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# Post Massive Weight Loss Brachioplasty Aesthetic Outcome and Complications

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## ABSTRACT

**Background:** Some people have a "bat wing" deformity and an extension of skin redundancy from the axilla along the lateral chest wall that overlaps in the breast region, which has an effect on surgical choices. Forearm redundancy can also occur in certain people.

**Objectives:** To evaluate the aesthetic outcome and complications of brachioplasty in post massive weight loss patients.

**Patients and methods:** This is a prospective comparative study conducted on 24 patients with brachioplasty; to evaluate the aesthetic outcome and complications of brachioplasty in postoperative weight loss patients, in the Plastic Surgery Department of Menoufia University and Maadi Military Hospital, during a period time from April 2019 to October 2022.

**Results**: According to Spearman's correlation analysis, there was a highly significant positive association between preoperative average arm circumference and postoperative arm circumference ($p < 0.01$). All three procedures displayed non-significant predictive results when separating patients with reduced arm circumference from those without ($p > 0.05$) using ROC-curve analysis. By using ROC-curve analysis, mini brachioplasty technique predicted complications-free patients with good (82.5%) accuracy, sensitivity= 100% and specificity= 65% ($p = 0.0002$).

**Conclusion:** In certain patients with generalised inferior arm skin and fat redundancy, a brachioplasty surgery is an effective and repeatable therapy. The markers and resection are made simpler. By protecting lymphatics and nerves and reducing blood loss, it offers a safe process. It generates consistent, foreseeable consequences with reliable performance.

**Keywords:** Aesthetic, Bariatric, Brachioplasty, Complications, Obesity, Massive Weight.

## INTRODUCTION

Excess bodily fat is a definition of obesity. This fat may be evenly distributed throughout the body or may be concentrated in one area [1]. A new group of persons known as post bariatric patients emerged with the development of bariatric surgery. Massive weight reduction brought on by bariatric surgery typically leaves the belly, breasts, arms, and thighs with superfluous and amorphous skin. Intertrigo, difficulties walking, peeing, or engaging in sexual activity are just a few of the issues loose skin can lead to [2].

Formerly obese individuals have adipose and cutaneous excess after significant weight reduction, and their skin has lost the majority of its flexibility [3]. Body contouring following bariatric surgery considerably enhances one's physical and mental state, according to studies. Cosmetic surgery may also motivate the patient to pay more attention to weight management, increasing the likelihood of long-term weight reduction success [4].

Dissatisfaction with upper arm excess is common in patients who have had significant weight reduction. They often describe their arms as "bat wings" because of hanging tissue that can get caught in clothing and can cause rashes [5].

Embarrassed about the appearance of their arms, these individuals avoid short sleeved clothing. Finding apparel that has sufficient material to conceal their arms, however, is often difficult, if not impossible. They will often have learned to cope with excess in other parts of their body but feel that their arms are difficult to conceal, especially in hot weather [6].

Although the canopy-like draping between the axilla and the elbow is the most striking feature, the unsettling deformity always encompasses the axilla and spans across the chest and lateral breast [7]. It can also occasionally extend distally into the forearm. Despite the numerous treatments proposed for its enhancement, surgical rejuvenation of the upper arm continues to be a challenge for both the patient and the physician [8].

Correa-Iturraspe and Fernandez originally described brachioplasty in 1954. Since then, a number of adjustments have been made to the surgery to enhance the look of the scar and the arm's subsequent shape. This includes techniques such as S-incisions, W-plasty, re-epithelialization rolled-up flaps, T-incision, fascial system suspensions and using molds [9].

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 [10]. Edema, seroma, wound dehiscence, subcutaneous abscess, and a short period of lymphorrhea may occur. Median antebrachial cutaneous nerve (MACN) injury (paresthesia) and chronic regional pain syndrome were recorded [11].

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 [12]. So, the aim of this study was to evaluate the aesthetic outcome and complications of brachioplasty in post-massive weight loss patients.



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## PATIENTS AND METHODS

This is a prospective comparative study conducted on 24 patients with brachioplasty; to evaluate the aesthetic outcome and complications of brachioplasty in post-massive weight loss patients, in the Plastic Surgery Department of Menoufia University and Maadi Military Hospital, during a period time from April 2019 to October 2022. They were divided into 3 groups according to type of Brachioplasty technique:

**Mini Brachioplasty** (4 patients), **Standard Brachioplasty** (15 patients), and **Two-ellipse Brachioplasty** (5 patients).

**Inclusion Criteria:** All patients who were seeking arm contouring surgery after massive weight loss with age above 18 and fixed weight for 6 months.

**Exclusion Criteria:** Uncontrolled diabetic patients and uncontrolled patients with hypertension, immunodeficient patients, patients with vascular insufficiency and lymphatic disorders, patients who refused to stop smoking and patients who were suffering from coagulopathy.

