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Long-Term Efficiency of Myofascial Repair in Abdominoplasty

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ABSTRACT

Muscluapneurotic rehabilitation is an integral step for gaining superior aesthetic outcome in full abdominoplasty to correct moderate to sever abdominal laxity. The myofascial repair is gaining popularity because of the durable rehabilitative outcome. The retromuscular sub-lay mesh placement has proven to provide the most durable repair in treating groin hernias. This study aim to document and evaluate the long-term durability of musculoaponeurotic reconstruction in abdominoplasty using a modified myofascial repair with or without sub-lay mesh application technique. Thirty-eight female patients underwent abdominoplasty to treat moderate to sever abdominal laxity were included in the study over a four-year period from July 2010 to June 2014. They were followed-up to a minimum of 18 months. They were assessed for both functional & aesthetic outcomes. The changes in intraoperative airway pressure (Paw) values, before and after myofascial repair, indicated moderate statistical significant changes (r=4707 and p-value=0.0213). The reduction in waist circumference averaged 9.5cm, ranging from 4 to 17.5cm. The changes in the waist/hip ratios from preoperative to postoperative were statistically significant (r=0.6859 and p-value=0.0003). The subjective assessment of the aesthetic outcome rated as 8.13/10 by an independent panel of 4 plastic surgeons & a nurse while that of the patients was 8.05/10. Patient satisfaction had been extremely high, and the complication rate was low. All patients gained improvements in their posture and no secondary hernias were seen.

In Conclusion: The myofascial repair modification of the rectus sheath described in this study provides durable functional and aesthetic outcomes in abdominoplasty even in sever degrees of abdominal laxity.

INTRODUCTION

Every abdominoplasty should have the following objectives, and every described technique should be measured against these objectives: (1) Place the incisions within the bikini line; (2) Reduce or eliminate striae; (3) Flatten and tighten the abdomen; (4) Decrease the size of the waistline; (5) Decrease the thickness of the subcutaneous fat throughout the abdomen, flanks, and iliac areas; (6) Rejuvenate the pubis from a triangular senescent to an oval youthful form; (7) Lift the lax anterolateral thigh skin near the groin crease and iliac areas; (8) Create a well-defined xiphoumbilical depression; (9) Give an illusion of an athletic abdomen, (10) Change body posture; (11) Correct any hernia; (12) Relieve back pain if this is related to muscle laxity of the abdomen. In many patients with severe aesthetic and functional problems, it is a truly rehabilitative operation **[1]**.

Nahas at 2001 **[2]** classified the abdominal deformities into four types based on the musculoaponeurotic layer: Type A deformity, with classic rectus diastasis caused by pregnancy and a well-defined waistline, Type B Deformity, with rectus diastasis secondary to pregnancy and do not have adequate tension of the lateral and infraumbilical areas of the myoaponeurotic layer, Type C deformity, with a congenital lateral insertion of the rectus abdominis muscles at the costal margins and associated with umbilical and epigastric hernias and Type D deformity, with rectus diastasis and poor waistline definition.

Since the introduction of suction-assisted lipoplasty, in association with abdominoplasty operation, the plastic surgeon has become capable of remodeling the entire trunk, assuring removal of considerable amounts of adipose tissue and creating more aesthetic results **[3]**. However, in multiparous females, the deformities of waist area are due to the significant divarication of the recti muscles rather than the fat content **[4,5]**. Moreover, with the recent advances in bariatric surgeries, the management of post-bariatric skin redundancy and musculoaponeurotic layer laxity becomes a common and challengeable procedure to achieve the ideal aesthetic contour of the abdomen **[5,6]**.

The plication of the musculoaponeurotic layer became an integral component of abdominoplasty **[4]**. Pitingue was the first to use non absorbable sutures for Recti in 1967 **[7]**. After that, all efforts were geared towards increasing the longevity of the repair through using braided sutures in combi-

nation with the non-absorbable mono-filamentous sutures, multiple strands and/or multiple layered repairs **[8-10]**. However, there has been accumulating evidence in the literature revealing the high incidence of recurrence following plication alone **[11]**. van Uchelen and associates **[12]** reported 40% recurrence in 63 women at an average of 64 months on ultrasound evaluation, while Al-Qattan **[13]** distinguished a bothersome 100% return of musculoaponeurotic laxity in 20 multiparous women with severe abdominal wall laxity one year following abdominoplasty and vertical midline plication. Furthermore, Seymour & Bell **[14]** expressed concern that rectus plication could actually introduce the risk of ventral hernia development. This could explain why some surgeons do not believe that rectus diastasis repair by plication will last in the setting of large intraabdominal fat volume and therefore did not attempt at repairing significant diastasis or even advised against the repair **[15]**. Placing running and interrupted sutures under tension can cut through the anterior rectus fascia like a cheese wire cutter. This suture pull-through is considered the main reason why suture approximation of the rectus muscles may not provide a durable repair accounting for "stretching" of rectus diastasis procedures and hernias recurrence **[16]**. The durability of plication alone was therefore questioned and mesh repair reinforcement was suggested.

