*Egypt, J. Plast. Reconstr. Surg., Vol. 49, No. 4, October: 331-340, 2025*

# Management and Maintenance of Results in Cases of Anterior Abdominal Wall Laxity During Abdominoplasty

MOSTAFA ABDELHALIM, M.D.*; AHMED M. ZEINA, M.D.*;
AHMED MOUSTAFA OMRAN, M.D.** and TAREK ZAHRA, M.D.*

*The Department of Plastic & Reconstructive Surgery*, Faculty of Medicine, Mansoura University and Plastic, Reconstructive & Maxillofacial Surgery Department**, Damietta Faculty of Medicine, Al-Azhar University*

## Abstract

*Background:* Rectus muscle plication, one of the primary procedures performed during abdominoplasty, aims to control rectus muscle diastasis by advancing the muscle to the midline, thereby restoring the normal anatomy of the abdominal wall. Constant forces like contraction of the abdominal muscles, tissue elasticity, and elevated intra-abdominal pressure have a significant impact on the durability of rectus plication. Therefore, we have to investigate the various rectus plication techniques in terms of their long-term effects and resilience.

*Objective*: To determine the optimal plane and technique for polypropylene mesh repair after abdominoplasty, as well as the longevity of various rectus sheath plication techniques. Our primary goal is to design an algorithm for managing rectus diastasis that focuses on the ultrasound evaluation and the state of each patient.

*Patients and Methods:* Ninety female patients seeking abdominoplasty or post-bariatric body contouring surgery participated in this prospective study, which was carried out at the Mansoura Burn and Plastic Surgery Center between August 2020 and July 2024. Patients were randomized to one of the three treatment groups using simple randomization. Group 1: (30 patients) Vertical rectus plication in double continuous layers was done. Full abdominoplasty and liposuction were done. Group 2: (30 patients) TULUA procedure. Group 3: (30 patients) Polypropylene mesh Ethicon™ was used (especially if hernia was encountered) either in retro-rectus position over the posterior rectus sheath (10 patients), over the muscle and involved with plication (10 patients) or over the vertical rectus plication (10 patients). Full abdominoplasty and liposuction were done.

*Results:* In group 1, The results obtained In this study were similar to the results obtained by multiple studies. In group 2, the diastasis was more at the level of the xiphoid than in the other groups. In group 3, the 6-month results are the best regarding durability.

*Conclusion:* Standard vertical plication is insufficient for optimal outcomes, particularly in patients with extensive rectus diastasis or significant hernias. The authors consider mesh application, if feasible, as it enhances the correction of abdominal wall laxity and yields more durable outcomes. The use of mesh at the sub-rectus muscle level yields optimal results with minimal problems. An algorithm is created to help in decision-making in abdominoplasty.

***Key Words:*** *Abdominoplasty – Diastasis – Liposuction – Rectus plication – TULUA procedure.*

*Disclosure:* No disclosur.

*Ethical Committee:* The study was approved by Mansoura Medical Research Ethics Committee, Faculty of Medicine, Mansoura University (R.20.08.963.R1.R2.R3).

## Introduction

A primary procedure in abdominoplasty is rectus muscle plication, which addresses rectus muscle diastasis by repositioning the muscle to the midline to restore the normal anatomy of the abdominal wall **[1]**.

The durability of rectus plication is greatly influenced by continual factors such as abdominal muscle contraction, tissue flexibility, and increased intra-abdominal pressure. So, we need to research the different methods of rectus plication in terms of long-term durability and effectiveness **[2]**.

Complications associated with classical abdominoplasty include seroma, skin flap necrosis, wound disruption, epigastric fullness and protrusion, high transverse scarring, and umbilical necrosis with low positioning. The TULUA procedure (trans-

***Correspondence to:*** Dr. Ahmed Zeina,
E-Mail: xeena66@gmail.com

verse plication, undermining limited, liposuction, umbilicoplasty, abdominoplasty) is gaining popularity among plastic surgeons because to its promising results, low complication rate, and significant advantages in terms of vascular safety, rapid feeling recovery, good location and aesthetically beautiful umbilicus, and correct level of the abdominal scar. However, this approach requires specially selected patients **[3]**.

Several types of hernias have been described during abdominoplasty, including umbilical, paraumbilical, epigastric, and incisional hernias. Synthetic mesh should be employed during hernia therapy, especially if the diameter exceeds 3cm, as advised by recent studies and data **[4,5]**.

Various degrees of rectus diastasis necessitate distinct management approaches, including vertical plication, TULUA and mesh application. Also, mesh can be applied in different levels as retro-rectus position over the posterior rectus sheath, over the muscle and involved with plication or over the vertical rectus plication **[6,7]**.

In the current study, the main objective is to put an algorithm to manage the rectus diastasis that depends on each patient's condition and ultrasound evaluation. Also, we want to detect the appropriate plan for polypropylene mesh application with the least complications.

*Aim of the work:*

To assess the longevity of different methods of rectus sheath plication, and best plane and method for polypropylene mesh repair during abdominoplasty.