**Preoperative Evaluation:** A thorough history, including information on weight loss and gain, cigarette usage, nutritional condition, and co-morbid illnesses, was gathered.

**A physical examination** was conducted to evaluate the arms, including range of motion at the shoulder, elbow, and hand as well as grip strength, check for excess fat and skin in specific areas as well as the overall quality and tone of the skin, as well as to conduct routine preoperative investigations (complete blood count, coagulation profile, kidney function tests, and liver function tests).

**Operation:** All patients were subjected to different variety of brachioplasty: Mini brachioplasty, standard brachioplasty and two ellipse brachioplasty.
These patients were followed up from time of admission to hospital till discharge and then in the outpatient clinic for six months.

**Postoperative follow up was classified into**: **Early assessment criteria:** Edema, Hematoma formation, Infection, Wound dehiscence, Late assessment criteria in 1$^{st}$, 3$^{rd}$ and 6$^{th}$ month, Accuracy of correction (Arm contour), Scar characters (color, healing, maturity, and visibility), Patient satisfaction, Chronic regional pain syndrome and antebrachial cutaneous nerve injury (Paresthesia).

**Methods:**

All patients underwent a thorough physical examination to assess grip strength, range of motion at the shoulder, elbow, and hand, as well as assess for excess fat, excess skin, specific areas of excess, and overall skin quality and tone. The complete medical histories of all patients were also taken, including information about weight loss or gain, tobacco use, nutritional status, and co-morbid diseases. routine preoperative exams (full blood count, coagulation profile, testing for kidney and liver function).

**Details of Brachioplasty operation: Brachioplasty procedure** included the following steps:

**General anesthesia** and intravenous sedation were options for anesthesia.

**The incision**: The amount and position of the extra skin that had to be removed during brachioplasty surgery, as well as the plastic surgeon's best judgement, determined the length and pattern of the incisions. Depending on the surgeon's discretion, incisions were often made on the inside or rear of the arm and might stretch from the axilla (underarm) to the area just above the elbow. Depending on your particular situation, excess fat was immediately removed or treated with liposuction, and incisions were smaller. Internal sutures were then used to tighten and restructure the supporting tissue beneath. The skin was then reapplied over your arm's new shape.

**Closing the incisions:** An absorbable suture or stitches were used to seal the incisions, and they were taken out one to two weeks after your brachioplasty.

**View the outcomes:** Although there might be some swelling and bruising, brachioplasty produced smoother, tighter shapes that were seen practically right away.

**Ethical considerations:**
**The Menoufia University Academic and Ethical Committee authorised the study. Each patient had to complete a written informed consent form in order to take part in the experiment. This study was guided by the World Medical Association's Helsinki Declaration, an ethical guideline for human research.**

***Statistical Analysis***

SPSS version 25 was used to code, process, and analyse the obtained data. The mean (±) SD was used to represent quantitative data, whilst frequency and percentage were used to express qualitative data. Analytic statistics comprised the following tests: ROC curves, Chi-Squared ($X^2$), one-way ANOVA (F). P value less than 0.05 was considered significant.

## RESULTS

The demographic and postoperative safety data of the patients of this study are shown in table 1.

**Table (1): Sociodemographic data and postoperative safety data (bad outcomes) among 24 brachioplasty patients**

| Variables | | Frequency (%) |
|---|---|---|
| **Age (years) Mean+ SD** | | 41.5 ± 4.9 |
| **Gender** | Female | 23 (95.8%) |
| | Male | 1 (4.2%) |
| **Early postoperative complications** | Edema | 4 (16.7%) |
| | Hematoma formation | 1 (4.2%) |
| | Infection | 1 (4.2%) |
| | Seroma | 5 (20.8%) |
| | Wound dehiscence | 2 (8.3%) |
| **Scar outcome** | Bad | 4 (16.7%) |
| | Good | 20 (83.3%) |
| **Paresthesia** | +ve | 1 (4.2%) |

There were no statistically significant differences in the patients' age, sex or in any of the preoperative variables (BMI, arm circumference, and comorbidities) **(Table 2).**

**Table (2): Comparison between the 3 groups as regards sociodemographic and preoperative data using ANOVA and Chi square tests**

