillary resection with circumferential liposuction was done in patients with skin laxity in the proximal one third of the upper arm. Modified Ted Lockwood with circumferential liposuction was done in patients with skin redundancy of more than proximal one third of the upper arm and not reaching the elbow. Non excisional brachioplasty with circumferential liposuction was done in patients with skin redundancy of more than proximal one third of the upper arm and reaching the elbow. Extended brachioplasty is done in patients with skin redundancy at the lateral chest wall. Severance of secondary zone of adherence and lipoinjection was done if it was present. Results were satisfactory. The upper arm contour was restored. There was no scar widening. Results remain almost unchanged except in post bariatric patients in whom minor brachial ptosis occurred. There was transient paresthesia which lasts for 3 weeks. Dehiscence occurred in 3 cases at the axillary sutures in which healing occurred by conservative methods.

### **INTRODUCTION**

The aesthetic arm is considered to be lean, tapering both to elbow and axilla with an anterior convexity of the deltoid region merging with the convexity of the biceps. Brachial deformities include flaccidity of internal surface of the arm, skin laxity, fat excess which may extend from the olecranon to the chest wall, loss of muscular mass, brachial ptosis with an increase in the inferior curve of the arm. Thin inner skin is more affected by aging or after major weight loss [1]. Chamosa found that the anterior aspect of the distal third of the upper arm tended to have less thick adipose tissue. A greater amount of fat is, therefore, found in the more proximal area of the arm. Occasionally, a specific lipodystrophic zone can be found on the posterior-external area of the arm, located between the proximal and middle thirds [2]. Bat's wing appears in severe weight loss that extends from

the olecranon across the axilla to the chest wall [3]. Loosening of connections of the superficial fascial system (SFS) to axillary fascia as well as relaxation of the axillary fascia itself with age, weight fluctuations and gravitational pull yield a loose hammock effect resulting in significant ptosis of posteromedial arm [4]. Flaccidity of posterior arm muscles caused by age and lack of exercise may add to the deformity [5]. Grade of ptosis is determined by measuring the distance from the brachial sulcus to the lowermost border of the pendulous skin [6]. Axillary contour deformities may occur in the form of axillary ptosis and loss of natural dome shape [3]. Hurwitz and Holland have classified brachial deformities after massive weight loss into five deformities; first, the upper arm skin sags along the posterior margin from the axilla to the elbow, second, the posterior axillary fold descends along the posterior axillary line, third, the axilla is oversized and distorted, fourth, the anterior axillary fold is poorly defined and does not relate to the breast; and fifth, the lateral chest skin is loose and leads into the midtorso transverse roll [7].

Thorek 1930, Posse 1943 and Correa-Iturraspe and Fernandez 1954 were the pioneers in brachioplasty [8-10]. Since then techniques have been modified with a subsequent improvement in outcomes. Different incisions were used; curved S incision [11], vertical incision and T closure [12,13], W-plasties [14], Fish tail incision in the axilla with or without perpendicular incision at the elbow [15], straight-line incisions [16], L brachioplasty [7] and limited Incision medial brachioplasty [17]. Some may use Z plasty in the axilla [18,19]. Traditional excision was done in most of brachioplasty techniques. Strauch et al described sinusoidal excision [19]. Axillary ellipse resection was recommended by lockwood [4]. Goddio advised not to excise the excess tissue but rather depithelization of posterior flap and inserted it beneath anterior flap [20]. de

Souza Pinto et al., tried to provide a natural contour and symmetrical scars, by using an italic double S-shape mold [1]. Ted Lockwood introduced axillary brachioplasty with anchoring of SFS to the axillary fascia which provides a more effective lift of both arm and axillary tissues and recreates a deep axillary hollow [4]. Many surgeons perform liposuction, whether associated or not with brachioplasty to attain better aesthetic results [21-25].