## Patients and Methods

Ninety female patients requiring abdominoplasty, or post-bariatric body contouring surgery, participated in this prospective study, which was carried out at the Mansoura Burn and Plastic Surgery Center between August 2020 and July 2024 with follow-up of the patients up to one year. The study was approved by the Mansoura Medical Research Ethics Committee, Faculty of Medicine, Mansoura University (R.20.08.963.R1.R2.R3). Informed consents were obtained from each participant in the study.

Patients who smoked, had diabetes mellitus and hypertension, were older than 60, or refused to participate in the study were all excluded. Clinical information about the patient was gathered before surgery, including height, weight, BMI, waist circumference, and hip circumference; standard anterior, posterior, lateral, and oblique views were taken; and the patient's abdomen was examined, paying particular attention to rectus diastasis and the presence of paraumbilical or umbilical hernias. Using Beer et al.'s classification for the usual width of the Linea Alba (Table 1) **[6]**, ultrasound was performed to determine the degree of rectus diastasis at the level of the xiphoid, 3cm above and 2cm below the umbilicus. Marking was completed for the abdominoplasty procedure.

Table (1): Level of normal rectus muscle diastasis by ultrasound **[6]**.

| Level | Age <45 years (mm) | Age >45 years (mm) |
|---|---|---|
| At the level of the xiphoid | 10 | 15 |
| 3 cm above the umbilicus | 27 | 27 |
| 2 cm below the umbilicus | 9 | 14 |

Patients received an intravenous dose of 1-2g amoxicillin clavulanate one hour before anesthesia induction, followed by additional doses every 8 hours. Antibiotics (875/125mg amoxicillin clavulanate) were prescribed thrice daily for a duration of seven days post-surgery. In case of penicillin allergy, clindamycin 600mg was delivered in the same manner.

Patients were randomized to one of the three treatment groups using simple randomization (computer-generated numbers for cases and sealed envelope technique for allocation).

*Intraoperatively:*

All patients had general anesthesia. The position was supine, and the markings were rechecked. Liposuction involved the infiltration of saline with adrenaline at a concentration of 1:500,000.

• Group 1: *(30 patients):*

Vertical rectus muscles plication was done using two nylon loop size 0 sutures on a round-bodied needle (Ethicon ™) in double continuous layers starting from xiphisternum to the symphysis pubis. Full abdominoplasty and liposuction were done. (Fig. 1).

• Group 2: *(30 patients):*

TULUA procedure: Transverse plication below the level of umbilicus level extending from the lateral ends of the anterior abdominal wall, No Undermining of the upper skin flap from the level of the umbilicus, Full Liposuction of the upper skin flap and waist area, Neoumbilicoplasty by skin

graft from the excised skin, and Low Transverse Abdominal Scar. In 10 patients, the umbilical stalk was long enough to be preserved, and by limited undermining of the upper abdominal flap, the umbilicus was transferred to a new position as in standard abdominoplasty. (Fig. 2).

• *Group 3: (30 patients):*

Polypropylene mesh Ethicon ™ was used (especially if a hernia was encountered) either in retro-rectus position over the posterior rectus sheath (10 patients), over the muscle and involved with plication (10 patients), or over the vertical rectus plication (10 patients). Followed by full abdominoplasty and liposuction were done.

*Group (3A):* The rectus sheath was incised along the 2 medial borders of the rectus muscles from xiphisternum to the umbilicus, exposing the rectus muscles that were dissected along with the anterior layer of the sheath and leaving the posterior sheath layer. Plication of the two parts of the posterior rectus sheath in the midline was done by using nylon loop size 0 sutures on a round-bodied needle (Ethicon ™ ) in one continuous layer. The Polypropylene mesh Ethicon ™ was adjusted to the size of the posterior rectus sheath from xiphisternum to umbilicus over this repair then the mesh was fixed by using nylon size 2-0 sutures in one continuous layer around the mesh edges and simple interrupted sutures in the midline area for complete coaptation of the mesh to the posterior rectus sheath. Then, the rectus muscles with the anterior layer of the sheath were plicated in the midline by using nylon loop size 0 sutures on a round-bodied needle (Ethicon ™ ) in one continuous layer. (Fig. 3).

*Group (3B):* The mesh was applied and fixed over the rectus sheath extending from the medial edges of the rectus muscles from xiphisternum to symphysis pubis with a hole made to expose the umbilicus. The plication was done by using nylon loop size 0 sutures on a round-bodied needle (Ethicon ™ ) in 2 continuous layers, bringing the rectus muscle back to midline, and the mesh was hidden under the plication. (Figs. 4,5).

*Group (3C):* After completing the vertical plication of the sheath as in Group 1, the mesh was applied over the entire exposed area of the anterior abdominal wall. The mesh was fixed by using nylon size 2-0 sutures in one continuous layer around the mesh edges and simple interrupted sutures in the midline area for complete coaptation of the mesh (Fig. 6).

