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ORIGINAL ARTICLE BODY CONTOURING

Repair of the Severe Muscle Aponeurotic Abdominal Laxity with Alloplastic Mesh in Aesthetic Abdominoplasty

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Abstract

Background Abdominoplasty is the most frequently performed surgical procedure for body contour; in our experience, we have observed some patients with prominent bulging that is difficult to treat and that presents results that are unsatisfactory or have recurrences to conventional treatments. This leads us to carry out an analysis of the elements responsible for the containment and abdominal format. We determined that it may be due to an inability of an important sagging aponeurotic muscle of primary origin to support the abdomen and could be caused by predisposing factors. For these specific cases, we developed a treatment proposing the use of a mesh.

Methods We present these cases over a period of 24 years. Fourteen patients were treated with primary and secondary abdominoplasties. The abdominal wall reinforcement was performed by placing polypropylene mesh at the submuscular plane, fixed with U-stitches on the fascia transversalis, seeking to strengthen the muscle and the fascia transversalis.

Results The results were satisfactory after long-term observation, gaining resolution of the abdominal bulges. Only two complications occurred; the presence of localized chronic pain and the appearance of umbilical fistula.

Discussion We emphasize the importance of avoiding unnecessary interventions in patients with marked bulging, associated with inability of abdominal restraint. We only consider its indications in patients with conventional recurrence treatment, also identifying the predisposing factors, the knowledge of the abdominal anatomy, the muscular dynamics of the abdomen and understanding its indication in these specific cases of difficult treatment.

Level of Evidence IV This journal requires that authors assign a level of evidence to each article. For a full description of these evidence-based medicine ratings, please refer to the Table of Contents or the online Instructions to Authors www.springer.com/00266.

Keywords Lipoabdominoplasty · Abdominoplasty · Abdominal bulging · Alloplastic mesh · Transversalis fascia · Transversalis muscle

Background

Abdominoplasty is one of the most popular surgical procedures performed by plastic surgeons around the world, because the abdominal region is an important functional aesthetic unit that defines the body contour; in our experience, we have observed some patients with prominent bulging, which is difficult to treat, presenting unsatisfactory results or with recurrence after conventional treatments [1].

One of the reasons for this dissatisfaction is the abdominal bulging, which usually occurs in the lower abdomen. Plication of the rectus abdominis in abdominoplasty only improves the area, without being able to completely correct the undesired bulging [1, 2].

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This bulging, which is the main complaint in the majority of patients seeking abdominoplasty, is in most cases due to the diastasis recti and may also be associated with aponeurotic muscle flaccidity or a physiological incompetence that may have predisposing and aggravating factors such as age, multiparity, cesarean, significant weight loss in obese (amount of containment), abdominoplasty postoperative without hernia report. But these present an altered abdominal balance that generates an overall incontinence of the muscles [1], translated as flaccidity of the aponeurotic muscle tissue and also diastasis recti when the distance between these two muscles exceeds 4 cm.

In accordance with the anatomy, the insertion of the external oblique aponeurosis passes through the rectus abdominis muscle and the aponeurosis of the transverse passes behind this muscle. We know that the aponeurosis of the internal oblique is divided into 2 layers, one anterior that merges with the aponeurosis of the external oblique and another posterior that merges with the aponeurosis of the transverse. In the inferior region of the abdomen from the arcuate line, this arrangement is modified so that the aponeurotic tendons pass in front of the rectus abdominis muscle, which is why it is deprived of the posterior layer of the aponeurosis, and rest directly on the transversalis fascia [3] (Fig. 1). that due to its disposition and dynamics, it is the main support of the abdominal contents.

The anterior abdominal wall has a greater or lesser competence, depending on the balance between the intra-abdominal pressure, viscera and diaphragmatic movements, muscular and aponeurotic tensions, which will determine the presence of abdominal bulges [4].

We also know that in the subcutaneous tissue the connective tissue is composed of fat cells that function as fat deposits, energetic sources and body lining, and that in the case of women is thicker in the abdomen, infra-umbilical region, back lumbar and trochanteric regions. Therefore, the skin has different thickness and characteristics, depending on the body area; elasticity and turgidity will depend on genetic, environmental and age factors. Even gradual distension such as pregnancy leads to thinning of the epidermis and atrophy of the elastic fibers of the dermis, with rupture of the layers underlying the epithelial layer with separation of the connective and elastic bundles, determining skin flaccidity and striations that also contribute to abdominal bulging [5]. However, that can be corrected with conventional treatment.

From all of the above, we conclude that the bulges are due to diastasis recti and also the aponeurotic muscle flaccidity of the abdominal wall, starting from the anatomical and dynamic conditions. Thus, considering the fascia transversalis and the transverse muscle as the true and most important contractors of the abdomen, we began our study in 1993 proposing the treatment of these patients through reinforcement of these structures with polypropylene mesh [1, 6] and since then we have been following these patients.