Teimourian and Malekzadeh suggested an algorithm based on the anatomic analysis of the arm. They proposed; circumferential suction lipectomy only for minimal to moderate subcutaneous fat with minimal skin laxity, suction lipectomy and ridge procedure for generalized accumulation of subcutaneous fat with moderate skin laxity, suction lipectomy with T-shaped skin resection and purse-string closure for generalized obesity and extensive skin laxity and brachioplasty for minimal subcutaneous fat and extensive skin laxity [26]. De Souza Pinto et al. proposed another algorithm in which; liposuction is done in patients with localized fat, good skin laxity and normal weight, brachioplasty and liposuction is done in patients with moderate fat excess, moderate skin laxity and overweight, brachioplasty is done in patients with minimal fat excess, poor skin laxity and massive loss of weight [1]. Strauch et al., proposed a treatment algorithm based on four treatment zones; zone II is defined as the region between the olecranon and the anterior axillary fold, zone III is defined by the borders of the axilla, zone IV is defined as the subaxillary lateral chest wall, and zone I is defined as the forearm. Liposuction is recommended for patient with zone I or II, sinusoidal excision with Z plasty in axilla for patient with zone II and III, sinusoidal excision with Z plasty in chest wall for patient with zone II, III, IV [19]. Appelt et al suggested an algorithm according to fat excess, amount and location of skin excess. Liposuction alone is done for type I patients with relative excess of fatty deposits in the upper arm but good skin tone and minimal skin laxity. Brachioplasty using excisional techniques is done for type II patients with moderate skin laxity and minimal excess fat. Location of redundant tissue determines what pattern of resection is performed. Patients with proximal laxity are candidates for limited brachioplasty, patients with laxity of the entire arm are candidates for traditional brachioplasty, and patients with significant laxity of the arm and lateral chest wall are candidates for extended brachioplasty. Type III patients have moderate excess fat and moderate skin laxity. Downstaging is recommended by further weight loss or staged fashion ultrasound- and

suction-assisted liposuction. Then revisional brachioplasty can be done [27]. Elkhatab suggested another algorithm according to his classification. Circumferential liposuction is done for stage 1 which is minimal adipose tissue deposit with no ptosis. Staged circumferential liposuction is recommended for stage 2a which is moderate adipose tissue deposit with grade 1 ptosis. Liposuction of the lower posterior and medial arm assisted short longitudinal scar brachioplasty are done for stage 2b which is severe adipose tissue deposit with grade 2 ptosis and also for stage 3 which is severe adipose tissue deposit with grade 3 ptosis. Traditional brachioplasty is recommended for stage 4 in which there is minimal or no adipose tissue deposit with grade 3 ptosis [6].

Flaws and complications may affect patient satisfaction. They include incorrectly placed incisions, asymmetric widened hypertrophic scar and pale scars similar to striae which may need revision [28]. Edema seroma, wound dehiscence, subcutaneous abscess, and a short period of lymphorrhea may occur. Median antibrachial cutaneous nerve injury and chronic regional pain syndrome have been recorded [29]. Postoperative contour deformities, transverse cutaneous folds and postoperative skin laxity and ptosis in the axillary region have been noticed. Fat over resection may cause impairment of venous and lymphatic circulation [1].

## PATIENTS AND METHODS

60 brachioplasties were done from 2004 to 2009. All patients were females. Their age ranged between 30 and 65 years of old. Preoperative evaluation was done for each case and categorized according to the present deformities. The technique was chosen according to a new algorithm established in Ain Shams University (Fig. 1). Postoperative evaluation was done at 6 and 12 months duration. Circumferential liposuction alone was done in 14 cases. Semilunar axillary resection with circumferential liposuction was done in 5 cases. Modified Ted Lockwood with circumferential liposuction was done in 10 cases. Non excisional brachioplasty with circumferential liposuction was done in 23 cases. Extended brachioplasty with excision of skin excess at lateral chest wall was done in 6 cases. Lipoinjection was done in 2 cases.

### *Type A:*

There is excess fat with good skin elasticity (Figs. 2,3). Type A also includes cases with minimal skin affection and anticipated skin retraction after superficial liposuction. In this type only circumferential liposuction is done to eliminate the defor-

mity and restore upper arm contour. Deep liposuction was done for arm contouring while superficial liposuction was done to induce skin retraction.