| **Variable** | | **Mini brachioplasty (4)** | **Standard brachioplasty (15)** | **Two-ellipse brachioplasty (5)** | **ANOVA test** |
|---|---|---|---|---|---|
| | | Mean ± SD | Mean ± SD | Mean ± SD | P value |
| **Sociodemographic** | | | | | |
| Age (years) | | 37.7 ± 2.5 | 41.2 ± 4.4 | 45.4 ± 5.8 | = 0.058 |
| | | **N (%)** | **N (%)** | **N (%)** | **$X^2$** |
| Gender | Female | 4 (100%) | 14 (93.3%) | 5 (100%) | = 0.7312 |
| | Male | 0 (0%) | 1 (6.7%) | 0 (0%) | |
| Preoperative | | Mean ± SD | Mean ± SD | Mean ± SD | P value |
| BMI change after weight loss | | 14.5 ± 3.7 | 18.8 ± 4.8 | 19.6 ± 5.4 | = 0.236 |
| Rt Arm circumference (cm) | | 48.5 ± 2 | 47.7 ± 3.5 | 47.6 ± 3.7 | = 0.911 |
| Lt Arm circumference (cm) | | 48.2 ± 0.9 | 48.3 ± 2.9 | 46.4 ± 3.2 | = 0.412 |
| Average Arm circumference (cm) | | 48.3 ± 1.4 | 48 ± 3.2 | 47 ± 3.5 | = 0.760 |
| | | **N (%)** | **N (%)** | **N (%)** | **$X^2$** |
| Co-morbidity | +ve | 0 (0%) | 3 (20%) | 1 (20%) | = 0.6188 |

Additionally, a comparison of the three groups showed no significant difference as regards all postoperative efficacy data (arm circumference and patient satisfaction) and the appearance of the scar. Furthermore, comparative study between the 3 groups revealed, significant increase in complications rate in two-ellipse brachioplasty (100%), compared to standard brachioplasty (53.3%), compared to mini brachioplasty (0%), (p=0.011) **(Table 3).**

**Table (3): Comparison between the 3 groups as regards postoperative efficacy data (good and bad outcomes) using ANOVA and Chi square tests**

| Variable | | Mini brachioplasty (4) | Standard brachioplasty (15) | Two-ellipse brachioplasty (5) | ANOVA test |
|---|---|---|---|---|---|
| | | Mean ± SD | Mean ± SD | Mean ± SD | P value |
| Good outcomes | | | | | |
| Rt Arm circumference (cm) | | 41.5 ± 4.3 | 39 ± 3.2 | 39.2 ± 3.8 | = 0.462 |
| Lt Arm circumference (cm) | | 42.2 ± 1.9 | 39.7 ± 2.98 | 38.6 ± 3.5 | = 0.197 |
| Average Arm circumference (cm) | | 41.8 ± 3 | 39.3 ± 3 | 38.9 ± 3.5 | = 0.319 |
| | | N (%) | N (%) | N (%) | $X^2$ |
| Patient satisfaction | Not satisfied | 1 (25%) | 1 (6.7%) | 2 (40%) | = 0.1979 |
| | Satisfied | 3 (75%) | 14 (93.3%) | 3 (60%) | |
| Bad outcomes | | | | | |
| Early postoperative complications | No complications | 4 (100%) | 7 (46.7%) | 0 (0%) | = 0.225 |
| | Edema | 0 (0%) | 3 (20%) | 1 (20%) | |
| | Hematoma formation | 0 (0%) | 0 (0%) | 1 (20%) | |
| | Infection | 0 (0%) | 1 (6.7%) | 0 (0%) | |
| | Seroma | 0 (0%) | 3 (20%) | 2 (40%) | |
| | Wound dehiscence | 0 (0%) | 1 (6.7%) | 1 (20%) | |
| Scar outcome | Bad | 0 (0%) | 3 (20%) | 1 (20%) | = 0.6188 |
| Paresthesia | +ve | 0 (0%) | 0 (0%) | 1 (20%) | = 0.1377 |

Additionally, a comparison of pre- and postoperative measures found that all three brachioplasty groups showed a very significant decrease in arm circumference measurements **(Table 4).**

**Table (4): Comparison between 3 groups of patients as regards serial arm circumference measurements**

| Variable | Preoperative measurement | Postoperative measurement | Paired t test |
|---|---|---|---|
| | Mean ± SD | Mean ± SD | P value |
| **Average Arm circumference** (cm) (Mini brachioplasty group) | 48.3 ± 1.4 | 41.8 ± 3 | = 0.0087** |
| | Preoperative measurement | Postoperative measurement | Paired t test |
| | Mean ± SD | Mean ± SD | P value |
| **Average Arm circumference** (cm) (Standard brachioplasty group) | 48 ± 3.2 | 39.3 ± 3 | < 0.0001** |
| | Preoperative measurement | Postoperative measurement | Paired t test |
| | Mean ± SD | Mean ± SD | P value |
| **Average Arm circumference** (cm) (Two-ellipse brachioplasty group) | 47 ± 3.5 | 38.9 ± 3.5 | = 0.0003** |

**: Highly significant

Additionally, Spearman's correlation analysis revealed that there was a highly significant positive link between preoperative average arm circumference and postoperative arm circumference **(Table 5).**

**Table (5): Spearman's correlation analysis for some preoperative factors associated with postoperative arm circumference**

| Associated Factor | Postoperative arm circumference | |
|---|---|---|
| | rho | P |
| **Age** (years) | 0.03401 | =0.8747 |
| **BMI** | -0.1898 | =0.3744 |
| **Average Arm circumference** (preoperative) | 0.7386 | <0.0001** |