The concept of combining mesh reinforcement in abdominoplasty is not new; and ventral hernias repair with mesh is well established to be more durable than suture repair alone **[17-20]**. Mesh placed overlay to cover the anterior abdominal wall has been used to support the midline plication in patients with marked musculoaponeurotic laxity. However, concerns regarding risk of dehiscence, infection, extrusion, pain, and the need for removal of the mesh would not be suitable with cosmetic surgery procedures and led many plastic surgeons to avoid its use **[16]**. Moreover, the placement of onlay mesh can obscure normal abdominal muscle contour as noted by Marques and collaegues **[17]**. The idea of placing the mesh in the retromuscular sub-lay plane has been introduced long time ago to treat groin hernias by Rives & Stoppa **[21,22]**. Long-term outcomes for sub-lay mesh placement for hernia repair has demonstrated a relatively low complication rate and is considered the safest position to provide the most durable repair **[23,24]**. Placing the mesh in a submuscular sublay position could provide an alternative solution for treating abdominoplasty patients with severe rectus diastasis & ventral hernias.

DiBello in 1996 **[25]** introduced sliding myofascial release and repair as an alternative technique for the closure of recurrent ventral hernias. It relied on creation of fascial raw area that promoted more solid healing between both recti. Moreover, it avoided the centrifugal forces of recti after plication; which acts to detach the repair **[1]**. Myofascial repair was originally introduced to reconstruct congenital rectus abdominis diastasis specifically; where diastasis was considered midline abdominal defect. The midline plication with suture was considered inefficient for reconstruction; and recurrence was very common **[26]**.

Acknowledging the necessity to reinforce the anterior abdominal wall in abdominoplasty cases with moderate to severe rectus diastasis along with recognizing both the limitations & the probable high rate of recurrence following the plication procedure together with the complications associated with the onlay mesh application, the senior author (M.H.) has been performing the myofascial repair & the sublay mesh when indicated since the year 2000. However, his work was not published, and this prospective study aim at both documenting as well as evaluating the long-term durability of musculoaponeurotic reconstruction in abdominoplasty using myofascial repair with or without sublay mesh application.

PATIENTS AND METHODS

This prospective study was conducted between July 2010 to June 2014 at Ain Shams University Hospitals. Patients undergoing abdominoplasty to treat moderate to severe abdominal laxity were included. Patients with systemic collagen disease or history of regular corticosteroid administration were excluded from the study. Risk factors such as smoking, hypertension, diabetes, previous abdominal surgeries, or Pfannenstiel incision were recorded.

Preoperative evaluation:

Preoperative patient counseling focused on their concern and expectations. Standard photography was taken after having a detailed written consent from the patients. The routine laboratory tests were done; including complete blood count, liver function tests, kidney function tests, fasting blood sugar, prothrombin time and concentration, HIV and HBsAG.

With the patient standing and according to the WHO data **[27,28]** waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest,

using a measuring tape. Hip circumference was measured around the widest portion of the buttocks, with the tape parallel to the floor. Then, waist/hip ratio (WHR) was calculated.

Spirometry was performed preoperatively to measure the forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and FEV1/FVC, and assessed according to the American Thoracic Society criteria **[29-31]**.

Preoperative markings:

Markings were made in the standing position. Reference lines were determined. These include groin lines with direct extension into the upper iliac areas, central midline of the abdomen, parallel lines to the central midline (6 to 9cm) that determine the outer border of the rectus abdominis muscle. Another horizontal line perpendicular to the midline is made across the abdomen usually at the level of the navel. These reference lines are useful for markings of the planned flap excision as symmetrical as possible (Fig. 1).

