



Evaluation of Drain-Free Abdominoplasty After Application of Tissue Adhesive and Progressive Tension Sutures

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ABSTRACT:

Background: As the demand for abdominoplasty has increased, many efforts have been made to provide improved techniques to reduce postoperative complications related to seroma formation. Progressive tension sutures (PTS) and cyanoacrylate tissue adhesives are mentioned as techniques that are applied in a drain-free manner, enhancing comfort and outcome for the patients. The objective of this study is to check the efficacy of drain-free abdominoplasty by having either progressive tension sutures or cyanoacrylate tissue adhesives in preventing the formation of seromas and postoperative complications, with the evaluation of operative time and satisfaction of patients.

Methods: This is a prospective randomized clinical trial conducted in Zagazig University Hospitals from April to September 2024 on 12 patients who were assigned randomly to progressive tension sutures (PTS) or cyanoacrylate tissue adhesive groups for abdominoplasty. They had a BMI of less than 35 kg/m² and had written an informed consent form. Comprehensive preoperative evaluation, including clinical examination, laboratory tests, and abdominal ultrasound, was performed in all patients. Six-month follow-up structured visits to assess postoperative outcomes, complications, operative time, and patient satisfaction were conducted after surgery.

Results: The study population consisted of 9 females and 3 males, with a mean age of 35.1 years (SD: 7.69 years) and a mean BMI of 32.5 kg/m² (SD: 1.88 kg/m²). The mean operative time was 151 min (SD: 9.25 min). The most frequent complication was ecchymosis (75%), and none of the patients developed seromas. The overall patient satisfaction of 91.7% shows that there is a high acceptance of the drain-free techniques.

Conclusion: Progressive tension sutures or cyanoacrylate tissue adhesive culminate in effective drainage-free abdominoplasty to prevent seromas, enhance patient comfort, and give the highest satisfaction grades. Thus, these methods seem to be clinically feasible alternatives to conventional drains.

Keywords: Drain-Free Abdominoplasty; Tissue Adhesive; Progressive Tension Sutures.

INTRODUCTION

Abdominoplasty demand continues to rise steadily, especially in response to increased prevalence of bariatric surgery. An increased number of patients are approaching body contouring procedures for the purpose of medical weight loss and postoperative abdominal changes. Therefore, there are

improvements in abdominoplasty techniques that contribute to the safety and aesthetic results of the procedure. However, many surgeons resist the inclination toward new surgical approaches in favor of adhering to methods learned in training or proven successful by their own practice for many years [1].

There has been much debate about whether to drain the abdomen after surgery. Although they have become established in surgery, the discomfort and type of surgery carried out make patients find them a nuisance and one of the main downsides of the surgery. What makes it worse is that drains do not completely prevent complications after surgery; seroma formation is still significant. The symptoms of this include more clinic visits than expected and more money spent, thus affecting the patient's experience and recovery [2].

Many different techniques for abdominoplasty have been developed in an attempt to reduce or even eliminate the associated seroma rates as compared to traditional techniques without drains introduction. One has to understand the mechanism in order to optimize seroma-preventive strategies. Much controversy still surrounds the exact etiology, although the hypotheses invoked include excessive dead space, the disruption of lymphatic channels, and movement of the abdominal flap that may repeatedly interfere with the healing process [3].

Progressive tension sutures are a means of securing the abdominal flap reliably at multiple points to the underlying tissue. Such sutures in abdominoplasty are placed between the superficial fascia of the flap to the muscle fascia and thus help keep the flap in its position while diminishing the disturbance that may be caused during abdominal movement and. Also, PTS ensures distributing the tension evenly across the flap and will eliminate dead space thereby reducing the formation of seromas [4].

Another alternative to mechanical fixation includes cyanoacrylate tissue adhesives in providing good stabilization of the flap while reducing dead space, which might have advantages such as shorter operative times compared to PTS [4]. Therefore, we aimed at this study to assess progressive tension sutures as a mechanical fixation for seroma prevention and as a hemostatic agent in cases of abdominoplasty to evaluate the drain-free procedure.

METHODS

Between April and September of 2024, this prospective randomized clinical trial was conducted at the Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Zagazig University. Patients were divided into two groups; one group underwent abdominoplasty with cyanoacrylate tissue glue, while the other underwent abdominoplasty using progressive tension suture technique.