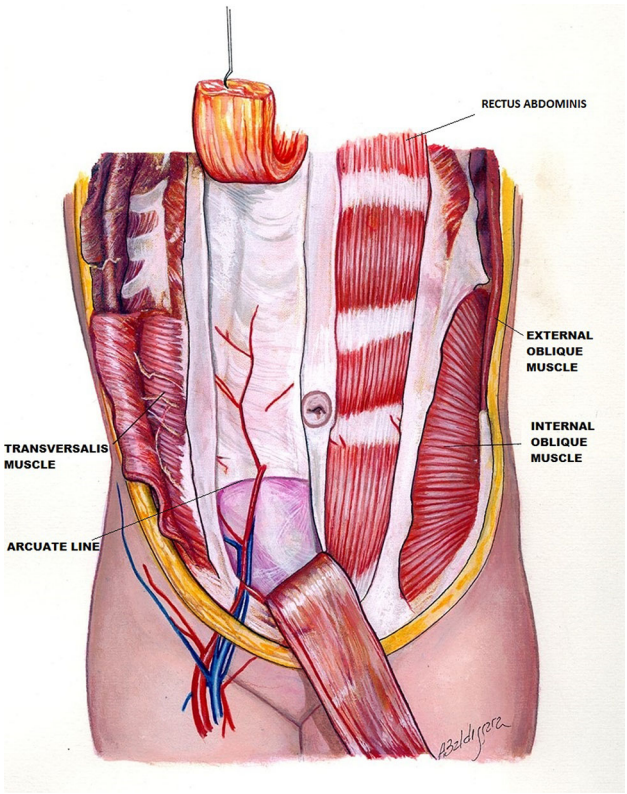

Fig. 1 Front view of muscle distributions and arcuate line; superior to the arcuate line, the internal oblique aponeurosis splits to envelop the rectus abdominis muscle both anteriorly and posteriorly. Inferior to the arcuate line, the internal oblique and transversus abdominis aponeuroses merge and pass superficial to the rectus muscle

Materials and Methods

In 32 years of professional practice, we treated 925 patients who submitted to body contour surgery. In this period, we observed a few patients with prominent abdomen who experienced unsatisfactory results or recurrences. Therefore, we decided to treat these unusual cases and make our observation. To measure the satisfaction of our patients, we use the patient-reported instrument named the Body-Shape-Related Quality of Life (Body-QoL®) [7].

We declare that the principles of the Helsinki declaration were respected in the construction of this study.

Our study is a case series with a 24-year follow-up. During this time, we treated 14 patients (Table 1), 7 of whom underwent primary abdominoplasty and 7 underwent secondary abdominoplasty previously operated on using conventional abdominoplasty with diastasis recti correction by traction and suture of the rectus abdominis.

Table 1 Patients with polypropylene mesh treatment

	Patient	Age	Primary procedure	Secondary procedure	Complications	Results[c]
1	C.S. M. A. T.	52	Abdominoplasty rectus plicature external oblique flap liposuction	After 2 years: abdominoplasty with polypropylene mesh	None	Satisfactory
2	M.E. B. P.[b]	42	Abdominoplasty rectus plicature external oblique flap liposuction	After 14 years: abdominoplasty with polypropylene mesh	None	Satisfactory
3	M.G. E.	41	Midabdominoplasty rectus plicature external oblique flap liposuction	After 6 years: abdominoplasty with polypropylene mesh	None	Satisfactory
4	R.C. M. A.	40	Midabdominoplasty plicature external oblique flap liposuction	After 1 year: abdominoplasty with polypropylene mesh	None	Satisfactory
5	T.M. A. B.	52	Abdominoplasty rectus plicature external oblique flap liposuction	After 15 years: abdominoplasty with polypropylene mesh	Chronic pain	Satisfactory
6	T.J.	70	Abdominoplasty polypropylene mesh liposuction	–	Chronic pain	Satisfactory
7	C.X.[a]	34	Fleur de Lis Abdominoplasty polypropylene mesh rectus plicature liposuction	–	None	Satisfactory
8	A.M. N.	55	Abdominoplasty polypropylene mesh liposuction	–	None	Satisfactory
9	L.E. M. C. B.	51	Abdominoplasty polypropylene mesh rectus plicature liposuction	–	None	Satisfactory
10	A.I.	46	Abdominoplasty polypropylene mesh rectus plicature lipoaspiration	–	None	Satisfactory
11	O.A. P.[a]	40	Anchor-line abdominoplasty polypropylene mesh rectus plicature liposuction	–	None	Satisfactory
12	R.F.S.	31	Abdominoplasty polypropylene mesh rectus plicature external oblique flap liposuction	–	Umbilical fistula	Satisfactory
13	R.S.C.	25	Miniabdominoplasty rectus plicature liposuction	After 3 years: midabdominoplasty polypropylene mesh	None	Satisfactory
14	E.C.G.	30	Vertical abdominoplasty polypropylene mesh liposuction	–	None	Satisfactory

Obs: [a]Post-bariatric patients; [b]previous abdominoplasty performed by other surgeon; [c]obtained by the Body-QoL® [7]

These patients had an important abdominal aponeurotic muscle flaccidity, and even after abdominoplasty still had abdominal bulging and therefore dissatisfaction with the result [1, 6].

All our patients were submitted to abdominoplasty using low incisions with easily disguised scars, concave with a swimsuit design, in the secondary cases respecting the preexisting scars. Our proposal to solve the aponeurotic flaccidity was the reinforcement of the abdominal wall through the polypropylene mesh implantation according to the technique described by Usher and popularized by Rives, in which the use of Marlex mesh was recommended at sub-aponeurotic muscle level for correction of abdominal hernias [8, 9].