**rho:** Spearman's rho (correlation coefficient)

Also, all three approaches had non-significant predictive results when separating patients with reduced arm circumference from those without using ROC-curve analysis. Additionally, the mini brachioplasty approach has excellent (82.5%) accuracy, 100% sensitivity, and 65% specificity when employing ROC-curve analysis. Two-ellipse brachioplasty approach used ROC-curve analysis to identify complex patients in this case with fair (79.9%) accuracy, 100% sensitivity, and 57.9% specificity. Additionally, standard brachioplasty procedure demonstrated non-significant predictive values in differentiating patients with problems from patients without utilising ROC-curve analysis, because nearly half patients were complicated, **(Table 6 and figures 1-6).**

**Table (6): Data of ROC-curve of each surgical technique to predict decreased arm circumference and complications occurrence**

| Variable | AUC | SE | Sensitivity (%) | Specificity (%) | P value |
|---|---|---|---|---|---|
| **Decreased arm circumference** | | | | | |
| **Mini brachioplasty** | 0.600 | 0.140 | 100 | 20 | 0.4758 |
| **Standard brachioplasty** | 0.544 | 0.122 | 20 | 88.89 | 0.7154 |
| **Two-ellipse brachioplasty** | 0.521 | 0.150 | 20 | 84.21 | 0.8885 |
| **Complications occurrence** | | | | | |
| **Mini brachioplasty** | 0.825 | 0.0863 | 100 | 65 | 0.0002** |
| **Standard brachioplasty** | 0.511 | 0.124 | 46.67 | 55.56 | 0.9287 |
| **Two-ellipse brachioplasty** | 0.789 | 0.0927 | 100 | 57.89 | 0.0018** |

ROC (Receiver operating characteristic), AUC= Area under curve, SE= Standard Error