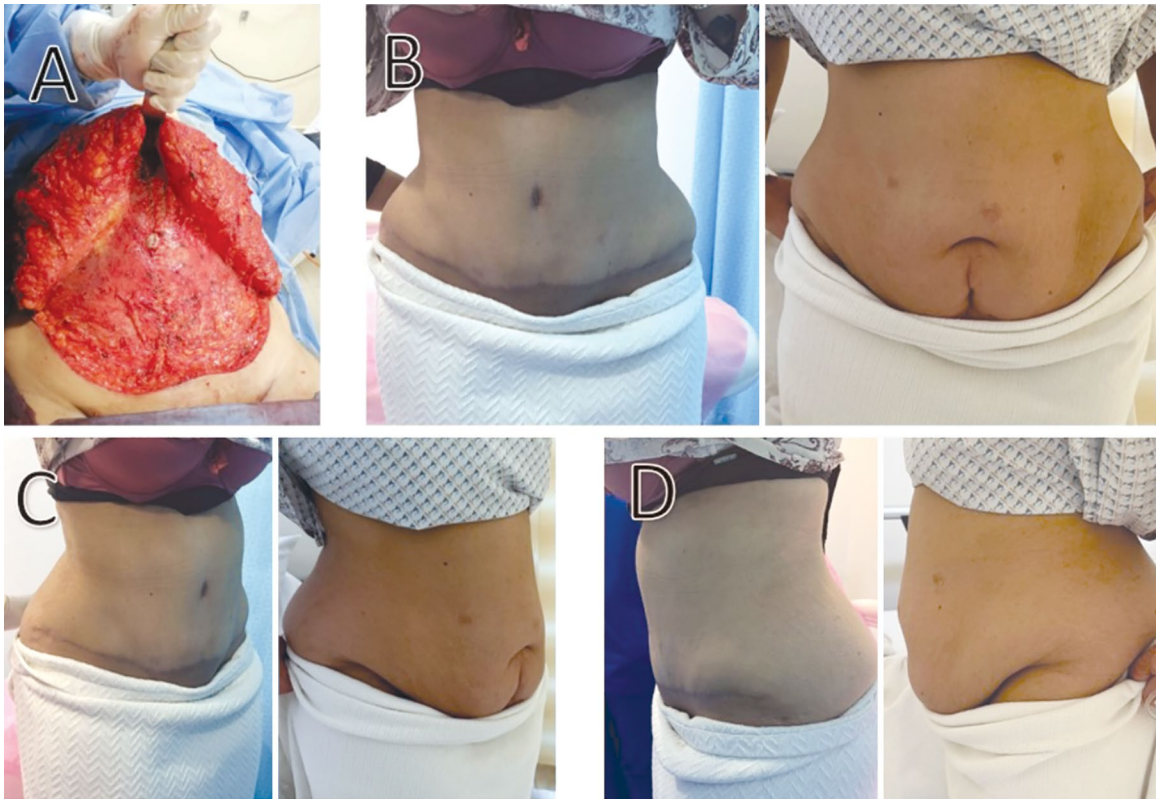


Fig. (1): Group (1) (A): Vertical rectus muscle plication. (B, C and D): Pre and postoperative photos anterior, right oblique and left lateral views respectively.


Fig. (2): Group (2) TULUA. (A): Marking for transverse plication and umbilicus is removed. B: transverse plication done. (C): Our modification of TULUA by preserving the umbilicus. (D and E): Pre and postoperative photos anterior, right oblique and right lateral views. (F): Neo-umbilicoplasty done by skin graft from excess removed skin.

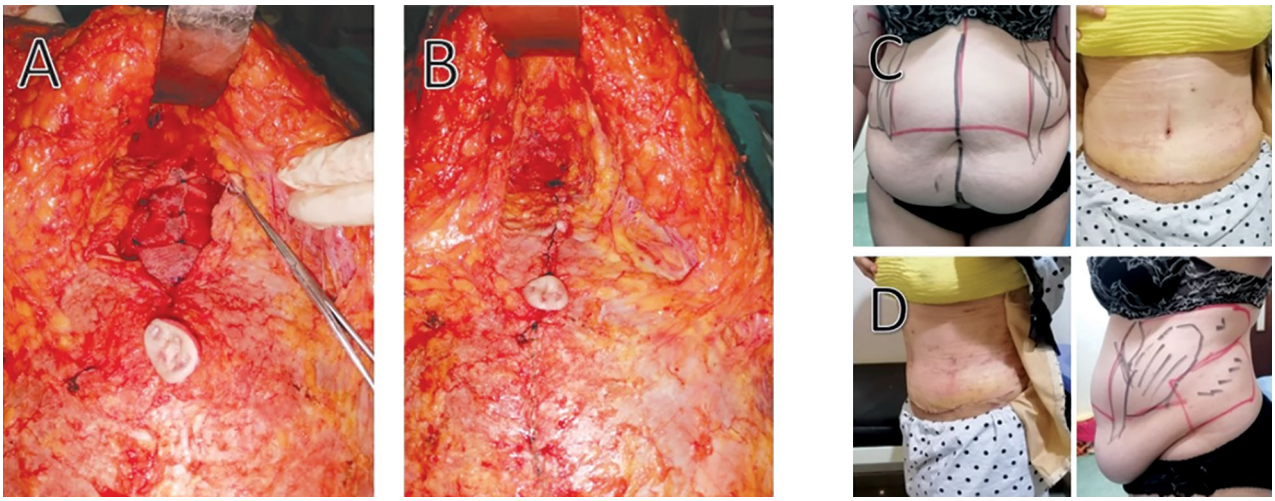


Fig. (3): Group (3A) patients. (A): Mesh over posterior rectus sheath. (B): After repair of anterior rectus sheath. (C and D): Pre and postoperative photos anterior and left lateral views respectively.