We made a supra-pubic cut incision describing a curved line of superior concavity according to the preexisting scar. Afterward, we proceeded to dissect the skin and subcutaneous flap, to the xiphoid process, and we incised the alba line to dissect the rectus abdominis muscle of the posterior aponeurotic layer and the transversalis fascia reaching the external border of the rectus abdominis on both sides (Fig. 2). We applied the polypropylene mesh in direct contact with the deep aponeurotic lamina and the transversalis fascia, fixing it in a cranial direction up to the xiphoid process and caudally in the pubis at the origin of the pyramidal muscle, laterally with the aponeurotic muscle complex of the oblique and transverse muscles [9] (Fig. 3). The alloplastic material was sutured with prolene 0, with U-stitches held distended over the transversalis

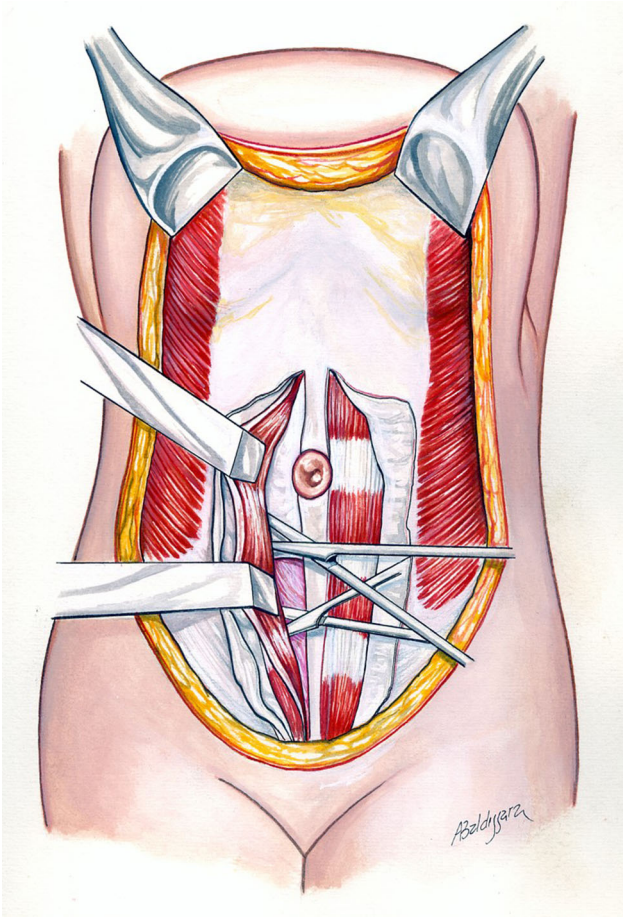

Fig. 2 Image shows the dissection of the rectus abdominis muscles for visualization of the transversalis fascia

fascia and the posterior sheath of the rectus abdominis, resecting its excess. Posteriorly, we continue with the suture of the rectus abdominis muscle in the midline and closure of its sheath with U-stitches (Fig. 4a). Through the placement of the mesh, we reinforce the function and traction of the transversalis fascia along its disposition in the medial direction allowing the replacement of the abdominal contents (Fig. 4b). We believe that the umbilical scar should be fixed to the aponeurosis at a height of 14 cm from the implantation of pubic hair, obtaining the vision of a long and harmonious abdomen. Aesthetically related to the body contour, if the umbilical scar is positioned below this measure, the appearance will be of a short and unaesthetic abdomen [10]. We left suction drainage underneath the dermal fat flap and closed in three planes.

In these procedures, the dissection goes from the xiphoid process to the pubic symphysis and we only resect excess skin to accommodate the flap.

All patients were followed up for the first 5 years postoperatively with annual abdominal wall ultrasound studies.

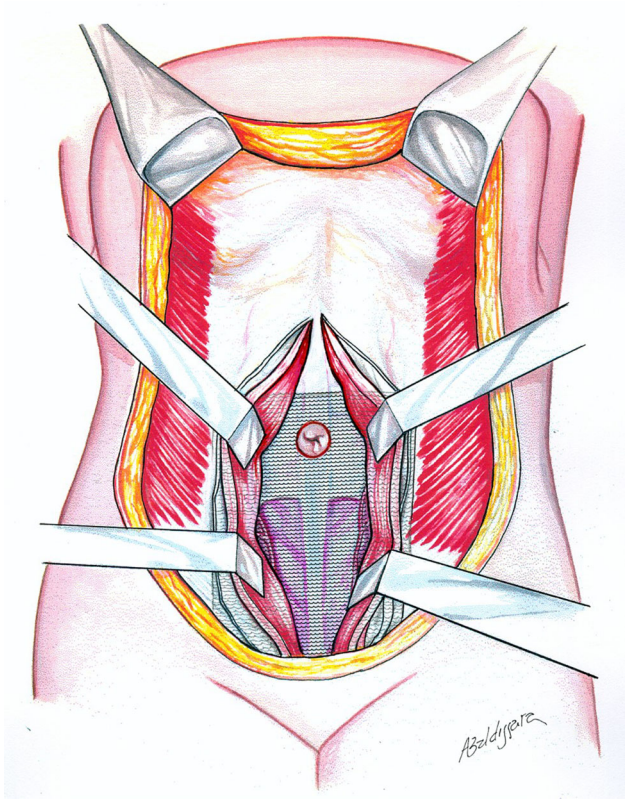

Fig. 3 Image presents positioning of the sub-muscular polypropylene mesh generating greater stability and strengthening of the abdominal wall

Results

After performing the surgery, we obtained aponeurotic muscle traction to the midline after fixating the alloplastic material resulting in a more pronounced reduction of abdominal circumference in the anteroposterior as well as transverse direction.

During the time of observation, the aesthetic results and the integrity of the abdominal wall were maintained without relapse. We followed up with photographs at 15–20 years. Therefore, we chose two representative cases.

The first case was a fifty-two year-old patient, who presented with a large bulge in the lower abdomen (Fig. 5a, b) so she underwent abdominoplasty with plication of the rectus abdominis and external oblique aponeuroses flaps [11] obtaining a slight decrease in the waist and an improvement of the abdominal projection. She returned 2 years later presenting a mild recurrent lower distension (Fig. 6a, b). Due to the recurrence and the observation of an important abdominal flaccidity, a secondary abdominoplasty was performed with reinforcement of the abdominal wall with polypropylene mesh, obtaining a satisfactory result that in the control at 7 years was still maintained (Fig. 7a, b).