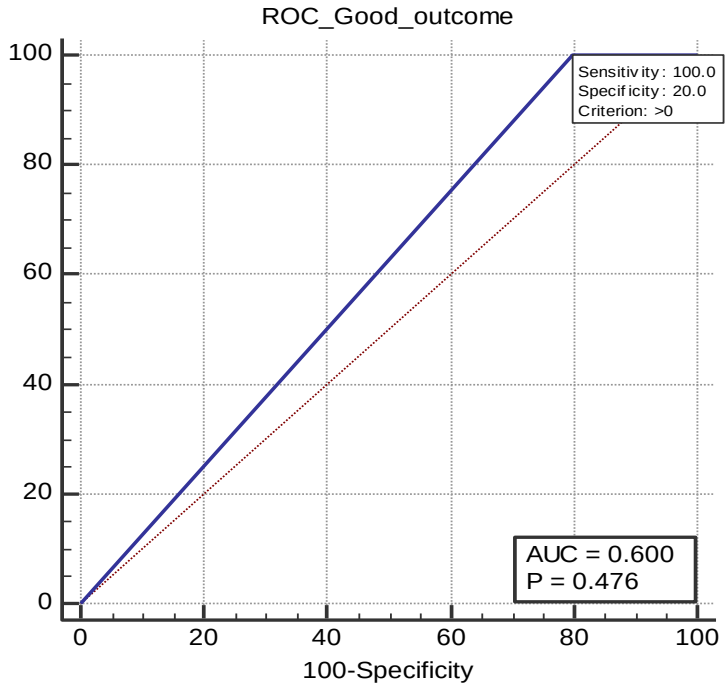


**Figure (1): ROC curve of mini brachioplasty technique (decreased arm circumference)**

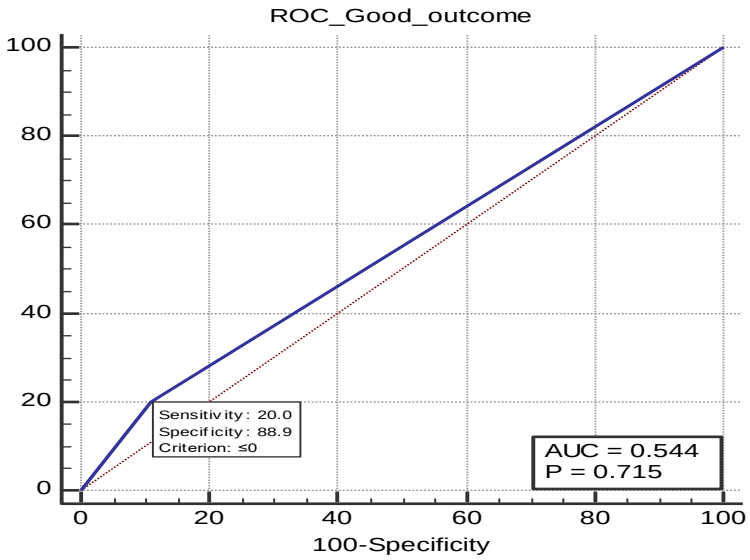


**Figure (1): ROC curve of standard brachioplasty technique (decreased arm circumference)**

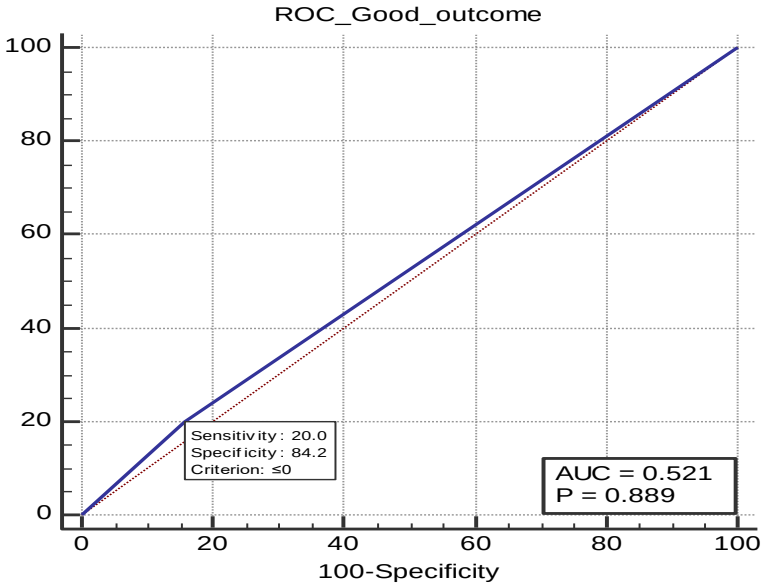


**Figure (2): ROC curve of two-ellipse brachioplasty technique (decreased arm circumference)**

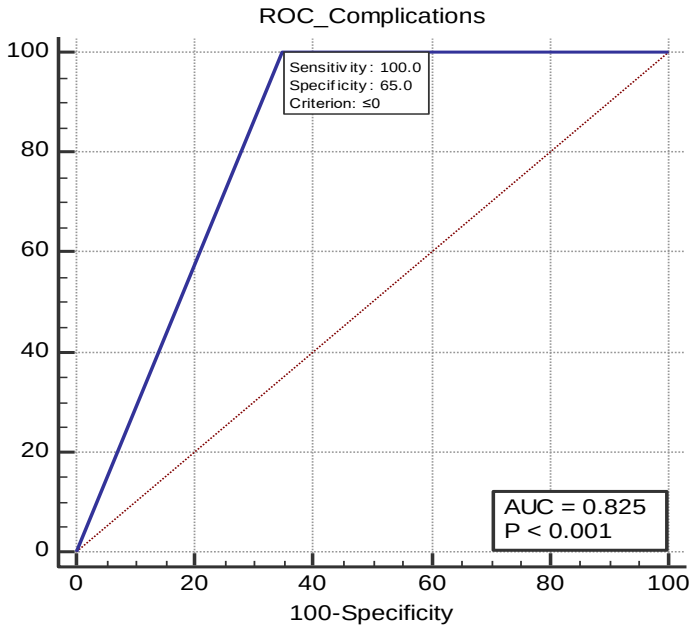


**Figure (4): ROC curve of mini brachioplasty technique (complications occurrence)**

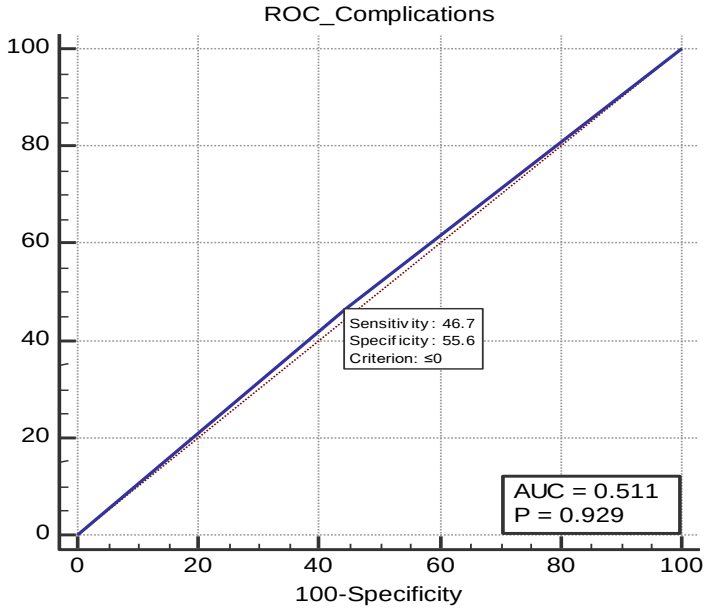


**Figure (5): ROC curve of standard brachioplasty technique (complications occurrence).**

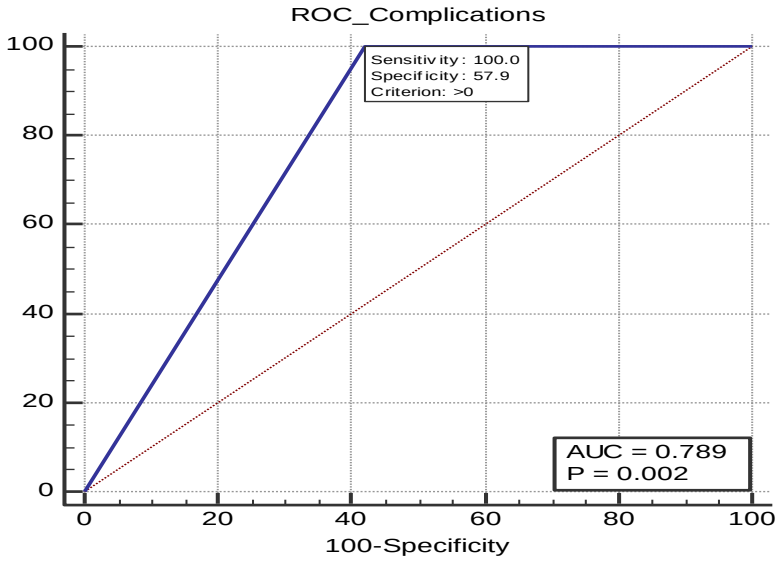


**Figure (6): ROC curve of two-ellipse brachioplasty technique (complications occurrence).**

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## DISCUSSION

The purpose of arm lift surgery is to improve the appearance of arm deformities. The significant area of loose tissue that extends on the upper arm, like a wide portion of "bat wings", causes patients who seek arm-lift treatments great agony. Recently, there have been more requests for brachioplasty, mostly as a result of the rise in bariatric surgeries. Within two to three years of the execution of bariatric surgery, which causes a large decrease of weight, brachioplasty is frequently performed. Senile elastosis and drastic weight reduction from diet and exercise are other factors [13].

**El Khatib** [14] suggested categorising the contour deformity of the arm based on the degree of ptosis (measured the vertical distance between the brachial sulcus and the inferior curvature of the arm) and the amount of lipodystrophy. Brachial ptosis was divided into five phases. Small wound separations, dehiscence, seroma, lymphocele/lymphedema, difficulty to seal the arm, poor scarring, infection, hemorrhage, nerve compression/compartment syndrome, neuromas, and sensory loss are complications that can follow brachioplasty [15].

In the current study, a total of 24 patients showed that the mean age of all patients was (41.5 ± 4.9) years. Regarding gender of the patients, the majority (95.8%) of patients were females, while (4.2%) were males.

According to **Bossert *et al.*** [16], 144 consecutive patients with considerable weight reduction received brachioplasty alone or in conjunction with other body sculpting surgeries, which is consistent with our findings. With an average age of 46±11 years, there were 139 female patients and 5 male patients. From six months to two years were spent on follow-up. Additionally, **de Runz *et al.*** [17] reported that sixty-six consecutive patients had medial brachioplasty aided by liposuction. With an average age of 44.4 years, there were three males and 63 women (95.45% of the total population).