*Type B:*

It is classified into types 1,2,3 and 4:

*Type B1:*

There is skin redundancy of proximal one third of inferior border. Semilunar excision at axilla with upper arm lift with circumferential liposuction is done to induce uniform skin retraction (Fig. 4). Semilunar incision is drawn between point A which is the meeting of pectoralis major and biceps muscle and point B which is the meeting of latismus dorsi and triceps muscle. Lifting is done with anchoring of SFS to the axillary fascia with non absorbable sutures. No dissection is done (Fig. 5).

*Type B2:*

There is Skin redundancy more than one third but not reaching the elbow (Fig. 6). A Modified Ted lockwood technique is used to correct deformities in such case. Circumferential liposuction is done. Modifications are depithelialization of the excess skin planned to be excised in the original Ted lockwood technique (Fig. 7). Excessive liposuction in all layers is done in the depithelialized region to make it paper thin layer which can be invaginated easily. The excision is done only at the axilla with repair of SFS. Dermis to dermis suturing is done (Fig. 8).

*Type B3:*

There is skin redundancy of more than one third and reaching the elbow (Fig. 9). Non excisional brachioplasty described by Mahmoud and Sadek is done [30]. Superficial curvilinear incision is drawn one cm posterior to the inner sulcus with vertical incision in the axilla between A and B. Circumferential liposuction is done. Excess redundant skin is assessed and depithelialized. The upper incision is marked first while the lower incision is marked as needed thus the wound will be closed with neither tension nor excess. Excessive liposuction in all layers is done in the depithelialized region to make it paper thin layer which can be invaginated easily. Neither excision nor undermining was done. Excision is done only at the axilla with anchoring of SFS to the axillary fascia. Dermis to dermis suturing is done (Fig. 10).

*Type B4:*

There is skin redundancy of the whole inferior border with skin redundancy at the lateral chest. Non excisional extended bracioplasty is done. It is the same technique as in type B3 with circum-linear excision at the chest wall (Fig. 11).

*Secondary zone of adherence:*

Secondary zone of adherence at the midarm is present in some cases. Severance of the adherent zone and lipoinjection was done to eliminate this deformity (Figs. 12,13).

