

## Vertical Plication Versus Combined Vertical & Transverse Plication in the repair of abdominal musculo-aponeurotic laxity

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### ABSTRACT

*The abdomen plays a leading role in the aesthetic image of the human body and is of prime importance in defining the overall contour of the individual. Abdominal girth and waistline measurement are constant sources of anxiety and reflection. Improvement of the waistline is one of the goals of abdominoplasty. However, its shape depends on several factors, such as fat deposit, individual abdominal contour, and degree of muscular tension. This randomized prospective comparative clinical study was conducted on patients complaining of various degrees of abdominal wall laxity and comparing various techniques of management. In this study the strategy of plication was made to get both functional outcome of effective, tight and safe plication beside aesthetic outcome to all patients.*

**Keywords:** *abdominoplasty, abdominal wall laxity, plication, waistline measurement.*

### INTRODUCTION

The anterior abdominal wall represents a unique musculo-tendinous unit; the interplay of paired muscular elements contributes to a laminar architecture that provides dynamic stability against intra- and extra-abdominal forces, while at the same time remaining elastic and flexible<sup>1</sup>. The abdomen plays a leading role in the aesthetic image of the human body, and in defining the overall contour of the individual. The form of the abdomen is defined by the skeletal structure, the quantity and distribution of fat, the appearance and condition of the skin, the tone of the aponeurotic and muscular system and the protrusion of the intra-abdominal organs<sup>2</sup>. Abdominal beauty does not arise from a strictly defined form and there are varied appearances which are considered aesthetically pleasing. Improvement of the waistline is one of the goals of abdominoplasty; however, its shape depends on several factors, such as fat deposit, individual abdominal contour, and degree of muscular tension<sup>3,4</sup>. Rectus plication, commonly performed during abdominoplasty, aims to relocate the rectus muscles to the midline and restore abdominal contour. The classic Pitanguy technique described in 1967plicates the fascia in the midline using a non-absorbable suture, since then, various techniques and suture types have been used for correction of rectus diastasis<sup>5</sup>. In 1990 Marques et al. report a T-shaped plication with a subcostal transverse limb in addition to the vertical rectus

plication then Marques et al. in 1995 recommended the use of a polypropylene reinforcing mesh over three longitudinal fusiform plications<sup>6,7</sup>. Abramo et al. in 1999 describe an H-shaped plication with subcostal and supra-pubic transverse fascial plications in addition to the midline plication<sup>8</sup>. Nahas in 2001 alters the fascial plication depending on the diastasis of the rectus muscles as well as the definition of the waistline preoperatively; all patients receive rectus plication in the midline, for more severe deformities, mirrored L-shaped plications are added in the lower external oblique, and for the very poorly defined waistline, bilateral external oblique flaps are raised and sutured together at the midline<sup>9</sup>. Sozer et al. in 2007 combined the use of vertical plication of the rectus sheath to horizontal triple plication<sup>10</sup>.

The aim of this study is to compare vertical plication of the rectus sheath muscles with combining vertical plication of the rectus sheath and horizontal plication of the anterolateral abdominal wall muscles

### PATIENTS AND METHODS

This randomized prospective comparative clinical study was conducted on 50 female patients complaining of various degrees of abdominal wall laxity, in the period from April 2011 to March 2013 at Kasr El-Ainy hospital for correction of abdominal wall laxity. Their ages

varied from 27 years to 58 years (Mean age: 42.5).

The sample population was divided randomly into two equal groups according to the type of management of abdominal wall laxity; the first group was managed by vertical midline plication of the rectus sheath; the second group was managed by combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles.

**Pre-operative measurements for all patients were done as following:**

- *Vertical measurements:* From Xiphoid process to Umbilicus and From Umbilicus to Symphysis pubis.
- *Waist circumference:* at the level of the umbilicus in standing, leaning and in leaning with valsalva's maneuver.
- Post-operative measurements were done in the same positions after 3 months to compare them with the pre-operative measurements

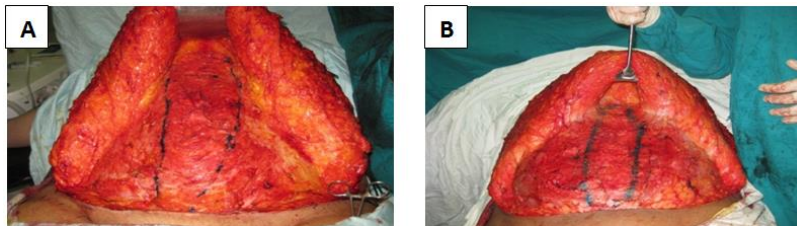
and thus; to compare the efficacy of both types of repair in both groups of patients.

