Clinical Study

Crossed abdominal wall plication in abdominoplasty

Mohamed Farouk, MD a and Abdelhamied Askar, MD b, *

a Department of Plastic Surgery, Baniswaf University, Egypt
b Department of General Surgery, Cairo University, Egypt

Received 8 December 2012; revised 10 March 2013; accepted 10 April 2013

Abstract

Objectives: Plication of the anterior abdominal wall musculature and the anterior rectus sheath is a common procedure during abdominoplasty. The purpose of this study was to compare a newly modified technique for oblique plication of the anterior rectus sheath with classic vertical rectus plication, on the assumption that oblique plication is more physiological and anatomical.

Methods: Fifteen patients underwent oblique plication of the anterior rectus sheath to correct both vertical and transverse laxity, and the results were compared with those for an equal number of patients who underwent vertical rectus plication. The average duration of follow-up was 18 months. The comparison was made by four non-medical judges from pre- and post-operative photographs. We compared waistline contour, definition of the linea alba, hip–waist transition and anterior abdominal wall contour. The rated areas were judged on a 5-point Likert scale, and the global score was based on the average of the four scores.

* Corresponding address: Department of Surgery, College of Medicine Taibah University, Almadinah Almunawwarah, Kingdom of Saudi Arabia. Tel.: +966 4 8460008; fax: +966 4 8461407.
E-mail: ahaskar@hotmail.com (A. Askar)
Peer review under responsibility of Taibah University.

Production and hosting by Elsevier
Introduction

Abdominoplasty is one of the most common aesthetic procedures. Kelly, more than 100 years ago, was the first surgeon to attempt correction of excess abdominal skin and fat by a transverse incision. Since that time, numerous variations have been suggested. The classic Pitanguy technique involves suturing the anterior rectus sheaths together in the midline with permanent sutures; however, in this procedure much of the rectus muscle is turned inwards and is no longer part of the abdominal wall. Vertical plication may correct the transverse redundancy but not the vertical one and also cannot address epigastric laxity, as the upper end of the plication ellipse is least tightened. Although aponeurotic suturing of the midline reduced anterior projection of the abdominal wall, it did little to reduce the diameter of the waist. In 1978, Psillakis suggested suture plication of the external oblique musculature after raising it in a belt-like fashion. In this way, he was able to reduce the diameter of the waist dramatically. In 1995, Lockwood described high lateral tension abdominoplasty, the key feature of which include limited direct undermining, increased lateral skin resection with high tension wound closure along lateral limbs, and two-layer superficial fascial system repair. Yousif suggested transverse plication at the location of the tendinous insertions of rectus muscles in the anterior rectus sheath.

Common abnormalities that in many cases require an abdominoplasty procedure are diastasis of both recti and laxity in the musculofacial layer in both vertical and transverse directions. Vertical plication of the rectus sheath reduces it to 25% or less of the anterior abdominal wall instead of 50% in normal subjects and usually leaves the abdomen flat rather than preserving the original outline of the rectus sheath. Anatomical correction of laxity in the musculofacial layer maintains a youthful, natural appearance of the abdominal musculature.

Operative technique

When rectus diastasis was present, it was corrected with a running loop nylon suture only to the extent that the rectus muscles were brought into opposition to correct the diastasis and not to reduce the total area of the rectus sheath.

The location at which the oblique plication was to be made was then marked. The upper oblique plication extended from a point below the mid costal margin downwards and medially towards the umbilicus. The lower oblique limb started from the umbilicus and extended downwards and laterally to a point 5 cm above the midinguinal point. The second limbs of the crossed pattern were done in the same way. All the plications were 2–4 cm wide, depending on the degree of laxity, which was determined intra-operatively. Plication was performed with interrupted 0 nylon figure-of-eight sutures (Figures 1 and 2).

Evaluation of the techniques

Four non-medical judges reviewed standard anteroposterior and bilateral oblique colour photographs taken before the operation and an average of 10.2 months after the operation. The four qualities rated were selected from Lockwood’s ideal abdominal aesthetics and Ramirez’s objective of abdominoplasty as those that could be influenced by abdominal wall plication. Four aspects were rated: anterior abdominal wall contour, definition of the linea alba, hip–waist transition and waistline contour. The aspects were judged on a 5-point Likert scale, as follows: 1, worse than before the operation; 2, unchanged; 3, mild improvement; 4, moderate improvement; 5, good improvement.
5, marked improvement. The global score was the average of the scores for the four aspects.

**Statistical analysis**

STATA version 9 was used for statistical analysis. The results are given as mean values and standard deviations or medians (range). Abdominal wall contour, linea alba definition and hip–waist transition scores were compared in a Mann–Whitney U nonparametric test. Waistline contour and the global score were analysed in a two-tailed unpaired \( t \) test. A \( p \) value lower than 0.05 was considered statistically significant. The Fisher exact test was used to compare the number of patients who subjectively rated their outcome as excellent or good (satisfied patients) with those with a subjective outcome of acceptable or poor (unsatisfied patients).