The incision marks were drawn while the pubic skin is lifted and a horizontal line was marked, leaving a reasonable pubic size. This mark is approximately 6 to 8cm above the anterior vulvar commissure. The line extends just medial to the groin areas. From here, the direction of the line is diverted toward the anterior superior iliac spines on both sides. The lazy M is marked next, with the central portion just above the umbilicus and the highest point at the level of the linea semicircularis. A gentle slope is constructed about the flank areas, and this line gradually tapers to meet the uppermost extension of the lower incisions marks. The M configuration can change slightly to adapt to the areas of more skin laxity or tension (Fig. 1).

Surgical procedure:

Surgery were performed under either general or spinal anesthesia. Crip bandages were applied to the lower extremities. After liposuction of the flanks and the epigastric regions using tumescent technique, dissection was performed. Liposuctioning the pubis was avoided; its shortening and lifting will usually decrease its bulk. The portion of flap above the position of the new umbilicus was further suctioned up to the subdermal layer to create the xiphoumbilical depression using small cannulas.

Dermolipectomy followed with flap elevation done using the electrocautery. The large perforators were handled by suture ligation to ensure complete hemostasis and avoid potential bleeding postoperatively with coughing. The large vessels underneath the useful portion of the flap were also suture ligated rather than electrocoagulated to avoid spread of heat damage on its corresponding vascular tree. Dissection extended up to the costal margins and the xiphoid areas after the incision around the original naval was done.

Myofascial repair:

The authors used two techniques for myofascial repair (Figs. 2,3,4).

1- *Myofascial repair without mesh:*

Estimation of extent of anterior abdominal wall laxity through stay sutures was followed by marking an ellipse on the anterior rectus sheath. Bilateral incision of the anterior rectus sheath (Fig. 2-A) divided each rectus sheath into medial and lateral leaflets. The medial leaflets of both recti were sutured together at the midline creating the first layer of the repair (Fig. 2-B).

Suturing both recti muscles at midline with vicryl 2/0 after insertion of suction drain was done adding the 2nd layer repair (Fig. 2-C). Suturing the lateral leaflets of both Recti at the midline with anchoring them to the repaired medial leaflets recreated a new linea alba adding the third layer of myofascial repair (Fig. 2-D).

2- *Myofascial repair with sub-lay mesh:*

These patients were managed in a similar manner in addition to performing herniorraphy & applying an in-lay propylene mesh., dissection of the recti muscles from the posterior rectus sheath was carried out while preserving the neurovascular bundles at the lateral 1cm of the muscles after suturing of the medial leaflets.

A polypropylene and poliglecaprone- 25 absorbable copolymer (propylene + monocryl) mesh 30x30cm (ULTRAPRO™ Mesh, Ethicon) was applied (sub-lay = submuscular = pre peritoneal) over the posterior rectus sheath and fascia transversalis below the arcuate line adding the fourth layer over the reduced hernia sac (Fig. 3-C), (Fig. 4). The mesh is stapled in place to the under surface of the rectus muscle under direct vision.

The changes in intraoperative airway pressure (Paw) values, before and after myofascial repair were recorded. To aid in muscle relaxation and avoid pain in the first 24 hours, the abdominal muscles were infiltrated with 0.25% bupivacaine mixed with 1:100,000 epinephrine solution. About 80 to 100cc of this solution was injected just underneath the external fascial layers of the rectus and external oblique muscles by using long blunt needles used for epidural anesthesia (Tuey needles).

After myofascial repair had been fisnished, advancement of the flap with the operative table bent to 45 degrees was made. The previously marked upper incision (M component) was matched against the lower incision. If any discrepancy exist, appropriate adjustments were made before committing the final flap trim. Umbilicoplasty and trimming of the upper abdominal flap were done with incision of the skin made perpendicular to the surface and the subcutaneous/Scarpa's fascia layer at a 45-degree angle. Abdominal flap closure was carried out in three layers. Two closed-system suction drains were left under the flaps with the ends toward the pubis and in a crisscrossed manner. A gauze dressing and a well contoured abdominal binder were applied.

Postoperative management:

After surgery, intravenous fluids and intravenous antibiotics were administered for 24 hours. Ambulation started on the first postoperative day. A clear liquid diet was given for 3 or more days. Supportive stockings were used until full ambulation. Drains were removed on the third or fourth postoperative day. They are removed when fluid collection was less than 50cc per 24 hours per drain. An abdominal binder was used for several weeks postoperatively, and exercise without restriction was allowed after 14 to 16 weeks.

Patients were followed-up to a minimum of 18 months. Spirometry was repeated postopertively to measure the forced vital capacity (FVC), forced expiratory volume in one second (FEV1) and FEV1/FVC, Standard photographs were taken at 6 & 18 months postoperatively and the outcome was rated independently by a panel of four plastic surgeons & a nurse in addition to the patients themselves. Waist circumference & waist hip ratio (WHR) were calculated and compared to the preoperative measurements. Statistical analysis of the collected data was done using the *t*-test with *p*-value considered significant when <0.05.