After IRB approval had been obtained (ZU-IRB#221-10/3/2024), all participants gave their written informed consent. The study adhered to the ethical principles as embodied in the Declaration of Helsinki.

The inclusion criteria for the study were patients admitted to the Plastic and Reconstructive Surgery Department at Zagazig University Hospitals for abdominoplasty, which included patients willing to accept the procedure after explaining its details with a BMI value of less than 35 kg/m². The exclusions were patients unfit for surgery, patients with psychiatric abnormalities or personality disorder, past history of injury or surgery to the abdomen, and those expecting to become pregnant. In addition, another exclusion criterion included body mass indexes exceeding 35 kg/m², major weight fluctuations over the last six months, and other systemic diseases affecting the healing capacity.

All subjects underwent a thorough health assessment starting with a thorough medical history. These included personal details such as name, age, parity, residence, occupation, and smoking habits, but also included chief complaints and their duration, any relevant past medical or surgical history, including drug allergies. A full physical examination was performed that included a general survey of vital signs, blood pressure, temperature, heart rate, and respiratory rate, and also assessment for any signs of either pallor or cyanosis, jaundice, or bulging of lymph nodes. The body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared, thus categorizing patients with low weight (<18.5), normal range (18.5-25), overweight (25-30), or obese (>30).

Abdominal examination checked for irregularities, asymmetry, distention, peristalsis of the bowel, or pulsation. Palpation was performed to assess rigidity, guarding, tenderness, masses, and Murphy's sign. Percussion was used to detect tympany or dullness, which could indicate fluid buildup or organ enlargement. Auscultation evaluated bowel sounds to assess normal or pathological activity.

Laboratory investigations included a complete blood count (CBC), erythrocyte sedimentation rate, C-reactive protein, liver and kidney function tests, coagulation profile (PT, PTT, INR), random blood sugar, and serological tests for HCV-Ab, HBS-Ag, and HIV-Ab. Radiological studies consisted of an abdominal ultrasound, conducted after fasting for six to eight hours, using a 3.5–5 MHz convex probe with multiple patient positioning techniques to enhance accuracy.

Surgical techniques varied between groups, with standardized preoperative preparation for all patients. Preoperative and postoperative photography was taken, and anatomical landmarks were marked in both standing and supine positions. General anesthesia was used, and patients received antibiotic and thromboembolic prophylaxis when indicated.

Lipoabdominoplasty involved tumescent infiltration with 500 mL of 0.9% saline solution containing 1/500,000 IU of epinephrine. Liposuction was performed on the upper abdomen and flanks using 4-mm and 5-mm cannulas. Flap elevation was carried out while carefully preserving Scarpa's fascia. Rectus abdominis muscle plication was performed using interrupted "X" sutures. The umbilicus was transposed with meticulous alignment using a high-frequency scalpel and single sutures. The abdominal flap was closed in three layers.

In abdominoplasty with progressive tension sutures (PTS), general anesthesia and prophylactic antibiotics were administered. Liposuction and flap elevation were performed using electrocautery. The first suture was placed at the highest point of dissection in the

midline, followed by midline sutures every 2 cm. Lateral sutures were symmetrically placed with wider spacing. Postoperatively, compression was applied for five minutes.

For abdominoplasty with cyanoacrylate tissue adhesive, the cyanoacrylate was applied in a grid pattern on the fascia, ensuring the flap was positioned to avoid overlap of adhesive droplets. Compression was maintained for five minutes to secure adhesion.

Postoperative care included maintaining patients in a semi-flexed position for one day. Preventive anticoagulants were administered to patients with a BMI greater than 30. Urinary catheters were removed on the first postoperative day, and patients were instructed to wear compression garments for three months. Early ambulation was encouraged to prevent complications.

Outcome measurements and follow-up were conducted weekly during the first postoperative month and then monthly until six months post-surgery. Outcome evaluation was based on scar quality, operative time, postoperative complications, and patient satisfaction. Satisfaction was graded as (A) Excellent, (B) Very Good, (C) Good, or (D) Unsatisfied.

Statistical Analysis:

Data was collected, coded, and analyzed using IBM SPSS Statistics for Windows, Version 23.0 (IBM Corp., Armonk, NY, USA). Qualitative data were summarized as frequency (n) and percentage (%), while quantitative data were presented as mean, standard deviation (SD), and range. Statistical significance was set at $P \leq 0.05$. A paired t-test was used to compare two paired quantitative variables within the same group, assuming normal distribution and random selection.