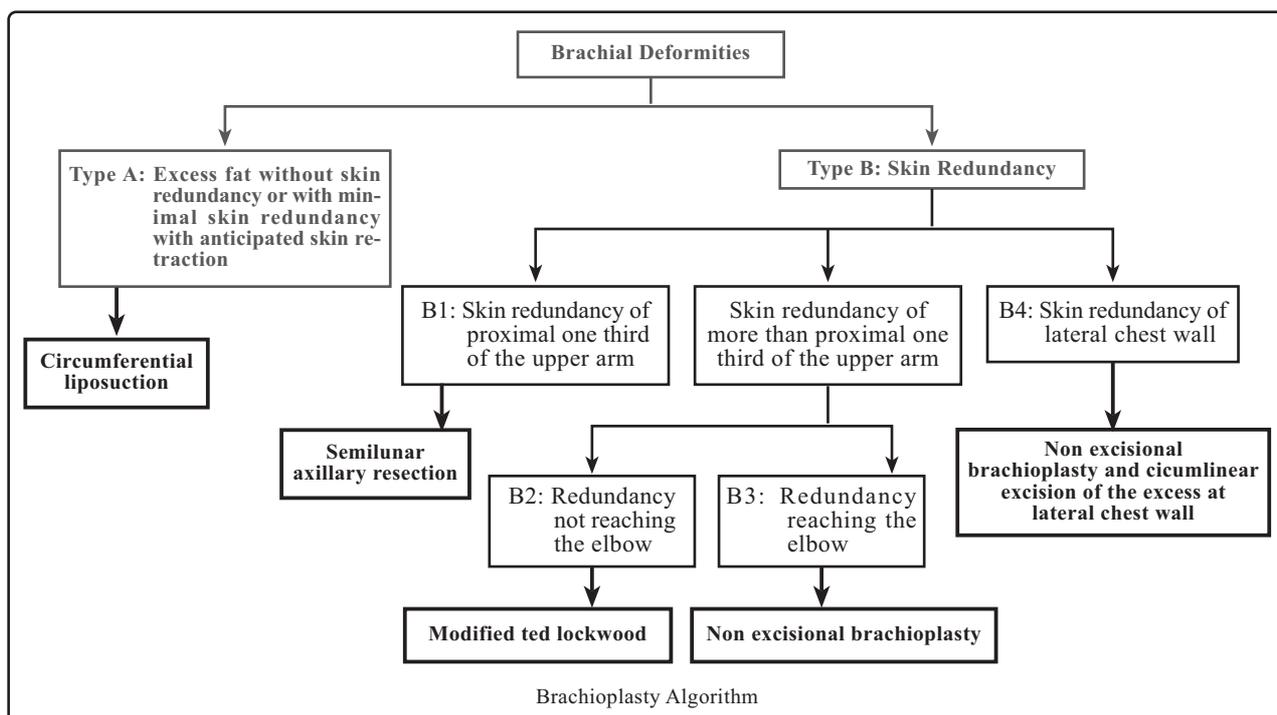


Fig. (1): Algorithm for Brachioplasty.

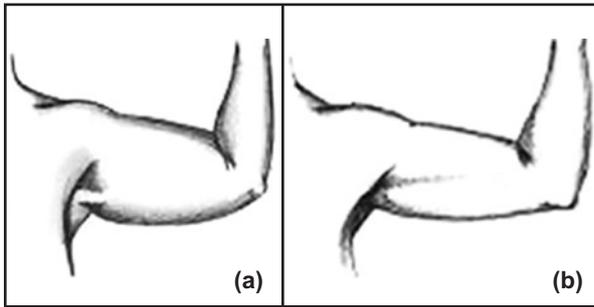


Fig. (2): Type A: Excess fat in the upper arm (a), Arm contour after liposuction (b).

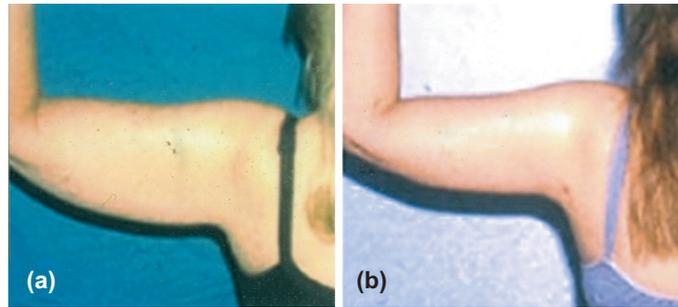


Fig. (3): Type A: Preoperative view of patient with excess fat in the upper arm (a), Postoperative view after liposuction (b).

Fig. (4): Type B1: Skin redundancy of proximal one third of upper arm (a), Markings of semilunar axillary resection (b).