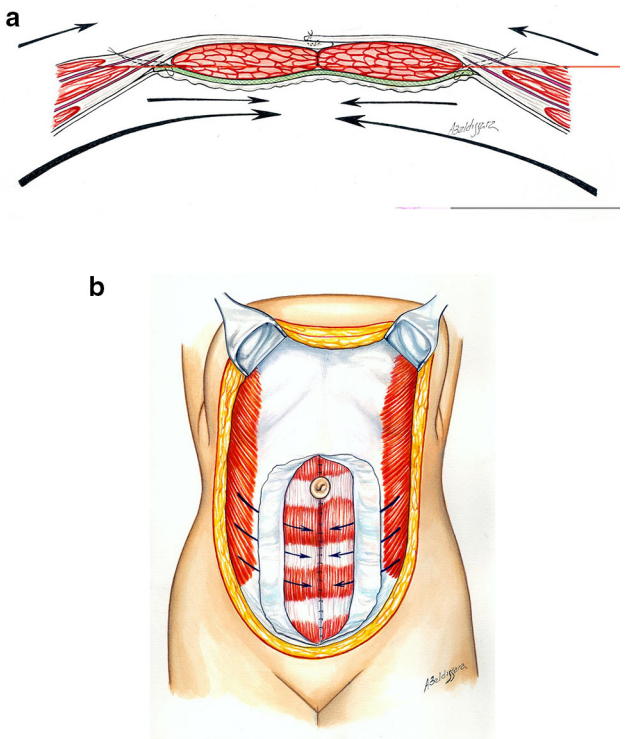

Fig. 4 **a** Image shows the sub-muscular position of the polypropylene mesh fixed anterior to the transversalis fascia with U-stitches and posterior plication of the rectus abdominis. **b** The image represents the approaching and repositioning of the intra-abdominal contents and the traction vectors

The second case was forty-two-year-old patient, previously submitted to abdominoplasty by another surgeon with unsatisfactory results (Fig. 8a, b). After an evaluation, secondary abdominoplasty was performed on her with plication of the rectus abdominis and external oblique aponeuroses flaps [11] to correct the abdominal expansion. Improvement was observed but a slight upper abdominal projection persisted. She returned 14 years later complaining of the increase in upper abdominal projection (Fig. 9a, b), so a magnetic resonance was performed to evaluate the diastasis recti, observing a distance of ± 1 cm (Fig. 10) that does not justify the bulging. We performed abdominoplasty with reinforcement of the abdominal wall with polypropylene mesh, totally correcting the abdominal projection, which is maintained even in the sitting position. (Fig 11a–c).

In all our cases, we had three complications, two patients presented localized, punctate, intermittent, chronic pain in the abdominal region (laparodinias), which began several years after surgery and improved with conventional anti-inflammatories. We resolved to treat them by infiltrations with corticosteroids, obtaining improvement in the second session. Another complication was early umbilical fistula with fast resolution only in one patient.

Discussion

We believe that after 24 years of observation of patients treated with our proposal, we offer a better view of the aspects to be taken into account in patients with prominent bulging when we treat the body contour, compared with other short-term studies.

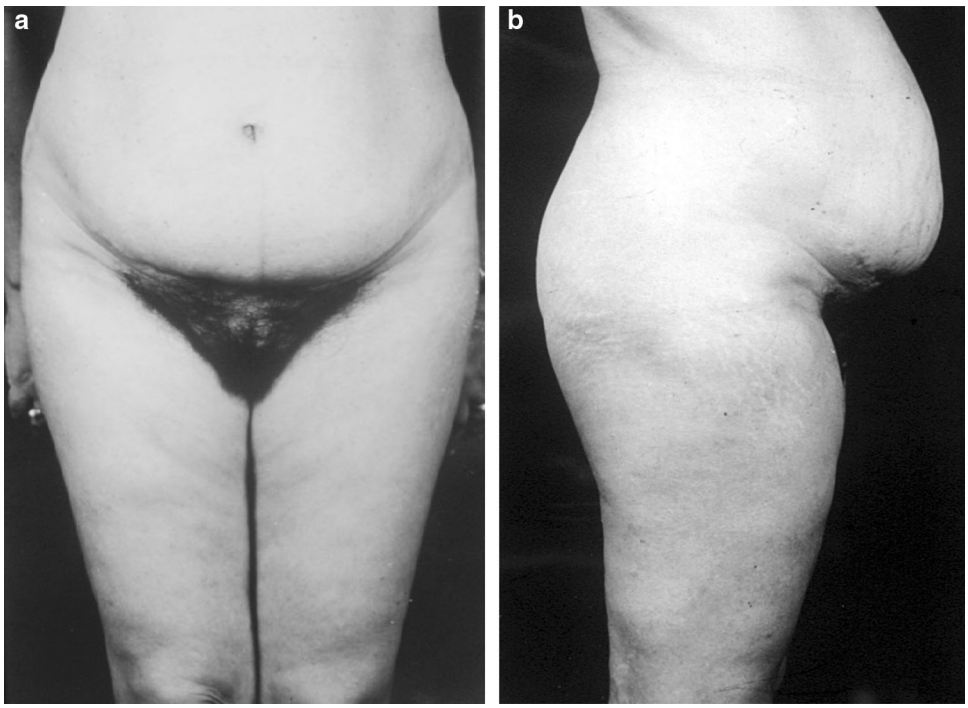

Fig. 5 **a** Front view preoperative. **b** Preoperative view profile left of the first surgical time