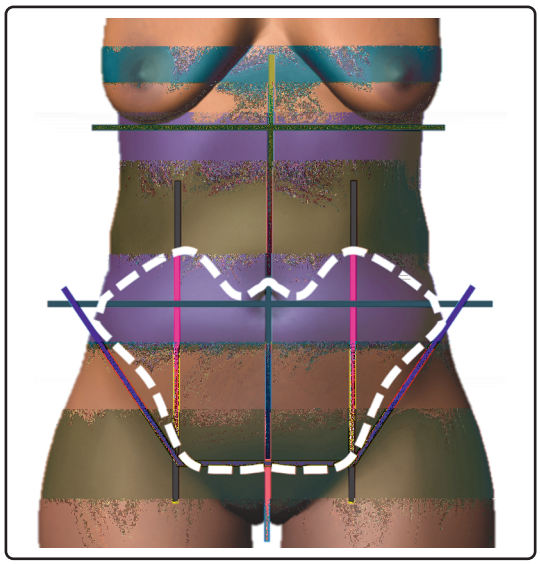

Fig. (1): Preoperative marking: Groin lines with direct extension into the upper iliac areas (red), central midline (blue), parallel lines to the central midline (6 to 9 cm) (yellow), perpendicular to the midline at the level of the navel (blue), incisions lines (white).

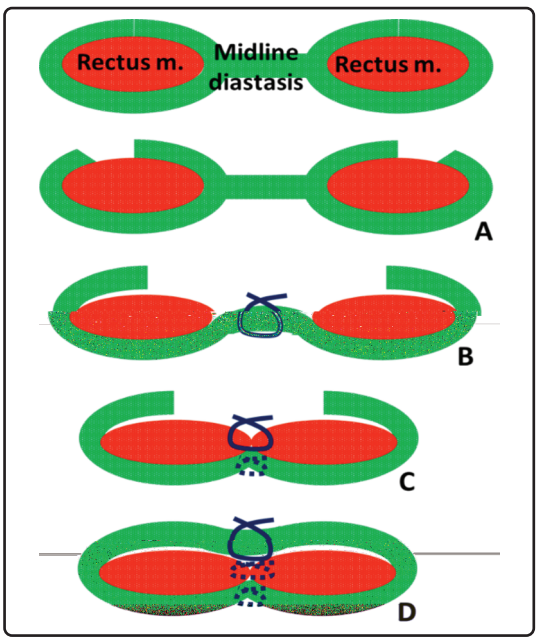

Fig. (2): (A,B,C,D): Illustration for myofascial repair. (A) Bilateral incision of the anterior rectus sheath. (B) suturing the medial leaflets of both recti at the midline (1st layer of the repair). (C) Suturing both recti muscles at midline (2nd layer of the repair). (D) Suturing the lateral leaflets of both Recti at the midline (3rd layer of the repair).

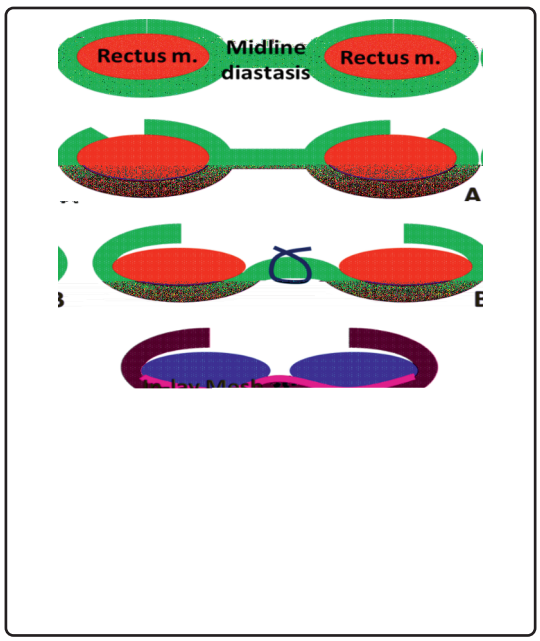

Fig. (3): (A,B,C,D): Illustration for myofascial repair. (A) Bilateral incision of the anterior rectus sheath. (B) Suturing the medial leaflets of both recti at the midline (1st layer of the repair). (C) Application of sub-lay mesh (2nd layer of the repair). (D) Suturing both recti muscles at midline (3rd layer of the repair). (E) Suturing the lateral leaflets of both Recti at the midline (4th layer of the repair).