RESULTS

This study included 12 patients seeking abdominoplasty. Their ages ranged from 21 to 48 years with a mean \pm SD of 35.1 ± 7.69 . (25%) were males and (75%) were females. Their BMI ranged from 29 to 35 kg/m² with a mean \pm SD of 32.5 ± 1.88 (Table 1).

There was a statistically significant reduction in HB and HCT, as preoperative HB

preoperatively was 12.1 ± 0.71 and reduced to 11.6 ± 0.75 postoperatively ($P < 0.001$). Also, HCT preoperatively was 36.4 ± 1.91 and reduced to 34.9 ± 1.59 postoperatively ($P < 0.001$). (Figure 1).

Table (4) shows that the operative time ranged from 140 to 165 minutes with a mean \pm SD of 151 ± 9.25 . All the patients (100%) had minimal intraoperative bleeding. Fat liposuced ranged from 1200 to 1700 with a mean \pm SD of 1445 ± 137 (Table 2).

The most frequently detected complication among the studied patients was ecchymosis which was detected among (75%) of the patients, followed by infection among (16.7%) of the patients, while the least frequently detected complications were skin necrosis, wound dehiscence, scar complications,

redundant skin and need for revision which were detected among (16.7%) of the patients. (Figure 2).

Table (3) shows that (91.7%) of the patients were satisfied, while (8.3%) were not satisfied. Also, the total satisfaction score ranged from 15 to 28 with a mean \pm SD of 23.4 ± 4.09 .

A 31year old male patient came to Zagazig university hospitals outpatient clinic with a complaint of pendulous abdomen who underwent lipoabdominoplasty by using P.T.S technique pre and postoperative photo (Figure 3).

A 29year old female patient presenting to our opc with pendulous abdomen who underwent abdominoplasty using cyanoacrylate tissue adhesive (Figure 4).

Table 1: Demographic data among the studied patients

| Variables | | All patients (n=12) |
|--------------------------------|---------------|---------------------|
| Age (years) | Mean \pm SD | 35.1 ± 7.69 |
| | Range | (21 – 48) |
| Sex (n. %) | Male | 3 (25%) |
| | Female | 9 (75%) |
| BMI (kg/m^2) | Mean \pm SD | 32.5 ± 1.88 |
| | Range | (29 – 35) |

*BMI=Body mass index

Table 2: Intraoperative data among the studied patients

| Variables | | All patients (n=12) |
|-------------------------------|---------------|---------------------|
| Operative time (minutes) | Mean \pm SD | 151 ± 9.25 |
| | Range | (140 – 165) |
| Intraoperative bleeding (n.%) | Minimal | 12 (100%) |
| | Severe | 0 (0%) |
| Fat liposuced | Mean \pm SD | 1445 ± 137 |
| | Range | (1200 – 1700) |

Table 3: Patient satisfaction among the studied patients

| Variables | | All patients (n=12) |
|--------------------------|---------------|---------------------|
| Satisfaction (n. %) | Not satisfied | 1 (8.3%) |
| | Satisfied | 11 (91.7%) |
| Total satisfaction score | Mean \pm SD | 23.4 ± 4.09 |
| | Range | (15 – 28) |