Fig. 6 **a** Front view 3 years postoperative from abdominoplasty. **b** Left profile view 3 years postoperative from abdominoplasty first surgical time, where it is possible to observe bulging in the lower abdomen

Fig. 7 **a** Front view 5 years after abdominoplasty 2nd surgical time with polypropylene mesh. **b** Left profile view 5 years after abdominoplasty with polypropylene mesh. We can observe the improvement of infra-umbilical bulging after placement of the mesh

First, it is important to discuss our indications for this treatment. It is not indicated as the first-line treatment because of the body's response to conventional treatment. Many of the patients who presented aponeurotic muscle flaccidity obtained satisfactory results with the conventional abdominoplasty or lipoabdominoplasty, and therefore, the reinforcement with polypropylene mesh was not necessary. On the other hand, in cases of recurrence of the aponeurotic muscle flaccidity and bulging, evidenced as persistence of bulging in the abdominal region even after conventional treatment, it is necessary to evaluate them to determine the etiology of the relapse and to plan a new intervention, secondary abdominoplasty with reinforcement of abdominal wall with alloplastic material. This

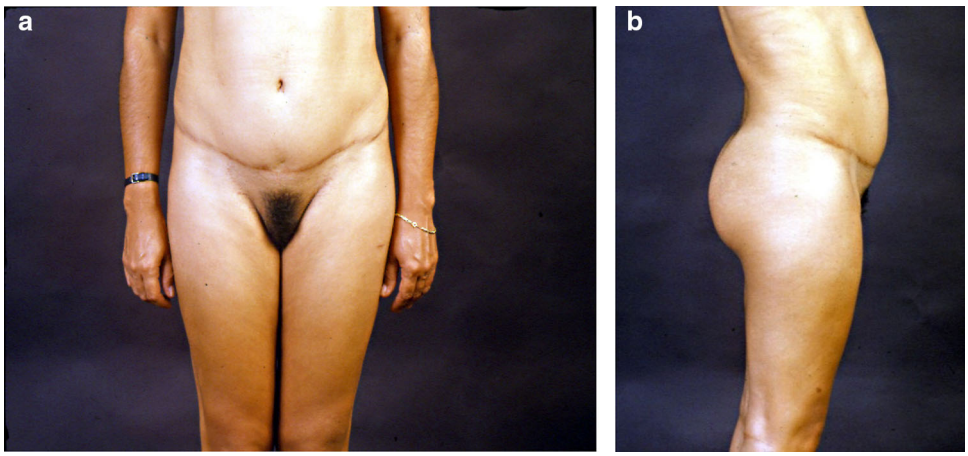

Fig. 8 **a** Front view of previous abdominoplasty, made by another surgeon. **b** Left profile view preoperative with previous abdominoplasty, presenting lower and supra-umbilical bulging

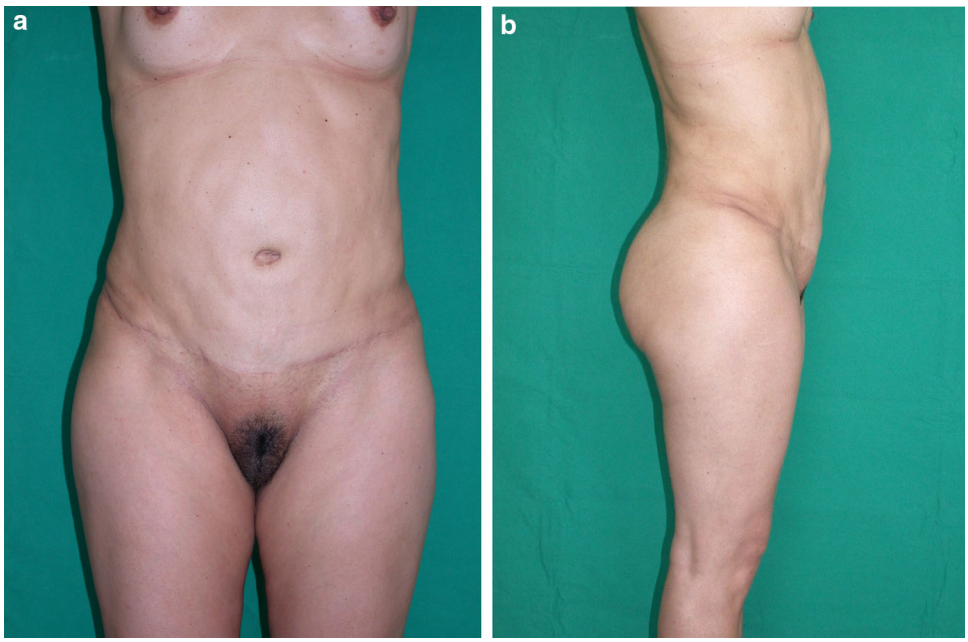

Fig. 9 **a** Front view 14 years after abdominoplasty. **b** Left profile view 14 years after abdominoplasty with plication of the rectus abdominis and external oblique, noting enlargement of the umbilical scar and bulging of the supra-umbilical abdomen

treatment is an aggressive intervention that we only indicate for a few specific cases.

For example, the second patient presented in this article had two abdominoplasties with unsatisfactory results. We observed that in the secondary surgery the correction of the diastasis recti by the plication of the rectus abdominis was made, to verify the effectiveness of the procedure, and a magnetic resonance was performed for evidence that the diastasis recti were resolved. However, this procedure did not improve abdominal bulging. This type of patient is challenging to treat (Fig. 10). Nonetheless, considerable abdominal bulging was present, probably due to other elements associated with abdominal restraint.