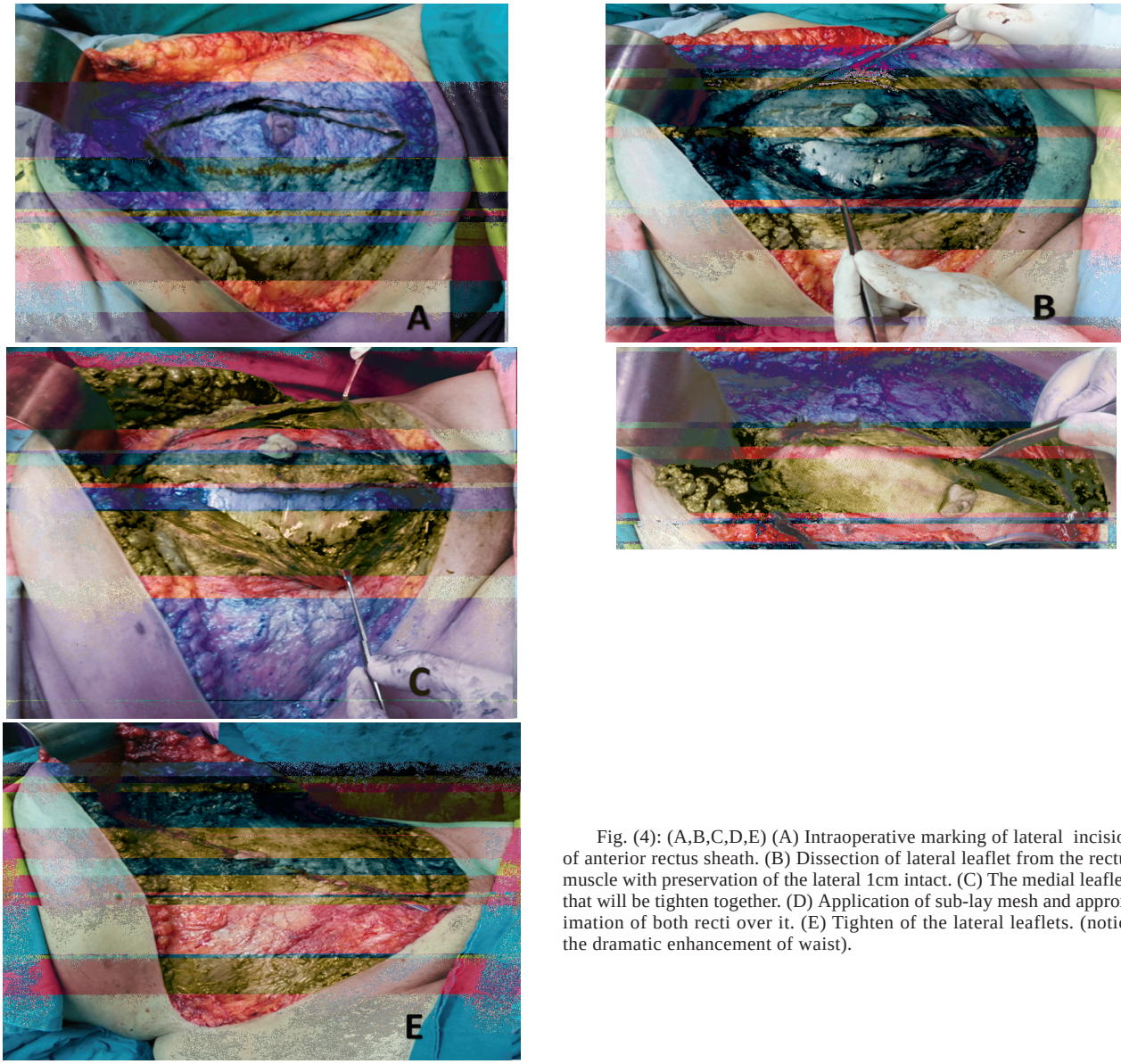

Fig. (4): (A,B,C,D,E) (A) Intraoperative marking of lateral incision of anterior rectus sheath. (B) Dissection of lateral leaflet from the rectus muscle with preservation of the lateral 1cm intact. (C) The medial leaflets that will be tighten together. (D) Application of sub-lay mesh and approximation of both recti over it. (E) Tighten of the lateral leaflets. (notice the dramatic enhancement of waist).