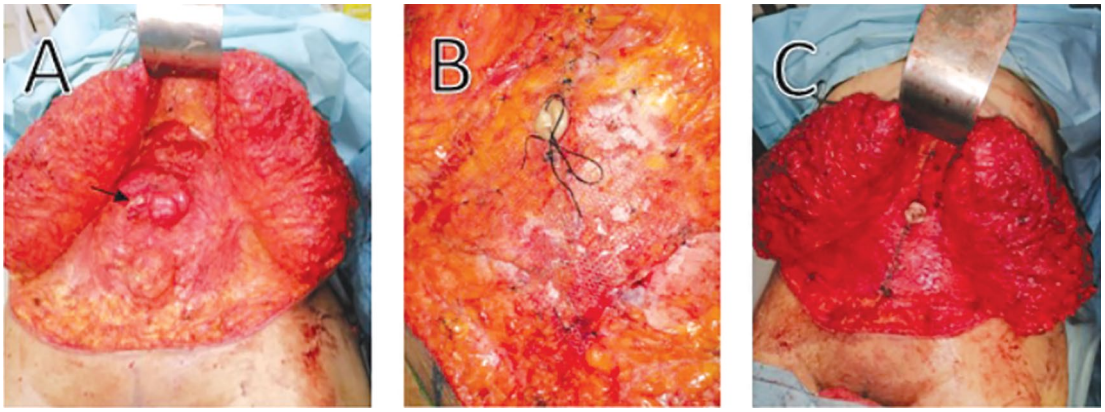


Fig. (4): Group (3 B) patients. (A): Three hernias and arrow to the umbilicus. (B): After repair of hernias and mesh applied to medial edges of rectus muscles. (C): Vertical plication with mesh completely involved and invaginated.

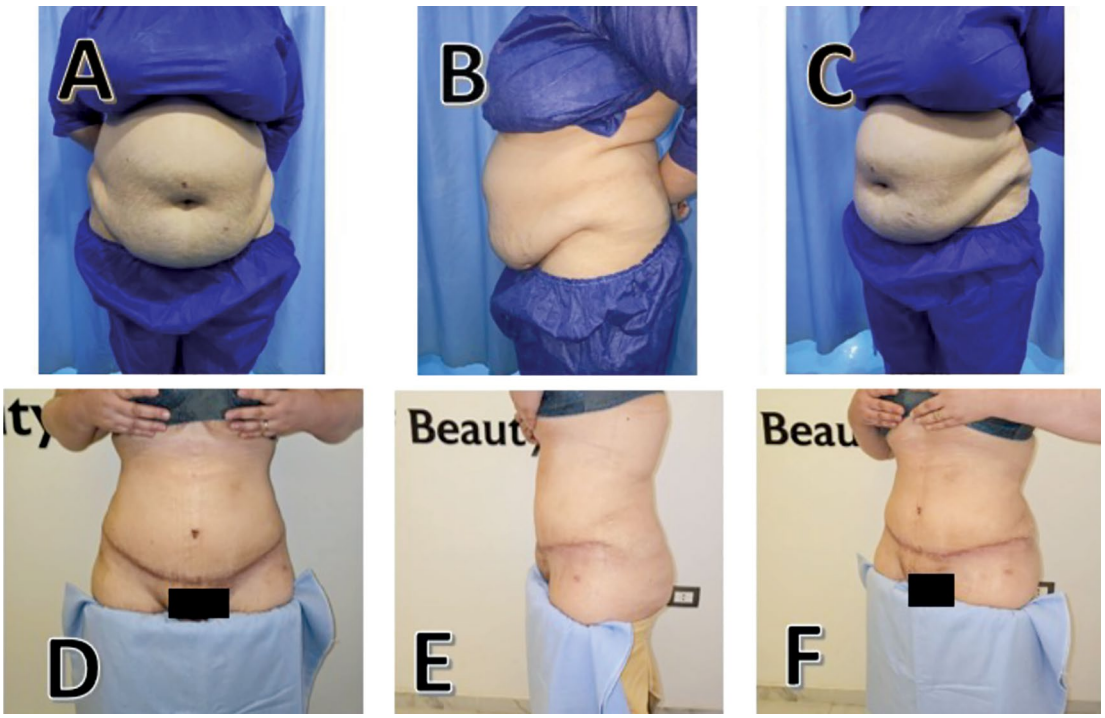


Fig. (5): Group (3B) patient. Pre and postoperative photos anterior, left and left lateral views.


Fig. (6): Group (3C) patients. (A): Mesh applied over plication and exposed parts of abdominal muscles. (B, C and D & E): Pre and postoperative photos anterior, left lateral views.

