Repair of Large Abdominal Wall Defects Using Total Anterior Aponeurotic Flap: Anatomical Feasibility Study and Comparison with Ramirez’s Technique

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OBJECTIVES

Various techniques have been proposed for giant complex hernia repair. Separation of the musculoaponeurotic components by fasciotomy of the external oblique muscle aponeurosis (EOA), developed by Ramirez et al in the 1990s, has proven its value in the reconstruction of midline abdominal wall defects. Several modifications for component separation (CS) and some original techniques of aponeurotic plasty have been described since. The current standard of mesh reinforcement improves the outcome of CS in terms of recurrence rates. Despite ensuring an important lateral width gain for midline defect closure, CS may provide an insufficient coverage in giant hernias or asymmetrical defects with unilateral destruction of abdominal wall anatomy. In this study, we explored the feasibility of an extremely large mobilization of the abdominal wall components to obtain maximal and tension-free covering of giant hernias. For this purpose, we detached a total anterior aponeurotic flap (TAAF) in a continuous layer to cover the midline defect (Fig. 1).

METHODS AND SURGICAL TECHNIQUE

Four fresh frozen cadavers without previous abdominal surgery or hernia history were chosen for the dissection study. Xyphopubic midline skin incision was extended laterally along the costal arches and the inguinal ligaments up to the anterior axillary line to lift the skin flap on each side. In 2 of 4 lifted skin flaps, the perforator vessels were preserved to test how far the skin can be detached laterally, keeping those vessels intact. The aponeurotic midline was opened along its entire length, taking care not to open the rectus muscle sheath. EOA was incised from the border of costal arch to the anterior iliac spine along the anterior axillary line. Incision was continued cranially through the anterior rectus sheath (ARS) along the border of costal arch and caudally at the level of arcuate line up to the midline. Separation of EOA from the muscle was initiated laterally and carried out up to the ARS, which was opened longitudinally between the external and internal oblique aponeuroses while keeping the continuity of ARS with the EOA to be able to lift an uninterrupted total anterior aponeurotic flap.

Summary: In this cadaveric study, we explored the feasibility of a maximal mobilization of the superficial abdominal fascia, in a continuous flap, to achieve a tension-free covering of midline defects. The aponeurosis of the external oblique muscle was incised along the anterior axillary line and then detached up to the anterior rectus sheath. The latter was opened between the external and the internal oblique aponeurosis while keeping the continuity with the external oblique fascia. The obtained flap was solid and uninterrupted. The width gain reached 15 ± 3 cm on each sides, providing tissue advancement 60% longer than Ramirez’s technique (n = 8). The described technique allows large covering with respect to the anatomical planes. Further clinical tests should evaluate the validity of such concept in the repair of giant and asymmetrical hernias. (Plast Reconstr Surg Glob Open 2016;4:e1153; doi: 10.1097/GOX.0000000000001153; Published online 20 December 2016.)

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A total of 7 TAAFs were prepared in the 4 cadavers. The measures of lateral and total width gain were taken by means of a regular millimeter ruler. On the 3 cadavers with bilateral dissection, the 2 TAAFs were folded down and closed with running suture in the midline. Abdominal wall circumference gain was subsequently measured, and intraabdominal volume increase was assessed. On the remaining half musculoaponeurotic wall of the cadaver with unilateral TAAF, two 1-cm-thick cross-sectional slices were taken at the umbilical level. Each of these was subsequently prepared according to the classical Ramirez’s and our new techniques, respectively. The obtained length gain was measured and compared.

**RESULTS**

TAAF mobilization was successfully carried out in all the 7 attempts. The junction between EOA and the rectus sheath was correctly identified and anatomically separated from the internal oblique aponeurosis. The lateral detachment of the EOA and the identification of the transition zone between the EOA and the ARS seemed to be easier when the dissection was started from the costal arch, continuing downward. The obtained aponeurotic layer was solid and uninterrupted and could be easily folded out to the opposite side of the abdomen and sutured together in the midline. Although being technically challenging, the preservation of the perforator vessels was possible during either the skin reflection or TAAF preparation. A lateral width gain of 15 ± 3 cm was obtained on each side at the umbilical level, reaching a total abdominal circumference increase of up to 30 ± 4 cm. Intraabdominal volume appeared to double on visual assessment after closing the 2 TAAF on the midline (Fig. 3) although no precise calculation was made. The unilateral TAAF could be easily folded out to the opposite side of the abdomen for the covering of a lateral defect, that is, after ostomies (Fig. 3). The cross-sectional slices of TAAF were longer by 60% than the slices dissected by classical Ramirez’s technique (Fig. 4).

**DISCUSSION**

Ramirez’s procedure, being based on the comprehensive study of anatomy and function of abdominal wall, remains so far the best way to repair a large midline hernia especially when associated with mesh sublay reinforcement. Either classical CS or further modifications allow an average of 8 cm gain of unilateral width. However, in case of a giant defect, loss of domain or...
when one side abdominal anatomy is broken or useless, additional coverage provided by CS may be insufficient for solid and tension-less repair. Few alternatives are available to deal with these situations. Bridging with prosthetic mesh and musculofascial flaps, procedures are suitable in selected cases of soft-tissue deficiency although with a relatively high complication rate and a poor functional outcome. To overcome these problems, the hypothetical best technique should fulfill 3 conditions: (1) allow larger solid tissue mobilization than current autoplasty techniques, (2) maintain tension within the physiological range, and (3) ensure the separation of the mesh from the skin by fascia closure on the top of prosthesis.

The TAAF technique combines the functional advantages of CS with the largest anatomically respectful aponeurosis mobilization ever proposed. We advocate the use of this technique for giant midline abdominal wall defect, in association with mesh (biological or synthetic) reinforcement in the sublay position, when Ramirez’s technique comes to its limit. The limiting factor of the technique remains the integrity of the musculoaponeurotic layers, which can be destroyed after multiple surgeries or retracted in chronic situations. However, the extreme unilateral mobilization gained with this technique may provide a sufficient coverage of a midline or even contralateral defect. In line with this observation, the technique remains also a reliable technique for the repair of unilateral defect after ostomy or traumatism. The main drawback of our technique is the disparity of aponeurotic surface gain compared with the remaining constant skin surface. It appears that huge volume of viscera could be contained within obtained new aponeurotic sheath but at the expense of skin coverage. To deal with this problem, many solutions can be studied as lateral releasing skin incisions or application of mesh graft on the aponeurotic surface immediately or after negative pressure therapy. Other potential difficulty is the perforator vessel preservation, although the latter seems not mandatory for sufficient blood supply of skin flap. Finally, the TAAF should not be raised below the arcuate line, given the absence of posterior rectus sheath on this zone.

In conclusion, the TAAF mobilization is a feasible and reproducible technique providing extremely large covering of abdominal wall defect using the natural anatomical planes. The TAAF allows larger extension of musculoaponeurotic layer than Ramirez’s technique and may be a valid alternative for repair of giant and asymmetrical hernia. Further clinical tests are necessary to evaluate the practical validity of this concept.

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