RESULTS

Thirty eight (38) female patients fulfilling inclusion criteria were included in the study. All included patients were categorized as either type B, C and D abdomen according to Nahas. 2 Their age ranged from 27 to 54 years, with a mean of 42.5±7.2 years. Their weight ranged between 71 to 102kg, with a mean of 81.7±7.2kg. Their height ranged between 150-172cm and their body mass index (BMI) ranged between 32-35 kilograms per square meter, with a mean of 32.3±1.7Kg/m^2. All included females were multiparous with 2 to 4 child.

Surgery was performed under spinal anesthesia for 22 cases, while the remaining 16 cases underwent general endotracheal anesthesia. All patients underwent myofascial repair with placement of the sub-lay mesh in only fifteen of them. The amount of resected skin and fat from the abdominal dermofat flaps ranged from 3.2 to 6.7Kg. The average hospital stay ranged between 1 to 3 days. There were no major complications, except for seroma in eight patients that was managed conservatively by aspiration and compression. Three patients suffered small areas of skin necrosis in the lower central abdominal flap that healed by secondary intention followed by secondary revision. No secondary hernias were seen.

Changes in intraoperative airway pressure (Paw) values, before and after myofascial repair, indicated moderate statistical significant changes (r= 4707 and p-value=0.0213) where the values were 18.8±1 and 22.7±1.1cmH_2O respectively. In all cases, the values of the forced vital capacity (FVC) and forced expiratory volume in one second (FEV1) were decreased. After calculation of FEV1/ FVC values

as sensitive indicators for the spirometric studies and by comparing preoperative and postoperative results, there was a moderate statistical significant changes (r=0.4957 and p-value= 0.0140) and the difference between the mean values pre and postoperatively (83±2.2%, 78.1±2.3% respectively) was less than 5% (safe changes <10%[24]).

By comparing the waist circumference preoperatively and at 6 and 18 months postoperatively, there was an average 9.5cm reduction in waist size, ranging from 4 to 17.5cm. As regard the waist/hip ratios, the preoperative WHR was 0.98±0.05 and the postoperative WHR was 0.91±0.03. By statistical analysis of the pre and postoperative values, there was a significant statistical changes all over the samples (r=0.6859 and p-value=0.0003).

Regarding the subjective assessment of the aesthetic results by the panel and the patients themselves, the mean of the doctors' score was 8.13/10, while that of the patients was 8.05/10. Patient satisfaction had been extremely high, and the complication rate was low. All patients gained improvements in their posture and how their clothing fit. (Figs. 5,6) (Table 1).

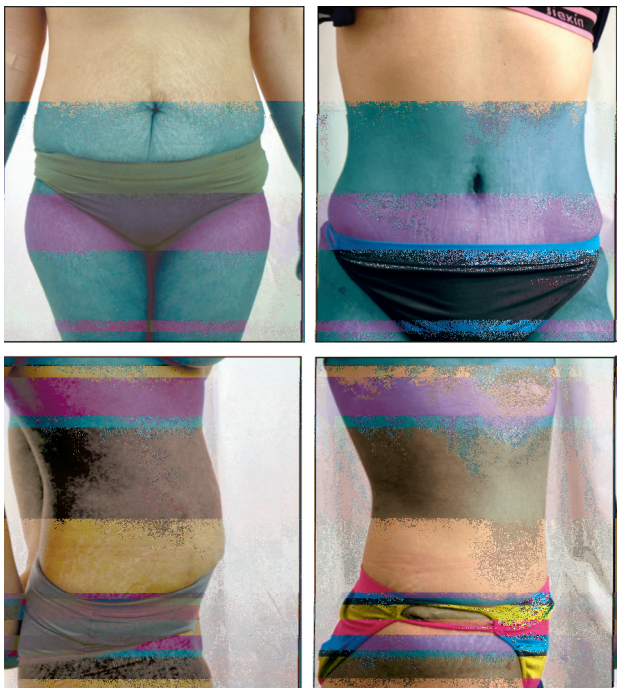

Fig. (5): Female patient, 46 years, weight 74Kg, BMI 32.1 preoperative (left) and postoperative (right) clinical photographs.

Fig. (6): Female patient, 46 years, weight 99Kg, BMI 35 preoperative (left) and postoperative (right) clinical photographs.

Table (1): Results of the subjective assessment of the aesthetic results by a panel of 4-independent plastic surgeons and a nurse, and the patients.