In our study, comparative analysis of the three groups in the current study found no statistically significant differences in any of the preoperative variables (BMI, arm circumference, and comorbidities) ($p > 0.05$). But, **Bossert *et al.*** [16] found that patients receiving concomitant arm liposuction had substantially higher body mass indices at the time of surgery than those undergoing excision alone (30.7 0.51 $kg/m^2$ versus 28.8 0.46 $kg/m^2$, $p = 0.01$).

According to the current study, a comparison of the three groups indicated a significantly higher rate of complications in the two-ellipse brachioplasty (100%), standard brachioplasty (53.3%), and small brachioplasty (0%), respectively ($p = 0.011$). A comparison between the three groups found no significant differences in the appearance of scars ($p > 0.05$).

Research by **Hota *et al.*** [18] revealed that excisional surgery, which must traverse the axilla to the lateral chest wall, is usually necessary for treating upper arm deformities in patients who have undergone considerable weight loss. A "double ellipse" marking approach is utilised to avoid over-resection while still obtaining the optimal outcome. With the "segmental resection closure" approach, the excision is carried out without the intervention of swollen soft tissue during wound closure. Compared to the more conventional bicipital groove placement, it sets the scar at the inferior border of the arm (when the arm is abducted). This method is flexible and produces the best upper arm shape feasible in patients who have had significant weight reduction [19].

In a recent study, **Di Pietro *et al.*** [12] reported that extra volume from leftover fat from bariatric surgery and MWL as well as excess skin are concerns in ex-obese patients' arms. By using liposuction to treat the first issue and surgical excision to treat the second, liposuction-assisted brachioplasty (LAB) overcomes both issues. Due to the fact that liposuction does not harm the perforator veins, it actually lowers the volume of the medial arm while not increasing the risk of complications [20, 21]. The microcirculation enables the interchange of fluid, molecules, gas, cells, and lymphatic channels [22, 23].