Therefore, it is important to perform an adequate post-surgical evaluation to identify the candidates with unsatisfactory results, thus avoiding the unnecessary indication of this approach.

We also have to mention that in many of our patients, plication of the rectus abdominis and external oblique aponeuroses flaps were performed [11] to improve the abdominal contour. After secondary abdominoplasty, we observed persistence of the external oblique aponeuroses flap [11], even after 14 years (Fig. 12). Also, widening of the umbilical scar (Fig. 9a) was observed, probably as a consequence of high tensional force concentrated in the midline. This leads us to reformulate our strategies in search of better results for cases with considerable bulging and difficult treatment, reinforcing the anatomical structures involved in abdominal contention.

We consider that an analysis of anatomical knowledge and the dynamics of the abdominal region are important. We know that the external oblique muscle determines a lateral traction up and the internal oblique downward acting as two equal antagonistic forces, these forces act in a

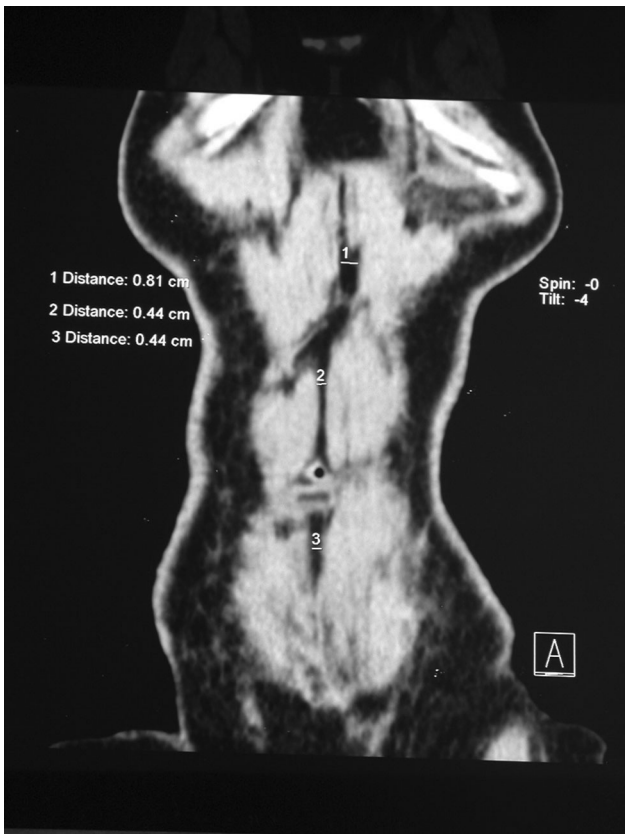

Fig. 10 View of the magnetic resonance of the abdominal wall, coronal cut, the correction of the diastasis is observed

harmonic way (Figs. 1, 13). On the other hand, we know also that the longitudinal position of the rectus abdominis helps to approach the thorax as an antagonist of the spinal muscles [4, 10] (Figs. 1, 14). Likewise, the transverse muscle allows the abdominal wall to contract and to

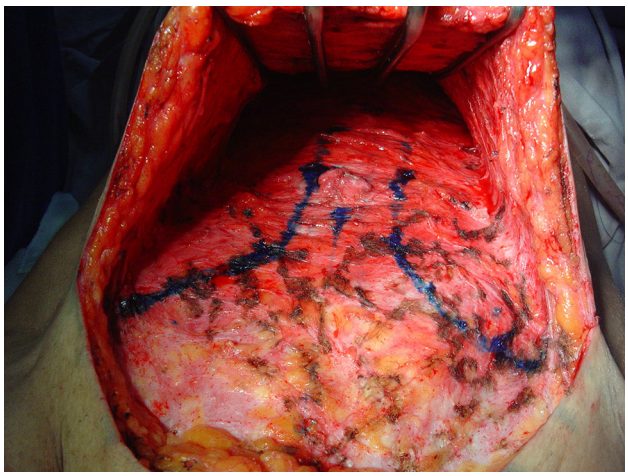

Fig. 12 Front image presents the rectus abdominis plicature and external oblique aponeuroses flaps

expand, keeping the viscera in the correct position, bringing the anterolateral muscles against the powerful spine [3, 4] (Figs. 1, 15).

These tensile forces make the alba line a neutral support point, allowing the intra-abdominal contents to be in perfect balance benefiting a normal function in the upper diaphragm, which facilitates pulmonary ventilation and the dynamics of the mesenteric complex. The rupture of this balance can lead to consequences such as removal of the rectus abdominis muscle, resulting in diastasis recti, a real increase of the abdominal continent, change in the center of gravity, altering the lumbar spine, causing low back pain, diaphragmatic domes falling with decreased pulmonary ventilation and digestive changes due to visceral dislocations [4]. We base our proposal on abdominal dynamics by