Case number	Mean of panel score	Patient score
1	10	7
2	8	9
3	9	9
4	8	7
5	7	8
6	9	8
7	8	7
8	7	8
9	7	7
10	7	9
11	8	7
12	9	9
13	7	9
14	7	8
15	8	8
16	9	9
17	9	9
18	9	8
19	9	9
20	8	9
21	8	9
22	7	9
23	8	7
24	9	8
25	9	7
26	9	8
27	7	8
28	7	9
29	7	7
30	9	8
31	9	8
32	8	8
33	8	9
34	7	7
35	9	8
36	8	7
37	9	7
38	8	8
Mean	8.13	8.05

DISCUSSION

Most patients with a small bulgy lower abdomen may benefit from a smaller procedure such as a liposuction 32 or mini-abdominoplasty **[33]**. However, patients with sever diastasis of the recti muscles, apron abdomen and/or skin laxity represent a completely different category that requires a more radical approach. Liposculpture, skin excision fashion and tension fascial suspension are all integral steps for satisfactory results in abdominoplasty. Never the less, it is believed that musculoaponeurotic rehabilitation enhances the aesthetic and functional outcome with durable stable results. The longevity of the results is a pivotal point in patient satisfaction **[34]**.

Suture plication of the musculoaponeurotic layer is commonly used to treat divercation of recti during abdominoplasty **[4]**. Many limitations and disadvantages have been implicated with suture plication. It does not treat the rectus sheath redundancy, which when tight along with an intact tendentious intersections act as pulley system for rectus muscle, thus keeping rectus muscle excursion consumed in the wide roomy intra rectus sheath spaces. Furthermore, suture plication can not correct congenital rectus muscle diastasis, where there is a gap between the rectus muscles attachments to the costal margins **[2]**. Additionally, it does not manage any concomitant ventral hernias, and can even worsen the condition through intestinal injury during repair and stimulation of other weak points to produce a clinically pronounced hernia **[35]**. The durability of suturing of the two gliding surfaces of the rectus sheath rely on the suture material hence the use of braided sutures in multiple layers to benefit from its higher tissue holding capacity and increase the fibrosis between the gliding recti sheath **[7-10]**. Undue plication increases the intra-abdominal pressure with diaphragmatic excursion leading to abdominal compartment syndrome that causes respiratory decompensation **[34,36-39]**.

The antagonizing biomechanics of the anterior abdominal wall, conditions with increased intra-abdominal pressure, and decreased anterior abdominal wall elasticity affect durability and efficacy of recti repair **[40]**. The incidence of recurrence of recti diastasis has been attributed to the applied surgical technique **[16]**, as long as the patient is not suffering from collagen disease or any other condition affecting collagen deposition and remodeling **[26,41]**. Finally, suture plication does not change rectus muscle orientation, so muscle action tend to separate the plication causing diastasis recurrence **[1]**.

On the other hand, Myofascial repair creates fascial raw areas into the rectus sheath layers; promoting more collagen deposition which will end with more solid healing. Approximation of both recti and converting their orientation inwards and medially, avoid the significant centrifugal forces acting on the repair **[37]**. This approach provides more effective traction on the external oblique muscle and decrease the size of the waistline. Furthermore, recreation of the physiological width of the linea alba avoids postoperative abdominal discomfort and gives superior aesthetic outcome **[26]**. Medial movement of both recti with the enclosing rectus sheath transmits tension to the abdominal muscles; which regain balance with back muscles and enhances the waist line **[41]**. In

turn, the superior abdominal aesthetics have positive impact on the breast and gluteal areas. Having all these benefits as opposed to suture plication limitations explain why myofascial repair was used in this study.

Combining abdominal wall mesh repair and skin surgery has been proven safe by Zemlyak and coworkers **[20]**, as there was no statistically significant differences between panniculectomy alone versus ventral hernia repair with mesh and panniculectomy. Decreasing suture pull-through during fixation of the mesh while aiming at high tension repair was achieved by increasing the number of sutures to lower the force at each suture-tissue interface **[42]**, which further improved the distribution of forces across the repair site.