**Pascal and Louarn** [24] already discussed brachioplasty and liposuction. Two trials that were just completed assessed the safety of these combination procedures. **Bossert *et al.*** [16] discovered that the complication rate of the patient who underwent brachioplasty with medial scar alone was the same as that of the patient who underwent brachioplasty and liposuction of the posterior arm (outside the brachioplasty excision site). **Gusenoff *et al.*** [25] suggested that brachioplasty could be safe when combined with other procedures.

According to **Di Pietro *et al.*** [12], the incidence of problems was considerably lower in the group receiving liposuction assistance during brachioplasty (9% vs. 60%, P0.01). In a recent study, **Allawi *et al.*** [26] discovered that one tiny incidence of wound dehiscence was identified near the axilla. Nine out of 66 patients, according to **de Runz *et al.*** [17], exhibited wound dehiscence. With the exception of the patient with skin redundancy who was waiting for an appointment for re-excision, no scar revision was performed for any of their study cases. While in 22 of the 66 instances according to their research had adjustments made. This could be brought on by the pressure put on the wound during closure. Nine instances (40.9%) of routine brachioplasty patients had problems, compared to a multiparticle cohort complication incidence of 53.1% in different research [27].

Also, **Allawi *et al.*** [26] pointed out that the routine brachioplasty group experienced wound dehiscence in four cases (18.1%). 6 incidences of wound dehiscence out of 96 patients (6.2%) were described by **Zomerlei *et al.*** [27]. According to **Sisti *et al.*** [13] review of the literature, the overall rate of wound dehiscence was 5.7%. In our investigation, wound infection was seen in three cases (13.6%), compared to 3.1% total findings in their study. Hematoma development was rare and only happened in one instance, which is consistent with the total report's 0.75%. Four cases (18.1%) involving the same patient who had severe edema and the other case involving a patient who had a hematoma both had paresthesia and nerve damage.

By using ROC-curve analysis, mini brachioplasty technique predicted complications-free patients with good (82.5%) accuracy, sensitivity= 100% and specificity= 65% ($p = 0.0002$), which concurred with **Chowdhry *et al.*** [28] conclusion that liposuction and mini brachioplasty procedures produce comparable contouring. To reduce the visible scar's external appearance, the entire scar is implanted in the axilla. While the resection and scarring are more transversely orientated, the liposuction cannula has the potential to harm these nerves or denervate the associated dermatomes, which might result in temporary or long-lasting anesthesia over the medial arm. It is also important to keep in mind that, despite the possibility of a more favourable cosmetic result with a micro brachioplasty in the right patient group, the surgeon is less free to shape the extra skin than with a regular brachioplasty [28]. Also, according to **Shermak** [29], concomitant liposuction and concurrent other operations were not linked to a noticeably higher risk of complications.

Small sample size, lack of follow-up, selection bias, and absence of universal outcome measures were some of the issues that impeded a thorough analysis in our study.

## CONCLUSION

In certain patients with generalised inferior arm skin and fat redundancy, a brachioplasty surgery is an effective and repeatable therapy. The markers and resection are made simpler. By protecting lymphatics and nerves and reducing blood loss, it offers a safe process. It generates consistent, foreseeable

consequences with reliable performance. In the advancement of upper arm contouring, this method offers another improvement.