Postoperatively, Regular wound dressing was done; instructions were given to wear compression garments for three months and how to return to normal daily activities after three weeks. Follow-up visits every three months for at least 12 months (Fig. 7). Aesthetic results were evaluated, including the frequency of problems such as seroma, infection, flap necrosis, umbilical issues, wound dehiscence, and palpable knots. Ultrasound was used at 1 and 6 months postoperatively to determine the durability of muscle plication between three groups at three levels. Antibiotics were given intravenously as preoperative, intraoperative, and 7 days postoperative.

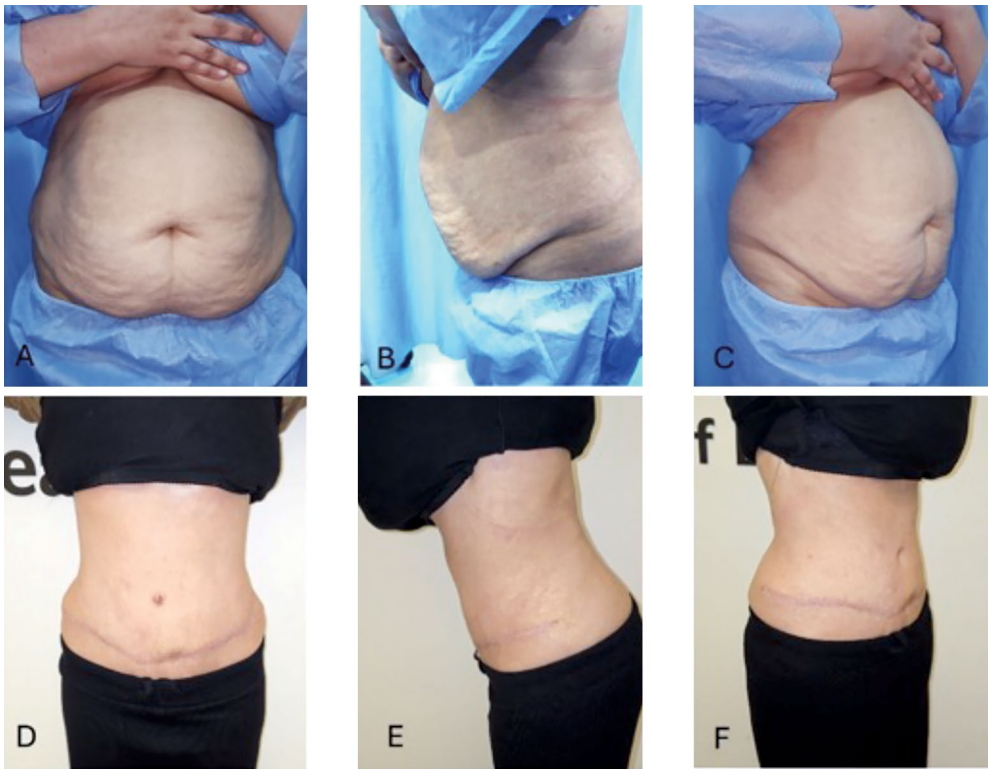


Fig. (7): (A, B, C): Preoperative and (D, E, F): Postoperative.

*Statistical analysis:*

Version 22 of SPSS (Statistical Package for Social Sciences) was used to examine the data. Quantitative data were reported as mean and standard deviation for normally distributed data and median and range for non-normally distributed data after being evaluated for normality using the Kolmogrov-Smirnov test. Qualitative data were displayed as numbers and percentages. Using the following recommended tests, the relevant statistical test was used based on the type of data: For categorical variables, use chi-squared. Kruskal Wallis and One Way ANOVA are tests for continuous variables.

## Results

The age ranged from 27 to 58 years, and the mean for group 1 was 39.4±8.8 SD, for group 2 was 38.9±8.2 SD, and for group 3 was 39.2±8.5 SD. BMI ranged from 27 to 34, and the mean for group 1 was 31.9±2.9 SD, for group 2 was 31.6±3.1 SD, for group 3 was 32.1±2.7 SD. There was no statistical difference between the three groups as regard age and BMI. The number of deliveries ranged from 1 to 5 children, 14 patients had normal delivery (15%) and 76 patients had caesarean sections (85%). The weight of excised tissue ranged from 2500 to 6100 grams and the mean was 4145.4±929.3 SD. The amount of lipoaspirate ranged from 1500 to 5000ml, and the mean was 3862±827.3 SD. The duration of drains ranged from 4 to 12 days, and the mean was 6.6±1.5 SD. The follow-up period ranged from 12 to 16 months postoperative, and the mean was 13±0.8 SD. Seven patients followed up only for about 3 months and escaped the 6-month follow-up visit. The pre-operative assessment of the rectus diastasis by ultrasound measured in mm showed there was no significant difference between the three groups. Hernia was encountered in 8 patients with the defect ranging from 25-53mm, and the mean was 38±0.6mm for those patients mesh repair was used.