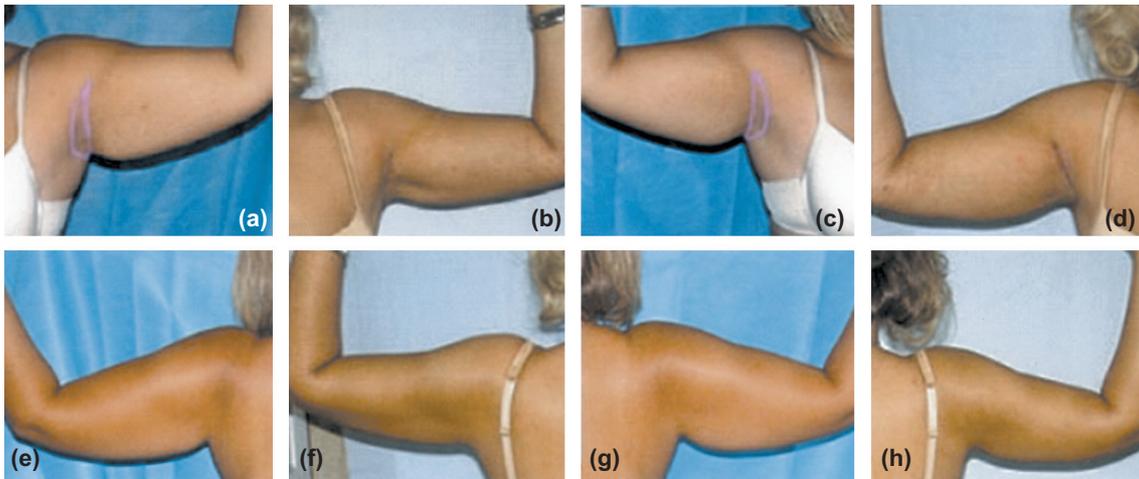
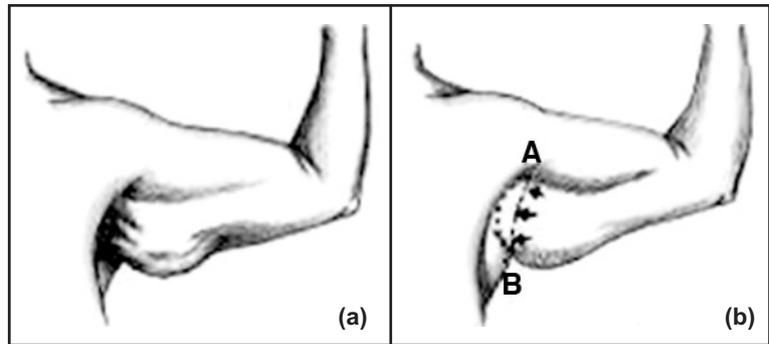


Fig. (5): Type B1: Preoperative frontal view of the left arm (a), Postoperative frontal view of the left arm (b), Preoperative frontal view of the right arm (c), Postoperative frontal view of the right arm (d), Preoperative posterior view of the left arm (e), Postoperative posterior view of the left arm (f), Preoperative posterior view of the right arm (g), Postoperative posterior view of the right arm (h).

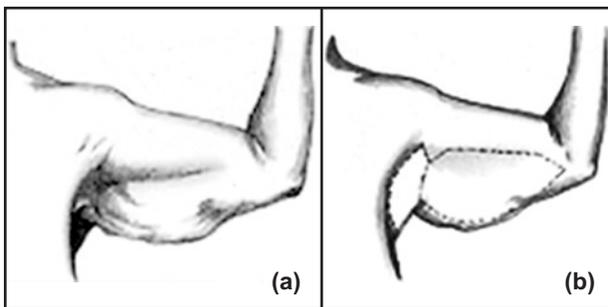


Fig. (6): Type B2: Skin redundancy of more than proximal one third of upper arm and not reaching the elbow (a), Markings of Ted Lockwood (b).



Fig. (7): Depithelialization is done in Modified Ted Lockwood technique.

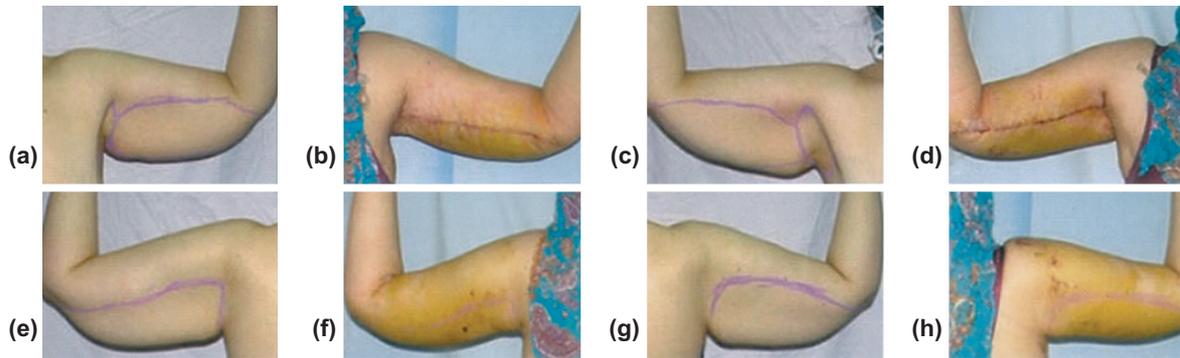


Fig. (8): Type B2: Preoperative frontal view of the left arm (a), Postoperative frontal view of the left arm (b), Preoperative frontal view of the right arm (c), Postoperative frontal view of the right arm (d), Preoperative posterior view of the left arm (e), Postoperative posterior view of the left arm (f), Preoperative posterior view of the right arm (g), Postoperative posterior view of the right arm (h).