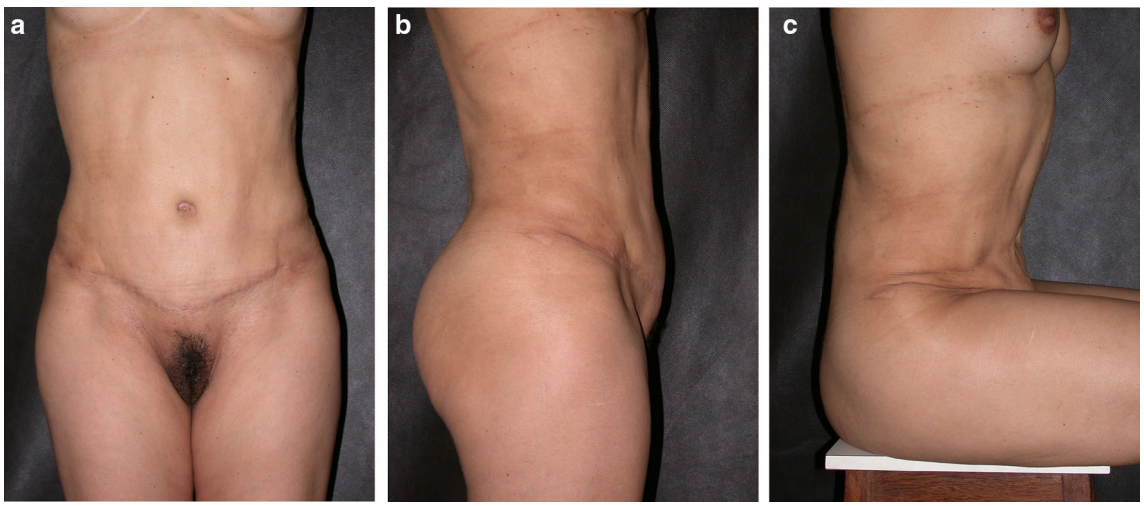

Fig. 11 **a** Front view 1 year postoperative of abdominoplasty with polypropylene mesh. **b** Left profile view 1 year postoperative of abdominoplasty with polypropylene mesh, showing improvement of the umbilical scar, lower and supra-abdominal bulge observed and concavity shape of the abdominal region. **c** View profile sitting left postoperative 1-year after abdominoplasty with polypropylene mesh

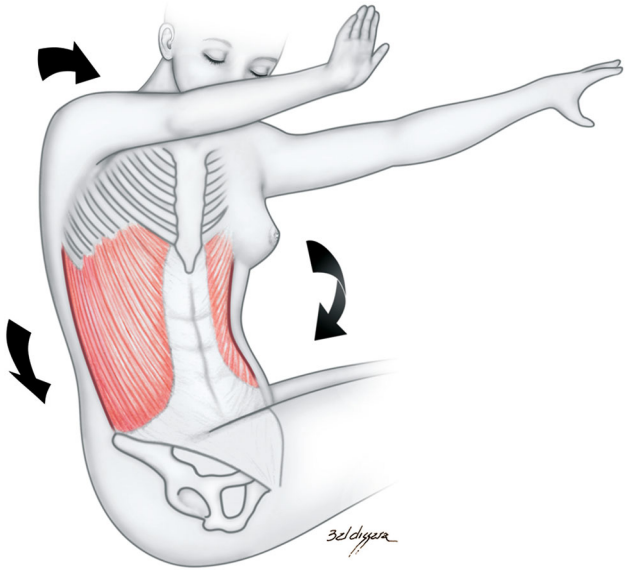

Fig. 13 Image represents the dynamic of the external oblique muscle

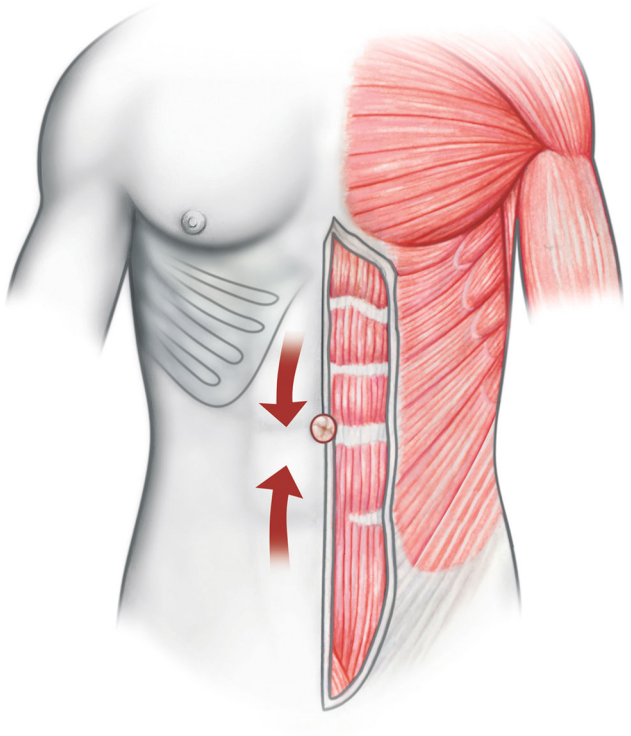

Fig. 14 Image presents the dynamic of the rectus abdominis, approaching the thorax as an antagonist of the spinal muscles

reinforcing the aponeurotic muscular wall and, therefore, restoring abdominal balance.

We also consider of importance the historical evolution regarding the proposals on the use of alloplastic mesh in aesthetic surgeries of the abdominal contour. We know that many surgical procedures have been described in the search for an improved abdominal silhouette, among them

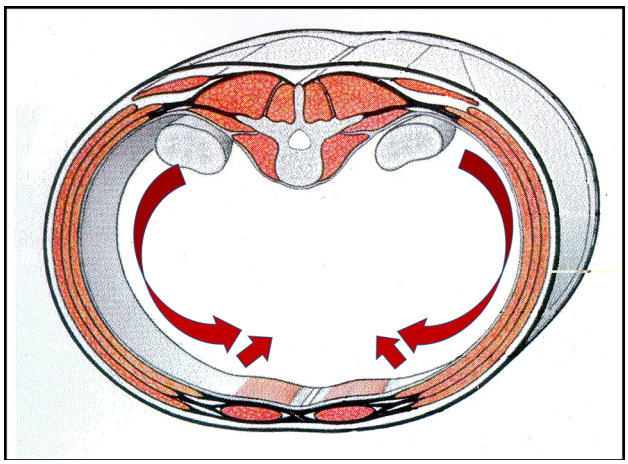

Fig. 15 Profile image represents the dynamics of the transverse muscle movements and importance of its function

Pitanguy [12] who performed plication of the rectus abdominis muscle, and Psillakis [11] who recommends the suture of the external oblique aponeuroses in the midline and resection of the ribs. However, in view of the existence of an important aponeurotic muscle flaccidity, abdominal postoperative bulges have been observed because these muscles do not participate in real abdominal restraint and therefore do not reach the muscles responsible for abdominal balance [4].