The total complication incidence was 13.3%. Seroma was encountered in 4 patients in group 3; seroma had been managed conservatively by repeated aspiration and compression. Umbilical complications occurred in 4 patients, two patients in group 1, as the umbilicus had superficial necrosis and sloughing and were treated conservatively; the other 2 patients in group 2 had disruption of the new umbilicus, and a second umbilicoplasty was done after 4 months. Wound disruption happened in 2 patients in group 1, these wounds were re-sutured after 3 weeks. Necrosis (about 2 × 3cm) of skin flap occurred in 1 patient in group 1, and this was treated conservatively for about 45 days, and secondary sutures were done. There were no other complications regarding infection, scar asymmetry, dog ears, supra-umbilical bulge, etc.

Table (2): Rectus muscle diastasis in mm between the 3 groups pre- and 6 months postoperative.

| | At level of xiphoid pre | At level of xiphoid post | 3cm above umbilicus pre | 3cm above umbilicus post | 2cm below umbilicus pre | 2cm below umbilicus post |
|---|---|---|---|---|---|---|
| *Group 1:* | | | | | | |
| Mean | 33±0.3 | 5±0.5 | 35±0.5 | 5±0.6 | 21±0.1 | 3±0.4 |
| Range | 28-41 | 3-9 | 28-39 | 3-6 | 18-25 | 2-7 |
| *Group 2:* | | | | | | |
| Mean | 31±0.5 | 11±0.5 | 34±0.3 | 12±0.6 | 20±0.1 | 5±0.1 |
| Range | 21-44 | 9-13 | 28-39 | 8-14 | 18-29 | 4-8 |
| *Group 3:* | | | | | | |
| Mean | 34±0.4 | 5±0.4 | 37±0.3 | 5±0.3 | 23±0.3 | 3±0.4 |
| Range | 28-43 | 3-8 | 28-41 | 3-5 | 19-30 | 2-6 |
| *p*-value | 0.745 | 0.015* | 0.556 | 0.022* | 0.698 | 0.012* |

(*): *p*-value <0.05 is considered statistically significant.

## Discussion

The challenge of anterior abdominal wall laxity places a significant weight on plastic surgeons' minds. If this laxity is not addressed, it will most likely have a significant impact on the overall cosmetic results of abdominoplasty **[5]**. Abdominoplasty and body sculpting procedures are becoming increasingly popular worldwide, which could be attributed to a rise in the number of bariatric surgeries, people decreasing weight through diet, or the high rate of cesarean sections, which produce abdominal wall laxity and redundant abdominal skin **[8]**.

Multiple trials have been done to study the normal anatomy of Linea Alba and to evaluate the rectus diastasis. Rath et al. **[9]** used the data from 40 fresh cadavers and 40 computed tomography (CT) scans on the abdominopelvic area and established the rectus diastasis parameters for patients below and above the age of 45 years. Beer at al. **[6]** used ultrasound to find the average range of Linea Alba width in 150 nulliparous women aged between 20 and 45 years and a BMI <30 especially at three reference points: The origin at the xiphoid and 3cm above and 2cm below the umbilicus.

Many surgeons created multiple techniques to deal with this laxity and to repair the rectus muscle diastasis and repair of Scarpa's fascia to improve the results **[10,11,12]**. The vertical rectus muscle plication with non-absorbable sutures is becoming the standard technique for most surgeons; it is easy, fast and rapidly mastered by surgeons. But the durability of this procedure is much questionable especially at 12 months postoperative **[13,14]**.

Multiple studies have used different methods to measure the width of the rectus diastasis, such as computed tomography (CT), ultrasonography, and magnetic resonance imaging (MRI). Ultrasound proved to be inexpensive, non-invasive, and easily repeatable with no radiation exposure. The CT and MRI were shown to be safe and operator-independent. However, they are pricey and cannot be used for abdominoplasty regularly **[15]**. In our study, the authors employed ultrasonography because it is relatively inexpensive and easily accessible to our patients.

In our study, we utilized three different methods for repair of the laxity of the abdominal wall and we assessed the durability of this repair by ultrasound (Table 2) at three standard points mentioned by Beer et al.

In group 1, the results obtained by US were similar to the results obtained by Tadiparthi et al. **[2]** and Van Uchelen et al. **[16]** and we agree with

them regarding that vertical plication alone is not enough to improve the waistline and could eventually lead to epigastric bulging especially after 12 months. This was approved by another study done on middle eastern patients comparing 2 different methods for rectus muscle diastasis repair **[17]**.

In group 2, the diastasis was more at the level of the xiphoid than in other groups; this could be attributed to that muscle plication is done transversely below the umbilical level, and so no repair of diastasis above the umbilicus. In group 3, the 6-month results are the best result, We think that the fibrosis enhanced by the mesh plays an important role in these results.

In group 2, the TULUA procedure forms the new umbilicus by skin graft obtained from excess removed skin and the complications described by its original surgeon were mostly due to this skin graft. In our hands, we tried two different modifications. First, if the umbilicus stalk is long enough, the umbilicus is transferred under the skin flap by simple short undermining. The second modification is that we created the new umbilicus by using the four quadrat flaps at the proposed new site and sutured by absorbable sutures to rectus sheath, this is easy especially that liposuction produce thin skin flaps. These two modifications reduced the complication incidence in our study to only 2 patients in this group.