Fig. (9): Type B3: Skin redundancy of more than proximal one third of the upper arm and reaching the elbow (a), Markings of curvilinear incision and vector of pull (b).

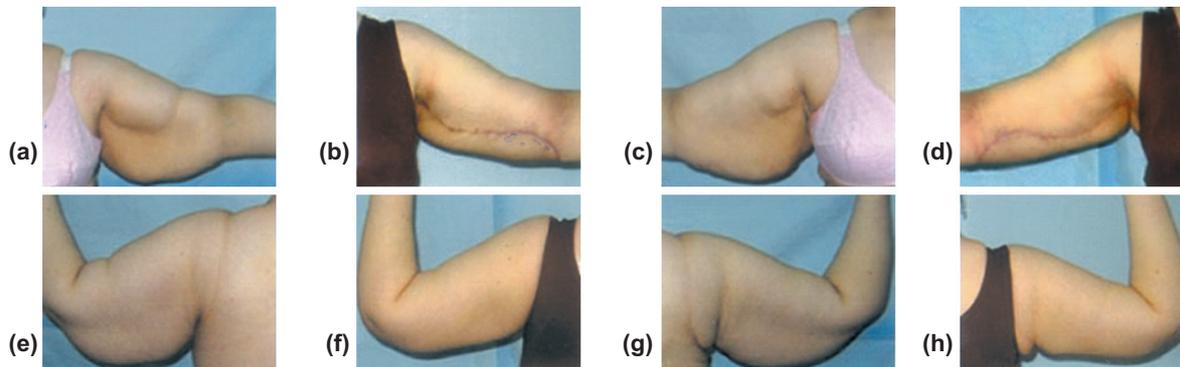
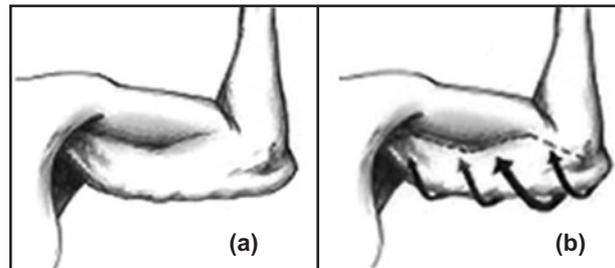


Fig. (10): Type B3: Preoperative frontal view of the left arm (a), Postoperative frontal view of the left arm (b), Preoperative frontal view of the right arm (c), Postoperative frontal view of the right arm (d), Preoperative posterior view of the left arm (e), Postoperative posterior view of the left arm (f), Preoperative posterior view of the right arm (g), Postoperative posterior view of the right arm (h).

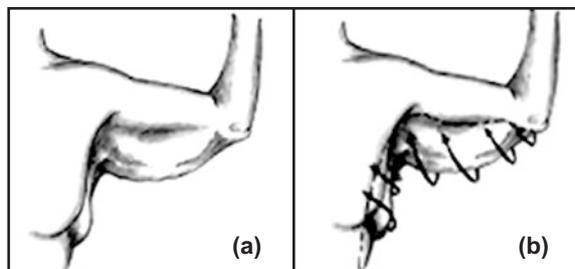


Fig. (11): Type 4: Skin redundancy at lateral chest wall (a), Markings of circumferential incision at lateral chest wall, arrows show the vector of pull (b).

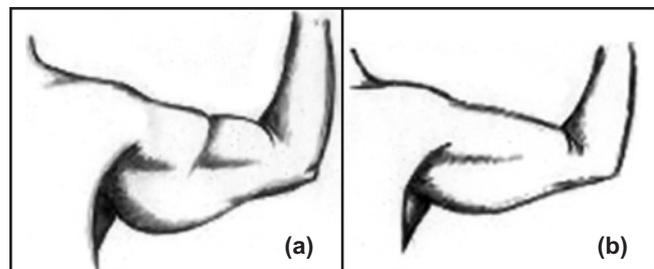


Fig. (12): Secondary zone of adherence at the mid-arm (a), arm contour is restored after severance of the adherent zone and lipoinjection.