**Operative Approach:**

All procedures were done under general anesthesia. The procedures start by a lower abdominal incision.

All patients in the two groups were subjected to standard abdominoplasty procedures but the difference between the two groups was the type of management of the abdominal wall laxity.

**Group (A):** After complete dissection of the skin and fat the extent of divarication of the recti was detected and marked using (Methylene blue) and measured and recorded intra-operatively (Fig. 1). The abdominal wall laxity was repaired using only vertical plication using continuous sutures (Prolene 1) supported by interrupted sutures (Vicryl 0) from the xiphoid process till the symphysis pubis (Fig. 2).



**Fig. (1):** Marking of the extent of divarication of the recti intra-operatively. (A) Showing the preservation of the umbilicus during dissection. (B) showing removal of the umbilicus during dissection.



**Fig. (2):** After completion of the vertical plication from the xiphoid process to the symphysis pubis.

**Group (B):**

After complete dissection of the skin and fat the extent of divarication of the recti was detected and marked using (Methylene blue) and measured and recorded intra-operatively. Another marking was done in a half ellipse shape (with a width 2-3 cm) between the umbilicus and the anterior superior iliac spine (ASIS) (Fig. 3). Combined

Plication was done to the patients of this group using vertical plication using continuous sutures (Prolene 1) supported by interrupted sutures (Vicryl 0) from the xiphoid process to the symphysis pubis with plication of the anterolateral wall muscles on the transverse marking mentioned previously using interrupted (Prolene 1) sutures (Fig. 4)



**Fig. (3):** Both vertical and horizontal markings intra-operatively.



**Fig. (4):** After completion of both the vertical and the horizontal plication.

A Prolene mesh was applied in all cases who complained from abdominal wall hernias and the mesh was fixed using (Prolene 2/0) sutures. The abdominal skin flaps are excised. The Umbilicus was sutured in its new place or an umbilicoplasty was done in patients where the umbilicus had to be removed in cases of large long standing paraumbilical hernias where the vascularity of the umbilicus was in a doubt. Umbilicoplasty was done by defatting a circle of 2.5 cm in diameter in the midline midway between the xiphoid process and the symphysis pubis and taking anchoring sutures between the dermis of the defatted skin and the abdominal wall using (PDS 0) sutures. Closure of the subcutaneous layer by using first vicryl zero to be followed by vicryl 2-0 and closure of the skin by subcuticular monocryl 3/0

#### **Statistical Analysis:**

Data were statistically described in terms of mean  $\pm$  standard deviation ( $\pm$ SD), median and range, or frequencies (number of cases) and percentages when appropriate. Comparison of numerical variables between the study groups was done using Student t test for independent samples. For comparing categorical data, Chi square ( $\chi^2$ ) test was performed. Exact test was used instead when the expected frequency is less than 5. p values less than 0.05 was considered statistically significant. All statistical calculations were done using computer programs SPSS (Statistical

Package for the Social Science; SPSS Inc., Chicago, IL, USA) version 15 for Microsoft Windows.

## **RESULTS**

There were multiple variables in all the patients in the study including age, BMI, no. of previous pregnancies and presence of abdominal wall hernias. All were compared as following:

Comparing the mean age of the two groups showed no significant difference at p value 0.298. Comparing the mean BMI of the two groups showed no significant difference at p value 0.077. Comparing the mean no. of pregnancies between the two groups showed no significant difference at p value 0.501. Comparing the percentages of presence of abdominal wall hernias between the two groups showed no significant difference at p value 0.648.

#### **Analysis of the Pre-operative and Post-operative Measurements:**

##### **I. Vertical measurements:**

###### **➤ Pre-operative:**

**Group (A):** The maximum (*XU*) was 34 cm and minimum was 18 cm with mean of 23.71 cm, while the maximum (*US*) was 18 cm and minimum was 13 cm with mean of 14.88 cm.