In cases where there was a large diastasis or if we found a hernia, mesh is thought to be the best option. Meshes distribute forces in the short term to limit suture pull-through. Over time, the filaments of meshes permit fibrovascular incorporation. The chronic foreign body response serves to create a scar scaffold that ensures that the tissue approximation will remain durable no matter the forces applied **[18]**. Three ways are described in this study for mesh application. In group 3a, the mesh is applied over posterior rectus sheath, that enables us to do perfect hernia repair and excellent plication as it is in our field of vision. This technique is recommended by multiple surgeons for its long-term results **[19,20,21]**. In group 3b, the mesh is hidden by plication. This produces good plication as the mesh provides an added layer to the sheath and gives good grip for the needle of the suture. In group 3c, the mesh application is over the vertical plication. This method is easy and provides good results, but the seroma rate is high as the mesh is totally subcutaneous and exposed to the exudate of liposuction. We recommend in this type that the drains are left for more time than other patient groups.

Although mesh application requires opening additional tissue planes and increases foreign body reaction, we found that many plastic surgeons have multiple concerns about the use of mesh because they fear seroma, infection, pain, and extrusion. As a result, they stopped using mesh during abdominoplasty in patients with severe rectus diastasis. However, our study found that the complication rate following mesh use in those patients was the same or even lower than standard vertical plication. As long as the mesh is implanted safely, appropriately, and with minimal tissue injury, the authors concluded that surgical mesh problems might be significantly decreased. These findings are consistent with research by Akila et al. **[23]** and Sood et al. **[22]**.

We designed an algorithm for decision making regarding the best method for dealing with rectus diastasis during abdominoplasty, many factors are taken in consideration especially BMI, number of pregnancies, exercise status, skin redundancy level and degree of diastasis detected by ultrasound (Fig. 8). We recommend that vertical plication to be limited to patients with BMI 25-30, one or two children and the diastasis is 20-25mm, while TULUA is limited in patients with BMI less than 25, less supraumbilical bulge, more skin redundancy, doing abdominal exercises and diastasis is 15-20mm. Mesh is recommended in patients with BMI more than 30, multiple pregnancies, no regular exercise, diastasis more than 25mm or presence of hernia.

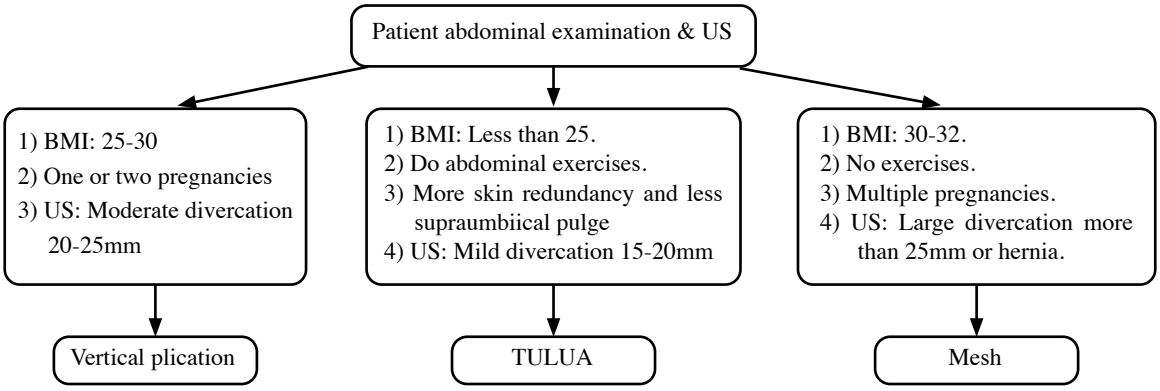


Fig. (8): Algorithm of rectus diastasis repair.

The limitations of this study are the small sample size, single-center study, patients are all Egyptians, short follow-up period, and the aesthetic results were the main concern for the surgeons. For more precise measurements, larger sample sizes, multicenter trials, and to examine the long-term effects of diastasis correction on patients' function, core strength, and exercise, we advise future research to employ CT or MRI.

*Conclusion:*

In conclusion, different care strategies are needed for the various types of patients undergoing abdominoplasty. Surgeons are increasingly using a combination of procedures to get better outcomes. For optimal results, standard vertical plication is insufficient, particularly in individuals with extensive hernias or wide rectus diastasis. Authors recommend using mesh because it increases abdominal wall flexibility and produces better long-lasting results. Applying mesh at the sub-rectus muscle level yields the best outcomes and there are virtually no problems.

## References


1- Nahas F.X., Ferreira L.M., Augusto S.M. and Ghelfond C.: Long-term follow-up of correction of rectus diastasis. Plast. Reconstr. Surg., 115: 1736-41, 2005.

2- Tadiparthi S., Shokrollahi K., Doyle G.S. and Fahmy F.S.: Rectus sheath plication in abdominoplasty: Assessment of its longevity and a review of the literature. Journal of Plastic, Reconstructive & Aesthetic Surgery, 65: 328-332, 2012.