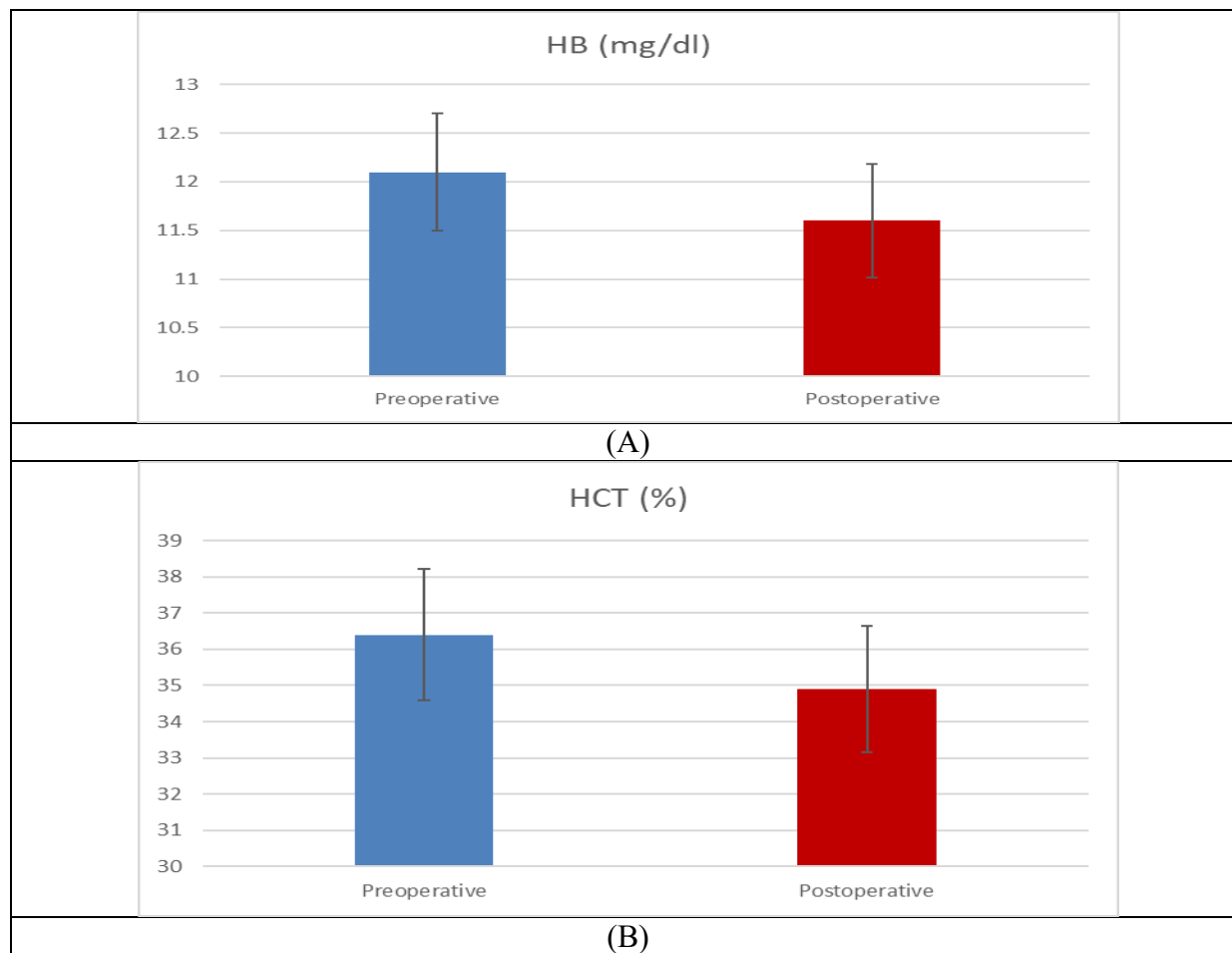


Figure 1: Bar plot showing HB and HCT change among the studied patients

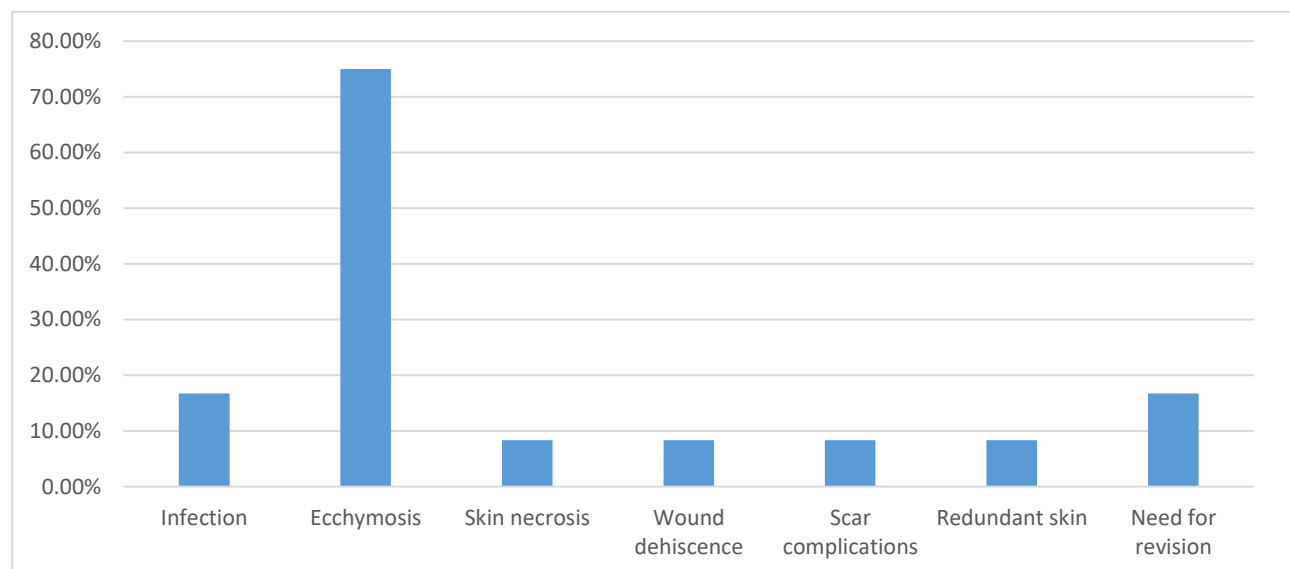


Figure 2: Postoperative complications among the studied patients



Figure 3: male patient, 31 years who underwent lipoabdominoplasty by using P.T.S technique pre and postoperative.



Figure 4: female patient 29 years old with abdominoplasty using cyanoacrylate tissue adhesive pre and postoperative.

DISCUSSION

Anterior abdominal wall deformities can be corrected surgically by abdominoplasty, which targets the musculoaponeurotic layer, fat, and skin. Like other operations, abdominoplasty has complications even though it is thought to be a safe technique [5].

Often referred to as a tummy tuck, lipoabdominoplasty is rapidly gaining popularity as a body contouring procedure. In addition to tightening the skin, this technique can remove excess fat, reducing abdominal fullness and improving overall body aesthetics [6].

Seroma formation is among the most common post-abdominoplasty complications, with reported incidences varying significantly in the literature, though a widely accepted rate is approximately 10%. Several factors can lead to the development of seromas, including damage to blood and lymphatic vessels, the creation of empty spaces beneath the skin (dead space), friction between skin flaps and underlying tissues, and inflammation [7,8].

Seromas usually resolve on their own, but occasionally they can cause significant problems. Fluid accumulation under the skin flap increases pressure, which might lead to tissue damage or even cause the surgical wound to reopen. Additionally, seromas can become infected, delaying wound healing and leading to further health issues [9,10].

Although rare, some serious complications have been reported, such as a systemic inflammatory response or persistent seromas that form pseudocysts. Even when they aren't severe, seromas can be uncomfortable and cause anxiety for patients. This often results in more frequent visits to clinics, higher medical costs, and extended recovery periods [11,12].