**Group (B):** The maximum (*XU*) was 34 cm and minimum was 20 cm with mean of 26 cm,

while the maximum (*US*) was 20 cm and minimum was 14 cm with mean of 15.5 cm.

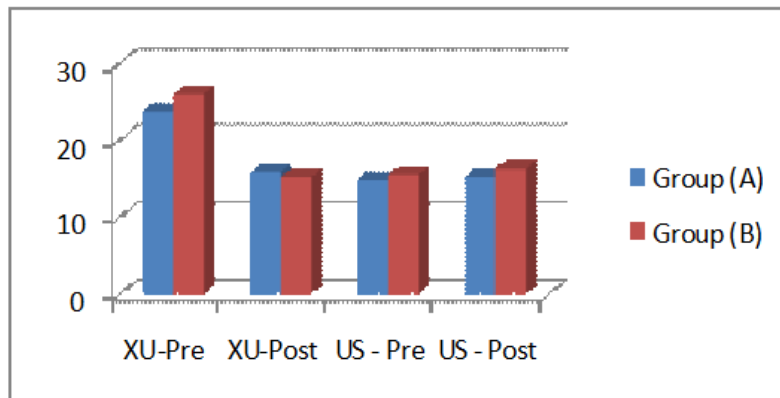
Comparing the vertical measurements (*XU*) & (*US*) between the two groups pre-operatively showed no significant difference at p value 0.114 & 0.164 respectively.

➤ Post-operative:

Group (A): The maximum (*XU*) was 22 cm and minimum was 15 cm with mean of 16.81 cm, while the maximum (*US*) was 22 cm and minimum was 14 cm with mean of 16.31 cm.

Group (B): The maximum (*XU*) was 18 cm and minimum was 15 cm with mean of 15.88 cm, while the maximum (*US*) was 17 cm and minimum was 14 cm with mean of 15.17 cm.

There was a significant change in the vertical measurements (*XU*) & (*US*) post-operatively in both procedures in the two groups with p value 0.02 and 0.004 respectively, but with no significant difference between the two groups (p value 0.59).



**Fig. (5):** A graph comparing the mean value of the vertical measurements (*XU*) & (*US*) between the two groups Pre and Post-operatively.

## II. Waist measurements:

➤ Pre-operative:

Group (A):

- *Waist in Standing Position:* The maximum measurement was 132 cm and minimum 100 cm with mean 111.96 cm.
- *Waist in Leaning Position:* The maximum measurement was 133 cm and minimum 102 cm with mean 113.67 cm.
- *Waist in Leaning with Valsalva:* The maximum measurement was 135 cm and minimum 104 cm with mean 115.58 cm.

Group (B):

- *Waist in Standing Position:* The maximum measurement was 134 cm and minimum 104 cm with mean 117.38 cm.
- *Waist in Leaning Position:* The maximum measurement was 136 cm and minimum 106 cm with mean 119.23 cm.
- *Waist in Leaning with Valsalva:* The maximum measurement was 137 cm and minimum 109 cm with mean 121.5 cm.

Comparing the waist measurements in all the previous positions between the two groups pre-

operatively showed no significant difference at p value 0.093, 0.083 & 0.062 respectively.

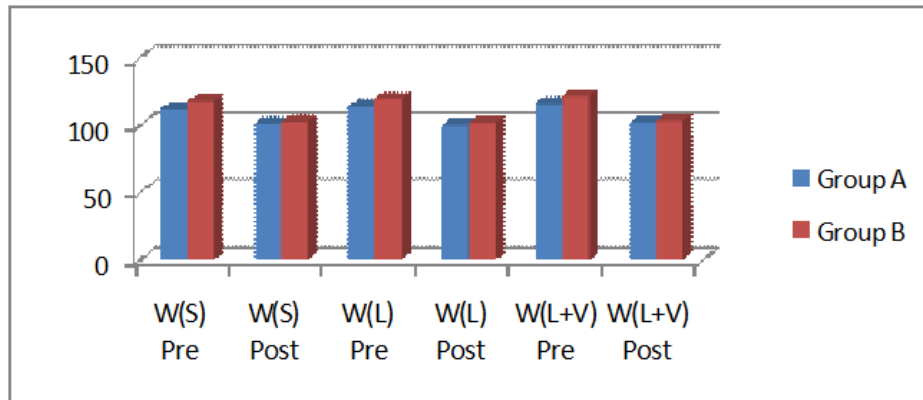
➤ Post-operative:

Group (A):

- *Waist in Standing Position:* The maximum measurement was 120 cm and minimum 91 cm with mean 100.88 cm.
- *Waist in Leaning Position:* The maximum measurement was 119 cm and minimum 90 cm with mean 100.08 cm.
- *Waist in Leaning with Valsalva:* The maximum measurement was 122 cm and minimum 102 cm with mean 101.88 cm.

Group (B):

- *Waist in Standing Position:* The maximum measurement was 117 cm and minimum 89 cm with mean 102.38 cm.
- *Waist in Leaning Position:* The maximum measurement was 116 cm and minimum 89 cm with mean 101.62 cm.
- *Waist in Leaning with Valsalva:* The maximum measurement was 117 cm and minimum 90 cm with mean 103.12 cm.



**Fig. (6)** :A graph comparing the mean values of the Waist measurements W(S), W(L) and W(L+V) between the two groups Pre and Post-operatively.

The post-operative measurements of all the previous positions in all patients were subtracted from the pre-operative measurements to detect the difference and the results were as following:

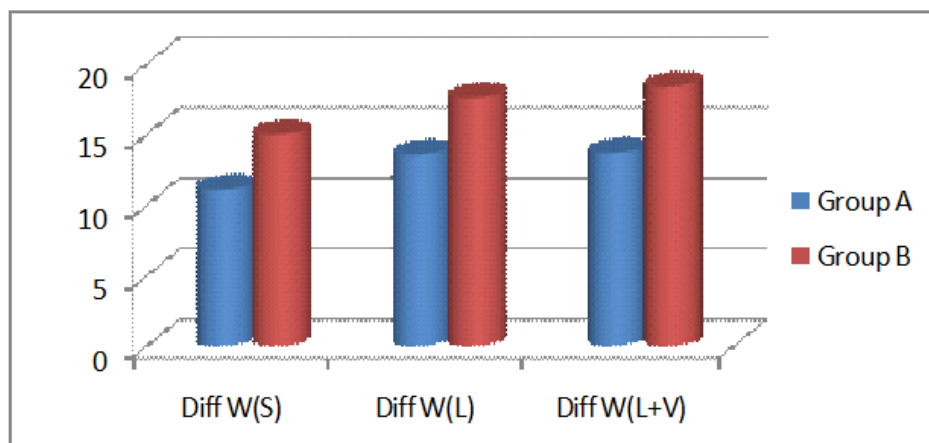
Group (A):

- **Waist in Standing Position:** The mean difference was 11.083 cm.
- **Waist in Leaning Position:** The mean difference was 13.583 cm.
- **Waist in Leaning with Valsalva:** The mean difference was 13.708 cm.

Group (B):

- **Waist in Standing Position:** The mean difference was 15 cm.
- **Waist in Leaning Position:** The mean difference was 17.615 cm.
- **Waist in Leaning with Valsalva:** The mean difference was 18.385 cm.

Comparing the difference in the waist measurements pre and post-operatively between the two groups; there were a statistical significant difference with p values 0.001, 0.002 and 0.000 respectively.



**Fig. (7):** A graph comparing the difference between the pre and post-operative waist measurements W(S), W(L) and W(L+V) between the two groups.

## DISCUSSION

Simon et al. in 2010 performed a study on 11 females to detect the change in horizontal and vertical dimensions of the trunk after abdominoplasty with vertical plication to rectus sheath. Baseline measurements were obtained pre-operatively that included waist circumference at the level of the umbilicus and distance from the xiphoid to the umbilicus and from the umbilicus to the most superior aspect of the labia majora. The post-operative measurements at 1 week and 6 months were recorded. The result of the study showed statistically significant reduction in the waist diameter (net mean decrease of 5.0 cm at 7 days and 7.9 cm at 6 months), in the xiphoid to umbilicus distance (net mean decrease of 2.2 cm at 7 days and 2.8 cm at 6 months) and umbilicus to labia majora distance (net mean decrease of 4.4 cm at 7 days and 5.09 cm at 6 months). The drawback of the study was it didn't use fixed bony reference points but showed significant decrease in the waist diameter following the tightening of the rectus sheath in the horizontal vector and it also showed that the umbilicus was shifted cephalically due to the superior pull of the tightened skin flap<sup>11</sup>.