3- Villegas F.J.: A Novel Approach to Abdominoplasty: TULUA Modifications (Transverse Plication, No Undermining, Full Liposuction, Neoumbilicoplasty, and Low Transverse Abdominal Scar). Aesth. Plast. Surg., 38 (3): 511-520, 2014.

4- Bruner T.W., Salazer-Reyes H. and Friedman J.D.: Umbilical hernia repair in conjunction with abdominoplasty: A surgical technique to maintain umbilical blood supply. Aesthetic Surg. J., 29: 333-4, 2009.

5- Nahas F.X., Ferreira L.M., Ely P.B. and Ghelfond C.: Rectus diastasis corrected with absorbable suture: A long-term evaluation. Aesthetic Plast. Surg., 35 (1): 43-8, 2011.

6- Beer G.M., Schuster A., Seifert B., Manestar M., Mihic-Probst D.A. and Weber S.A.: The normal width of the linea alba in nulliparous women. Clin. Anat., 22: 706-11, 2009.

7- Gama M., et al.: Single-Layer Plication for Repair of Diastasis Recti: The Most Rapid and Efficient Technique. Aesthetic Surgery Journal, 1–8, 2017.

8- Staalesen T., Olsén M.F. and Elander A.: Complications of abdominoplasty after weight loss as a result of bariatric surgery or dieting/postpregnancy. J. Plast. Surg. Hand Surg., 46: 416–420, 2012.

9- Rath A.M., Attali P., Dumas J.L., Goldlust D., Zhang J. and Chevrel J.P.: The abdominal linea alba: An anatomo-radiologic and biomechanical study. Surg. Radiol. Anat., 18: 281-8, 1996.

10- Matarasso A., Swift R.W. and Rankin M.: Abdominoplasty and abdominal contour surgery: A national plastic surgery survey. Plast. Reconstr. Surg., 117: 1797-1808, 2006.

11- Younis M.T., Mahfouz S.E., El Habaa G., Yousef A.A. and Abdelmofeed A.M: Role of Scarpa's Fascia Advancement in Waist Definition during Abdominoplasty. Egypt. J. Plast. Reconstr. Surg., 46 (2): 107-114, 2022.

12- Hassan M.S. and Ghebery W.N.: The Triangular Technique for Abdominal Myofascial Plication. Egypt. J. Plast. Reconstr. Surg., 45 (2): 105-112, 2021.

13- Yousif N.J., Lifchez S.D. and Nguyen H.H.: Transverse rectus sheath plication in abdominoplasty. Plast. Reconstr. Surg., 114: 778, 2004.

14- Mestak O., Kullac R., Mestak J., Nosek A., Krajcova A. and Sukop A.: Evaluation of the long-term stability of sheath plication using absorbable sutures in 51 patients with diastasis of the recti muscles: An ultrasonographic study. Plast. Reconstr. Surg., 130 (5): 714e-719e, 2012.

15- Elkhatib H., Buddhavarapu S.R., Henna H. and Kassem W.: Abdominal Musculoaponeuretic System: Magnetic Resonance Imaging Evaluation before and after Vertical Plication of Rectus Muscle Diastasis in Conjunction with Lipoabdominoplasty. Plast. Reconstr. Surg., 128: 733e 740e, 2011.

16- Van Uchelen J.H., Kon M. and Werker P.M.: The long-term durability of plication of the anterior rectus sheath assessed by ultrasonography. Plast. Reconstr. Surg., 107: 1578e84, 2001.

17- Nada A.M. and Wafaa R.A.: Assessment of the Correction of Rectus Abdominis Muscles Diastasis Using Two Different Techniques. Egypt. J. Plast. Reconstr. Surg., 43 (2): 275-282, 2019.

18- ElHawary H., Abdelhamid K., Meng F. and Janis J.E.: A comprehensive, evidence-based literature review of the surgical treatment of rectus diastasis. Plast. Reconstr. Surg., 146: 1151–1164, 2020.

19- Dumanian G.A. and Moradian S.: Mesh abdominoplasty for rectus diastasis in women and men. Hernia, 25: 863–870, 2021.

20- Dumanian G.A.: Discussion: advantages of a fixation-free technique for open retromuscular ventral hernia repair. Plast. Reconstr. Surg., 146 (4): 891–892, 2020.

21- Emanuelsson P., Gunarsson U., Dahlstrand U., Strigard K. and Stark B.: Operative correction of abdominal rectus diastasis (ARD) reduces pain and improves abdominal wall muscle strength: a ran domized, prospective trial comparing retromuscular mesh repair to double-row self-retaining sutures. Surgery, 160: 1367–1375, 2016.

22- Sood R., Janes L.E., Shah N., Sasson D.C., Ellis M.F. and Dumanian G.A.: Mesh Repair of Rectus Diastasis for Abdominoplasty is Safer than Suture Plication. Plast Reconstr Surg Glob Open, 9: e3721, 2021.

23- Akila A.A., Bakry S.A., Afify S.N. and Amr A.H.: Abdominoplasty Combined with the Anterior Component Separation Technique for Reconstruction of Midline Large Ventral Hernias: Functional and Aesthetic Outcome Clinical Study. Egypt. J. Plast. Reconstr. Surg., 46 (3): 273-282, 2022.