**Results**

Each group showed improvement at the 3-month follow-up (Table 1). The global score was significantly higher for the oblique plication group (4.21 versus 3.81), as were the scores for anterior abdominal contour (4.33 versus 3.66) and definition of the linea alba (4.4 versus 3.6). No significant difference was seen in hip–waist transition (4.00 versus 4.13) or waistline contour (4.06 versus 3.93).

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Oblique plication</th>
<th>Vertical plication</th>
<th>( p )</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior abdominal contour</td>
<td>4.33 (± 0.72)</td>
<td>3.66 (± 0.81)</td>
<td>0.0386</td>
<td></td>
</tr>
<tr>
<td>Definition of the linea alba</td>
<td>4.40 (± 0.63)</td>
<td>3.60 (± 0.15)</td>
<td>0.0099</td>
<td></td>
</tr>
<tr>
<td>Hip–waist transition</td>
<td>4.00 (± 0.65)</td>
<td>4.13 (± 0.19)</td>
<td>0.6288</td>
<td></td>
</tr>
<tr>
<td>Waistline contour</td>
<td>4.06 (± 0.7)</td>
<td>3.93 (± 0.7)</td>
<td>0.6511</td>
<td></td>
</tr>
<tr>
<td>Mean global score</td>
<td>4.21 (± 0.35)</td>
<td>3.81 (± 0.35)</td>
<td>0.0046</td>
<td>−0.6660 to 0.1340</td>
</tr>
</tbody>
</table>

**Figure 1**: Oblique plication in crossed fashion (left) and minimal vertical plication plus oblique plication (right).

**Figure 2**: Before (left) and after (right) oblique plication, showing improvements in vertical and transverse laxity.

Table 1: Mean scores for outcomes of plication of the anterior abdominal wall musculature and the anterior rectus sheath by oblique and vertical techniques (mean ± standard deviation).
There was no significant difference in the numbers of satisfied and unsatisfied patients in either group ($p = 0.6513$; relative risk $= 1.812$; 95% confidence interval $= 0.821–1.701$). Nevertheless, there were more satisfied patients in the group that underwent oblique plication (13 versus 11).

**Discussion**

This series therefore shows that oblique plication gives a superior overall result, anterior abdominal contour and definition of the linea alba. Transition from the hips to the waistline and waistline contour was better than with vertical plication but not significantly so.

Askar$^8$ dissected the anterior abdominal wall of 40 fresh cadavers and confirmed his anatomical findings in 25 patients during operations. He was able to trace the patterns of distribution of the aponeurotic expansions and determined the relation of structure to function. He pointed out that the linea alba should no longer be regarded as the line of insertion of the abdominal muscles but as the area of decussation of the tendinous aponeurotic fibres of the muscular strata passing from one side to the other, for which he proposed the name ‘midline aponeurotic area’. He described triple patterns of decussation in the midline aponeurotic area (linea alba) and two separate functional areas of the abdominal wall with different mechanisms, a ‘parachute respiratory mechanism’ in the upper abdomen and ‘belly support’ in the lower abdomen. The formation of the anterior abdominal wall aponeuroses from fine tendons invested in the loose areolar tissue gives them free mobility over each other, allowing appreciable mobility in the resultant fabric, the aponeuroses. The oblique direction in which the aponeurotic fibres are placed in this fabric offers freedom for changes in both the longitudinal and transverse diameters. This allows for changes in the shape of the aponeurosis in adaptation to movements of the trunk.

Abdominal contour is a product of the underlying muscles. A youthful abdominal contour is the main goal of abdominoplasty, keeping in mind the functional anatomy of the musculo-aponeurotic layer of the anterior wall. Multiple techniques have been described for musculo-facial plication during abdominoplasty Figures 3 and 4. Abramo et al.$^9$ described an H-shaped plication with subcostal and suprapubic transverse fascial plication in addition to midline plication. Marques et al.$^{10}$ reported a T-shaped plication with subcostal transverse limb in addition to vertical plication; however, the transverse element of any plication is liable to relaxation as it is in the line of trunk extension.

Our technique of oblique plication appears to be more functional and anatomical than vertical plication, with little alteration of abdominal wall function, as the plication is fashioned in lines parallel to the natural anatomical direction of the aponeurotic fibres. Oblique plication spares the parachuting action of the upper abdomen (respiratory zone), which is greatly altered by vertical plication. Oblique plication spares and in fact augments the lower abdominal wall, aiding and increasing the intra-abdominal pressure during straining, while transverse plication makes it liable to over-distension.

Minimal vertical plication corrects rectus diastasis, and oblique plication corrects musculoaponeurotic laxity. The result is a native position of both recti and a normal proportion of recti to anterior abdominal wall, which is 50%. Again, relaxation of plication is minimal, as it is not in the line of trunk extension as in transverse plication. The fascial plication de-

![Figure 3: Before (left) and 1 month after (right) abdominoplasty with the oblique plication method.](image-url)
scribed gives a youthful appearance to the abdomen and is both functionally and anatomically a simple way of correcting redundancy.

References


*Figure 4:* Before (left) and 3 months after (right) abdominoplasty with the oblique plication method.