In this study 50 female patients complaining of various degrees of abdominal wall laxity, the sample population was divided randomly into two equal groups according to the type of management of abdominal wall laxity; the first group was managed by vertical midline plication of the rectus sheath; the second group was managed by combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles.

The large sample size in this study ensured that the multiple variables in the patients including age, BMI, number of previous pregnancies, presence of hernias and the mean pre-operative measurements in all the patients did not affect the comparative result between the two groups and this was proved statistically when comparing the mean values of all these variables between the two groups.

The design of the transverse plication in the study was made according to both anatomical and functional considerations. It was designed as half an ellipse on each side of the umbilicus, with the medial side's width of 2-3 cm and tapers gradually towards the anterior superior iliac spine.

This was made at the level of the umbilicus which shows the maximum diastasis according to Rath et al. in 1996 and Van Uchelen et al. in 2001<sup>11,12</sup>. The design was made more or less with the direction of the antero-lateral abdominal wall muscle to avoid muscle ischemia and the unfavorable tension sometimes found in the L-shaped repair between the two vertical limbs stated by Nahas et al. in 2001<sup>9</sup>.

In this study the strategy of plication was made to get both functional outcome of effective, tight and safe plication beside aesthetic outcome to all patients.

When recording the vertical measurements in this study it differed from the study by Simon et al. in 2010 in using the symphysis pubis as a bony landmark instead of the superior margin of the labia majora to overcome the drawback of the previous study. Post-operative measurements in the study were recorded 1, 2 and 4 weeks and 3 months post-operatively but only the 3 months measurements were used to ensure that the post-operative edema had resolved as stated by Simon et al. in 2010<sup>11</sup>.

By comparing the vertical measurements in this study pre and post-operatively the results showed that there was a significant change in the vertical measurements xiphisternum to umbilicus (XU) & umbilicus to symphysis pubis (US) were they moved cephalically post-operatively in both procedures in the two groups with p value 0.02 and 0.004 respectively this is due to the pre-operative downward shifting of the umbilicus due to increased intra-abdominal pressure, but with no significant difference between the two groups (p value 0.59), showing that there is no difference between both procedures in the superior pull of the umbilicus.

When recording the waist measurements in this study the level of the umbilicus was chosen as it is the site of maximum divarication and stretch of linea alba as stated by Rath et al in 1996, Van Uchelen et al. in 2001 and Brauman in 2008<sup>12,13,14</sup>.

The waist measurements were recorded in three different positions in standing, leaning and in leaning with valsalva as not just detect the difference in waist measurements but to detect the efficiency of the repair in both procedures.

The post-operative measurements of all the previous positions in all patients were subtracted from the pre-operative measurements to detect the



difference and the results showed significant difference in the post-operative waist measurements in all three positions between the two groups where the mean change in group A (vertical plication only) in standing position: 11.083 cm, in leaning position: 13.583 cm and in leaning position with valsalva: 13.708; while in group B (combined vertical and horizontal plication) in standing position: 15 cm, in leaning position: 17.615 cm and in leaning position with valsalva: 18.385 cm.

The previous results show that the combined procedure of vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles significantly decreased the waist diameter and it also has a better efficiency in the repair in the abdominal wall laxity as the mean change in the leaning and leaning with valsalva are even more than the mean change in the waist diameter in standing position.

## CONCLUSION

Due to the wide and diversified range of cosmetic problems involving the abdominal wall, a great number of techniques were simultaneously created. In this study combined vertical plication of the rectus sheath and transverse plication of the anterolateral abdominal wall muscles showed an effective technique in giving a good aesthetic result by decreasing the waist measurements in comparison to the vertical plication alone.

Functional outcome should always precede the aesthetic outcome and it is of outmost importance to always make sure that effective, tight and safe plication is done and this can be achieved with good selection of patients and cautious intra and post-operative monitoring of all patients.

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