The retromuscular sub-lay application of mesh carries a lot of advantages over the onlay mesh placement. It provides mechanical advantage according to Pascals principle; as the intra-abdominal pressure is distributed over the inner surface of the mesh dissipating forces over a wider surface area of abdominal wall. Sub-lay or pre-peritoneal is a well vascularised pocket to harbour the synthetic mesh with diminished rates of infection **[43]**. Although, onlay mesh application is the easiest way to use, it can obscure normal abdominal muscle contour **[17]** and carries the risk of exposure in cases of abdominal flap necrosis should it occur after abdominoplasty. Besides, anchoring the new umbilicus in cases on neo-umbilicoplasty to the anterior rectus sheath is more successful than in cases of anchoring it to the onlay mesh. The abdominal bulge is not treated with the onlay placement hence there is no musculoaponeurotic rehabilitation. The incidence of hernia recurrence is higher in the onlay application, while it drops to almost zero percentage with the sub-lay **[44]**. Finally, the sub-lay mesh application avoid serious complications of in-lay (mesh applied directly in peritoneal pocket under the defect) such as gut injuries, adhesions, and intestinal fistula formation **[45]**. Recognizing all these advantages, justify the choice in preferring the sub-lay placement of mesh in this study.

Similar to results described by Rameriz **[1]** and Nahas **[2]**, the procedures described in this study corrected the functional problems and achieved the desired abdominal aesthetics. They removed the excess abdominal skin, improved the waistline, and tightened the lax abdominal wall musculature. Special attention was given for the long-term efficiency of myofascial repair in abdominoplasty. Because of the significant redefinition of muscle tension in the abdomen, the symptoms of all of the patients with a history of back pain have improved. This relief is probably due to an indirect pull of the internal oblique transversus abdominis muscles over the lumbodorsal fascia with reduction of stress at the intervertebral joint as suggested by Gracovetzky et al., **[46]** and clinically established by Toranto **[47]**. The significant reduction of weight of the abdominal apron and the abdominal muscle tightening accounts for the improvement in body posture. This improvement has been observed in the majority of patients, and they have emphasized this fact too.

The designed incision allows for easy removal of lax skin and fat around the waistline, thus creating a smaller waistline. Liposuction helps to better contour the abdomen and gives better definition to the distal ends of the line of closure. The myofascial repair with or without sub-lay mesh placement allows for better definition of the waistline because of the pull of the internal oblique and external oblique muscles toward the midline. The myofascial release and repair also decreases the entire surface of the abdominal wall, which in turn permits removal of more skin/fat from the abdominal wall. Eight patients were followed-up up to three years after surgery showed long-term efficiency of myofascial repair even after getting pregnant in two of them.

The technique that achieves the highest tension is probably the one that provides the best aesthetic abdominoplasty outcome **[16]**. Herein, anterior abdominal wall muscle tightening has been achieved through myofascial repair with or without retromuscular sub-lay mesh application rather than suture plication alone as performed for the standard abdominoplasty. This is different from the technique of Rameriz **[1]**, which neglected concomitant hernia management and excluded all patients with ventral hernias from his study hence not using a mesh. His comprehensive approach for abdominal rehabilitation was presented through retrospective data collection as opposed to the prospective study presented here. Cheesborough and Dumanian **[16]** described placing the mesh in a sub-lay position (submuscular and pre-peritoneal) in their patients similar to this study. However, they did not describe myofascial repair with their sub-lay mesh placement. Moreover, unlike the standard horizontal incision used in all of the patients in this study they have included a vertical abdominoplasty skin excision in some of their patients, which is not considered aesthetically attractive or acceptable.

Unlike previous studies, the myofascial repair was used as the standard technique for musculoaponeurotic rehabilitation with or without sub-lay

mesh for all our patients with resultant durable functional and aesthetic outcomes. The rate of complications as seroma and skin necrosis was less in this study and comparable to related studies **[1,2]**. Similar to Cheesborough and Dumanian **[16]**, the low rate of infection has been attributed to fixing the mesh well in a vascularized soft-tissue bed similar to the principle of placing plate and screws or metallic mesh in maxillofacial surgery. This can also be accredited to the cautious liposuction and the tension free closure, where tension was more lateral than central. Moreover, no hernia recurrence was noted with sub-lay mesh application in our study, or even since the senior author had started this technique in the year 2000.

Conclusion:

Myofascial repair modification of the rectus sheath described in this study provides durable functional and aesthetic outcomes in abdominoplasty even in sever degrees of abdominal laxity. The myofascial repair technique is superior than rectus sheath plication regardless of the suture material and the number of layers implemented. It restores the integrity of the anterior abdominal wall, especially in presence of concomitant ventral hernias, and relieves back pain through redistributing the forces between back and anterior abdominal wall musculature. Those functional outcomes go hand in hand with superior aesthetic refinements to the trunk region; it enhances the hip/waist ratio, giving more feminine trunk configuration and pronounces the breast aesthetics.

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