Several preventive measures have been suggested to avoid seromas. These include sealing off blood and lymphatic vessels, eliminating spaces where fluid might collect, stabilizing skin flaps, and minimizing friction. Techniques such as applying pressure dressings, sclerotherapy, using fibrin glue, and internal fixation methods have also been tried.

Despite these efforts, none of these approaches has completely solved the problem, and seroma prevention remains challenging [13,14].

Internal fixation techniques involve the placement of sutures between the flap and the fascia at regular intervals. This method was first briefly mentioned by Mladick and later elaborated on by Baroudi and Ferreira, who introduced the concept of "quilting sutures" to minimize shearing forces and dead space. Pollock and Pollock later refined this approach, terming it "progressive tension sutures," which allow the abdominal flap to advance tension-free from proximal to distal [15-17].

A retrospective study demonstrated that progressive tension sutures could be used effectively without drains in various abdominal wall surgeries. McCarthy et al. conducted a prospective, randomized trial assessing the impact of progressive tension sutures on seroma reduction in transverse rectus abdominis musculocutaneous (TRAM) flap reconstruction. However, evidence supporting their routine use in aesthetic abdominoplasty remains limited [18].

Additionally, surgical adhesives have been explored as an alternative for securing large tissue flaps. These adhesives reduce dead space and fluid accumulation, thus minimizing seroma formation and wound drainage [19].

Our study was conducted at the Department of Plastic Surgery, Faculty of Medicine, Zagazig University, utilizing progressive tension sutures and cyanoacrylate tissue adhesive to reduce complications such as hematoma, seroma, and infection. The operative time ranged from 140 to 165 minutes, with a statistically significant increase due to the application of these techniques. Andrades et al. similarly reported an increase in surgical time with progressive tension sutures [20]. Warner et al. further quantified this, noting that progressive tension closure typically adds approximately nine minutes to the overall procedure time [21].