**Sponsoring financially:** Nil.
**Competing interests:** Nil.

## REFERENCES

1. **Takemoto M, Lewars B, Hurst S *et al.* (2018):** Participants' perceptions on the use of wearable devices to reduce sitting time: Qualitative analysis. JMIR mHealth and uHealth, 6(3): e7857. doi: 10.2196/mhealth.7857
2. **Langer V, Singh A, Aly A *et al.* (2011):** Body contouring following massive weight loss. Indian Journal of Plastic Surgery, 44(01): 14-20.
3. **Dunne J, Wormald J, Ghedia R *et al.* (2017):** Implementation of national body contouring surgery guidelines following massive weight loss: a national cross-sectional survey of commissioning in England. Journal of Plastic, Reconstructive & Aesthetic Surgery, 70(1):54-9.
4. **Mukherjee S, Kamat S, Adegbola S *et al.* (2014):** Funding for postbariatric body-contouring (bariplastic) surgery in England: a postcode lottery. Plastic Surgery International, 14: 153194. doi: 10.1155/2014/153194
5. **Toma T, Harling L, Athanasiou T *et al.* (2018):** Does body contouring after bariatric weight loss enhance quality of life? A systematic review of QOL studies. Obesity Surgery, 28(10):3333-41.
6. **Botero A, Wenninger M, Loaiza D (2017):** Complications after body contouring surgery in postbariatric patients. Annals of Plastic Surgery, 79(3):293-7.
7. **Hurwitz D, Agha-Mohammadi S (2016):** Plastic Surgery in Massive Weight Loss Patients. In: International Textbook of Aesthetic Surgery. Springer, Berlin, Heidelberg. pp. 409-434. DOI:10.1007/978-3-662-46599-8
8. **Kubiak C, Etra J, Brandacher G *et al.* (2019):** Prosthetic rehabilitation and vascularized composite allotransplantation following upper limb loss. Plastic and Reconstructive Surgery, 143(6):1688-701.
9. **Bocchiotti M, Ruka E, Spaziante L *et al.* (2018):** 'J'brachioplasty technique in massive weight loss patients. Journal of Plastic Surgery and Hand Surgery, 52(5):282-7.
10. **Abboud M, Abboud N, Dibo S (2016):** Brachioplasty by power-assisted liposuction and fat transfer: a novel approach that obviates skin excision. Aesthetic Surgery Journal, 36(8):908-17.
11. **Chen W, James I, Gusenoff J *et al.* (2018):** The constriction arm band deformity in brachioplasty patients: Characterization and incidence using a prospective registry. Plastic and Reconstructive Surgery, 142(6):856-61.
12. **Di Pietro V, Colicchia G, Cervelli V *et al.* (2018):** Arm contouring after massive weight loss: Liposuction-assisted brachioplasty versus standard technique. Journal of Cutaneous and Aesthetic Surgery, 11(2): 73-78.
13. **Sisti A, Cuomo R, Milonia L *et al.* (2017):** Complications associated with brachioplasty: A literature review. Acta Bio Medica: Atenei Parmensis., 88(4): 393-402.
14. **El Khatib H (2007):** Classification of brachial ptosis: strategy for treatment. Plastic and Reconstructive Surgery, 119(4):1337-42.
15. **Aly A, Soliman S, Cram A (2007):** Brachioplasty in the massive weight loss patient. Clinics in Plastic Surgery, 35(1): 141-147.
16. **Bossert R, Dreifuss S, Coon D *et al.* (2013):** Liposuction of the arm concurrent with brachioplasty in the massive weight loss patient: Is it safe? Plastic and Reconstructive Surgery, 131(2): 357–365.
17. **de Runz A, Colson T, Minetti C *et al.* (2015):** Liposuction-assisted medial brachioplasty after massive weight loss: An efficient procedure with a high functional benefit. Plastic and Reconstructive Surgery, 135(1): 74–84.
18. **Hota A, Meky M, Nasef M *et al.* (2019):** Evaluation of different varieties of brachioplasty. The Egyptian Journal of Hospital Medicine, 75(3):2505-13.
19. **Gilliland M, Lyos A (1997):** CAST liposuction: An alternative to brachioplasty. Aesthetic Plastic Surgery, 21(6):398-402.
20. **Graf R, de Araujo L, Rippel R *et al.* (2006):** Lipoabdominoplasty: liposuction with reduced undermining and traditional abdominal skin flap resection. Aesthetic Plastic Surgery, 30(1):1-8.
21. **Salgarello M, Barone-Adesi L, Cina A *et al.* (2005):** The effect of liposuction on inferior epigastric perforator vessels: a prospective study with color Doppler sonography. Annals of Plastic Surgery, 55(4):346-51.
22. **Bertheuil N, Chaput B, Berger-Müller S *et al.* (2016):** Liposuction preserves the morphological integrity of the microvascular network: flow cytometry and confocal microscopy evidence in a controlled study. Aesthetic Surgery Journal, 36(5):609-18.
23. **Filho D, Kafejian-Haddad A, Alonso N *et al.* (2009):** Lymphoscintigraphic appraisal of the lower limbs after liposuction. Aesthetic Surgery Journal, 29(5): 396-9.
24. **Pascal J, Louarn C (2005):** Brachioplasty. Aesthetic Plastic Surgery, 29(5):423-9.
25. **Gusenoff J, Coon D, Rubin J (2008):** Brachioplasty and concomitant procedures after massive weight loss: a statistical analysis from a prospective registry. Plastic and Reconstructive Surgery, 122(2):595-603.
26. **Allawi B, Al-Farhan A, Wais M (2020):** Liposuction assisted brachioplasty, evaluation of its efficacy and safety. Archivos Venezolanos de Farmacología y Terapéutica, 39(7):884-93. DOI: https://doi.org/10.5281/zenodo.4425582
27. **Zomerlei T, Neaman K, Armstrong S *et al.* (2013):** Brachioplasty outcomes: A review of a multipractice cohort. Plastic and Reconstructive Surgery, 131(4): 883–889.
28. **Chowdhry S, Elston J, Lefkowitz T *et al.* (2010):** Avoiding the medial brachial cutaneous nerve in brachioplasty: an anatomical study. Eplasty, 10: 134-139.
29. **Shermak M (2014):** Aesthetic refinements in body contouring in the massive weight loss patient: Part 2. Arms. Plastic and Reconstructive Surgery, 134(5): 726-35.