Fig. (13): Preoperative view of secondary zone of adherence (a), postoperative view shows elimination of the adherent zone.

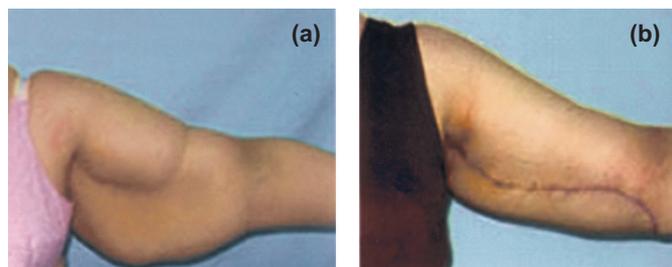


Table (1): Classification of deformities and algorithm.

| Grade | Deformity  | Technique  |
|-------|--|--|
| A     | Excess fat with no skin redundancy<br>Excess fat with anticipated skin retraction  | Liposuction  |
| B1    | Skin redundancy of proximal one third of inferior border   | Semilunar Axillary Resection   |
| B2    | Skin redundancy of more than proximal one third but not reaching the elbow   | Modified Ted Lockwood Technique  |
| B3    | Skin redundancy of more than proximal one third but reaching the elbow   | Non Excisional Brachioplasty   |
| B4    | Skin redundancy of the whole inferior border with skin redundancy at the lateral chest wall<br>Secondary zone of adherence | Extended Brachioplasty<br>Severance of the adherent zone and lipoinjection |

## RESULTS

All patients were satisfied with the surgical outcome as regards arm contour, scar placement and symmetry. The upper arm contour was restored. Apparent asymmetry was not noticed. There was no scar widening. Results remain almost unchanged except in post bariatric patients in whom minor brachial ptosis occurred. There was transient parathesia which lasts for 3 weeks. Dehiscence occurred in 3 cases at the axillary sutures in which healing occurred by conservative method. One case needed Z plasty.

## DISCUSSION

Different algorithms were proposed depending on amount of excess fat, severity of skin redundancy and location. Adiposity and skin laxity were combined in staging of brachial deformities [1,6,26,27]. In the current study patients are classified according to presence of excess fat, skin status and location of brachial ptosis. In group (A); liposuction only is done in patients with excess fat with good skin status or if skin retraction is anticipated. Skin retraction is anticipated when sagging of the inferior dependent portion of the arm is equal to or less than thickness of the dermosubcutaneous complex [31]. de Souza Pinto preferred to do liposuction in normal weight patients and he performed brachioplasty in patients with massive loss of weight [1]. The second group (B) is characterized by skin laxity and redundancy. The management in such group does not depend on severity of skin laxity but rather on the affected zone of brachial ptosis and accordingly the technique was chosen. There are 4 types; proximal one third, more than proximal one third but not reaching the elbow, more than proximal one third and reaching the elbow and the fourth one includes skin redundancy at the lateral chest wall. This is different than treatment zones used in previous algorithms. Lillis warns against immediate recommendation of brachioplasty except

in extreme cases, as skin contraction can be very good, and liposuction may be attempted first to see if results are beneficial [32]. Some authors may use liposuction as downstaging strategy to make minibrachioplasty feasible [17,27,33]. Some authors advise to do liposuction after closure of wounds because of the anticipated edema. Circumferential liposuction in the current study is done in all groups. It helps in arm sculpturing, adds the benefit of skin retraction and negates the need for undermining, dissection and excision except at the axilla [30].