Conversely, Cannistrà et al. found that mean hospital stays were significantly longer for patients undergoing classic abdominoplasty compared to those receiving modified

techniques, suggesting that alternative approaches may facilitate quicker recovery [22].

Our findings indicated a statistically significant reduction in hemoglobin (HB) and hematocrit (HCT) levels postoperatively. However, there was no significant difference in the frequency of blood transfusions compared to classic techniques reported in the literature.

Among the patients in our study, the most commonly observed complication was ecchymosis (75%), followed by infection (16.7%). Less frequently observed complications included skin necrosis, wound dehiscence, scar complications, redundant skin, and revision surgery needs (16.7%). Notably, none of the 12 patients developed seroma.

Our results align with those of Khan, who also reported significant differences in seroma rates among study groups [23]. However, Andrades et al. found no significant difference in clinical or ultrasound-detected seroma frequencies when comparing progressive tension sutures with drains alone [24].

Similarly, Cannistrà et al. observed no significant differences in postoperative complication rates between study groups, further questioning the added benefit of progressive tension sutures in reducing seroma incidence [22]. Macias et al. also reported no statistically significant difference in seroma rates or scar revision frequency between groups undergoing different abdominoplasty techniques [25].

In analyzing the relationship between complications and patient data, our study found no statistically significant association between age and the frequency of blood transfusions among complicated and non-complicated cases. However, we observed a statistically significant improvement in scar quality and patient satisfaction among non-complicated cases compared to those experiencing complications. Despite the promising findings, our study has several limitations. The sample size was relatively small, which may limit the generalizability of our results. Additionally, longer follow-up periods are necessary to assess

long-term outcomes and complications, particularly with regard to seroma formation and scar revisions. Future studies with larger cohorts and randomized designs are recommended to validate these findings and further explore the efficacy of progressive tension sutures and tissue adhesives in abdominoplasty.

Conclusion

Based on our findings, we came to the conclusion that tissue adhesives and progressive tension sutures offer an easy, affordable, and repeatable way to alter a traditional abdominoplasty operation. By reducing tension on the distal skin flap, these methods avoid compromising circulation. They prevent seroma formation by obliterating dead space and offering safe anchoring against shear forces. According to the authors' experience, using it greatly lowers complications, reduces recovery time and enables the safe addition of concurrent abdominal liposuction.

Conflict of interest: None.

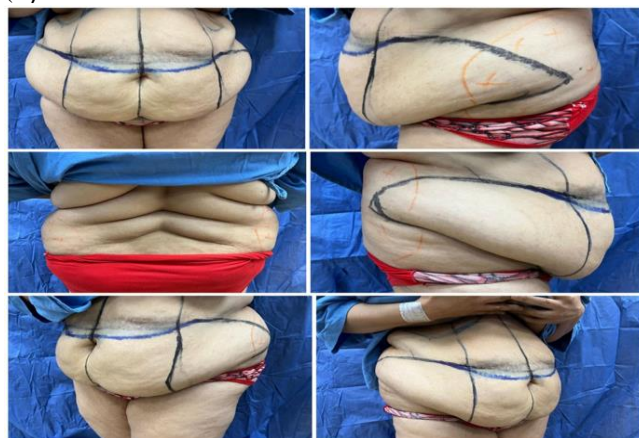
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(A)



(B)

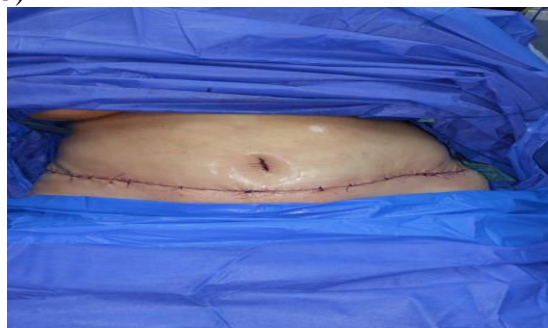




(C)



(D)



(E)



(F)



(G)

Supplementary Figure 1: Steps of Various Techniques (A): Surgical markings with the patient standing upright, (B): incision of the umbilicus area, (C): Supraumbilical detachment, (D): Plication of the rectus abdominus muscles and fixation and

shortening of the umbilical pedunculus, (E) Transposition and fixation of the umbilicus and Closure of the upper abdominal flap, (F): Application of extra progressive tension sutures, (G): Application of cyanoacrylate

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