Brachioplasty techniques are aiming to eliminate brachial deformities, lessen complications and make the achieved results long lasting. However most of the techniques have limitations. Type, length, location and symmetry of the incision may affect the surgical outcome. Location of incision may be at or posterior to the inner sulcus. The scar is not visible when the patient is viewed from the front, and it is not entirely visible from the back. Strauch et al stated that site for incision should be guided by the deformity [19]. In overweight patients the bicipital groove may be difficult to identify due to the reduction of muscle tone and mass of the arm musculature. Weight-loss patients may prefer inferior incisions (medial-epicondyle to axillary apex) over the conventional ones (bicipital groove incisions). They may accept scars for correcting their "bat wing deformity". Length of incision; short scar or traditional brachioplasty depends on the amount of resection. The incision in type B1, B2, and B3 are different according to the amount of resection. Straight line versus undulant incision: Strauch and Mahjouri used both straight-line incisions and the sinusoidal type pattern, without observing any linear contractions. Massive weight loss patients have cutis laxa with less possibility of scar contractions [19,34]. If there is skin excess at the elbow there may be need for transverse incision at the elbow or its extension onto the

forearm [15]. Fodor tried to gather skin excess of the forearm by performing V closure at the distal end of the incision with discontinuous undermining [35]. We prefer the undulant incision as it is less conspicuous and it causes no contraction. It also helps in excising skin excess distal to the elbow without extending the scar to the forearm. This is done by distributing the pull of excess skin and distributing the closure.

Location of redundant tissue determines which technique is performed. Trussler and Appelet et al., used limited brachioplasty [17,27] and Ambrason performed minibrachioplasty if there is brachial ptosis in the proximal one third [33]. Both end in scar at the axilla and short one in the upper arm. Short scar brachioplasty is recommended for redundant skin in the proximal two thirds of the inferior border. For the same deformity we use semilunar axillary excision which becomes completely hidden. We performed non excisional brachioplasty for patients with skin redundancy of more than proximal one third and reaching the elbow. Non excisional modified Ted Lockwood is recommended for skin redundancy of more than one third but not reaching the elbow. Appelt et al., and others chose traditional brachioplasty for patients with laxity of the entire arm [27]. Elkhatib did not use the location of redundant tissue but rather the amount of ptosis combined with the degree of adiposity for staging brachial deformities and treatment algorithm [6].

*Excision versus non excision:* Excision of the redundant skin is described in most brachioplasty techniques. Resection may lead to central narrowing and persistent atrophy of bicipital groove. Goddio had described non-excisional technique [20]. In the current study depithelilization replaces excision as a modification of the traditional brachioplasty and Ted Lockwood techniques. Many preferred not to perform undermining beyond the excision for better contour, less seroma and less lymphedema [11,12,18]. Fodor used discontinuous undermining with a blunt-tipped cannula without suction of the wound edges to facilitate tension-free closure and reduces pleating along the closure line distally [35]. We found that there is neither need for dissection nor undermining. This lessened the occurrence of seroma, lymphorrhea or nerve injury. Excision is recommended only in cases of dermochalasis with severe skin redundancy and no excess fat. SFS is repaired in type B which makes results long lasting. Overweight patients suffering of severe brachial ptosis may have secondary zone of adherence. In this series secondary adherent zone was noticed

in four cases. Two cases were treated in the traditional way and the deformity remained as such. In the other two cases lipoinjection was done after severance of the adherent zone to eliminate this deformity. This may need further studies Massive weight loss patients have cutis laxa with less possibility of scar contractions. Also, they may have minor postoperative brachial ptosis. Dehiscence at the axillary wound occurred in three cases; one in modified Ted Lockwood and two in non excisional brachioplasty technique.

#### *Conclusion:*

Brachioplasty became an interesting subject. Dermolipectomy was the main procedure then it was combined with liposuction. Different algorithms were suggested. In this algorithm one must discriminate between cases with adiposity alone and cases with adiposity and ptosis. Location of redundant tissue determines which technique is performed. Circumferential liposuction provides uniform skin retraction and better arm contouring. Advantages of depithelization are avoidance of undermining and excision. Excision without undermining is performed only at the axilla or at the lateral chest wall. This will preserve arm contour, lessens occurrence of oedema, seroma and injury of Median antebrachial cutaneous nerve. Anchoring of SFS tightens and rejuvenates the upper arm. It also makes the results long lasting. Dermal suturing strengthens the wound and lessens scar widening.

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