We consider that the surgeon must know about the myodynamism and the importance of the muscular layers in the manifestation of these abdominal bulges, being the transverse abdominal muscle the most important element [9, 13] (Fig 13b). Defects at this level may create a predisposition to the appearance of incisional hernias as described by Mac Vay [14], so in this work our proposal is to strengthen the abdominal wall without necessarily having abdominal hernias.

In the past, Marlex mesh began to be used in thorax and abdominal wall repairs with good functional results, Usher being one of the precursors [15, 16]. Therefore, Marlex mesh has a great tensional strength and shows low foreign body type reaction, if compared to other materials such as nylon, orlon and dacron, described by Usher in 1959 [15, 16]. At the beginning, it was noted by Jacob in 1965 that the mesh has physicochemical properties that are tolerable for the human body and is chemically inert [15].

Actually, new materials have appeared such as polypropylene, ADM, and Ultrapro, which have become the arsenal of available reinforcement materials, with minor adverse reactions reported in other surgical procedures. We used polypropylene mesh because it was the most accessible material with good experience.

Usher [8] advocated the use of Marlex mesh at the subaponeurotic muscle level, with few complications reported.

Following this study, the mesh is placed above the transversalis fascia and retro rectus abdominis plane, avoiding the sensation of a foreign body by the patient; the rectus abdominis muscle provides an additional protection and diminishes the possibility of infection.

However, the use of the mesh in abdominal aesthetic corrections was begun in 1981 and 1982 by Carreirão [16, 17], who performed experimental studies on dogs, showing the total integration of the surrounding tissues and a low percentage of rejection with the use of the Marlex mesh. Then he reported the inclusion of Marlex mesh in the repair of abdomens with vertical laparotomy, which presented incisional hernias and used the Marlex mesh to repair the abdominal protection in aesthetic surgeries [18, 19].

Given the above, we conclude that the use of materials such as Marlex and new meshes can offer a benefit in aesthetic surgeries of the abdomen [20].

Therefore, in 1993 we proposed the use of polypropylene mesh at the sub-muscular level to strengthen the muscular wall, already in aesthetic surgeries.

We have had satisfactory results maintained over time. This was achieved because the main abdominal support, like the transverse muscle and transversalis fascia, was properly treated and thus restoring the balance of the abdomen.

It is important to define the appropriate diagnosis to perform the appropriate treatment of abdominal wall flaccidity, which is usually observed in the postoperative period of abdominoplasty. We must have in mind that currently the associations of surgical techniques for the correction of functional and aesthetic abnormalities are more often recommended, as in unusual cases presented. Thus, to obtain the body contour desired by patients whose aesthetic surgery was not satisfactory due to aponeurotic muscle flaccidity, abdominoplasty with abdominal wall reinforcement was performed as a second line treatment.

One of the disadvantages that we found throughout our experience was the episodes of localized, intermittent, chronic pain (laparodinias), which are difficult to treat. Because the mesh is reabsorbed by the body, generating a fibrotic process, this fibrosis probably holds some neuromuscular bundles. We must understand that chronic pain is a very important complication; even being subjective, it has to be taken into account, and we must reflect if it is correct to make use of the polypropylene mesh for correction of muscle aponeurotic flaccidity in patients without abdominal hernias. We treated the episodes with infiltrations of corticosteroids, presenting a good response after these treatments.

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Compliance with Ethical Standards

Conflict of interest The authors declare that they have no conflicts of interest to disclose.

Ethical Approval All procedures performed during this study involving human participants were in accordance with the ethical standards of the institutional and national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

References

1. Caldeira AML, Lucas A (1998) Flaccidez musculo-aponeurótica abdominal intensa y su tratamiento. Rev Cir Plast Iberolatinoamericana 24(1):9–15
2. Caldeira AML (2016) Capitulo 30: challenges in abdominoplasty. In: Avelar J (ed) New concepts on abdominoplasty and further applications, vol 30 No. 1. Springer, Berlin, pp 481–495. https://doi.org/10.1007/978-3-319-27851-3_30
3. Testut L, Jacob O (1909) Paroi abdominale. In: Testut, L, Traite d´Anatomie Topographique. Doin, Paris, vol 1, No. 2, pp 1–72
4. Alcino LS, Luiz GP (2004) Hernia Incisional; Técnica da Transposição Peritoneoaponeurotica Longitudinal Bilateral. Editorial MEDSI 1(1):93–103
5. Caldeira AML, Nieves PA, Oliveira AL (1990) Cirurgia do Contorno Corporal – Reflexões sobre um novo enfoque da cirurgia plástica do abdome classificações das deformidades abdominais e suas correlações cirúrgicas. Rev Bra Cir 80(2):95–104
6. Zantut PC, Caldeira AML, Tournieux TT, Longo FH (2006) Torsoplastia. Atualização em Cirurgia Plástica Estética e Reconstrutiva - S. B. C. P. 1ed.São Paulo: Robe Editorial/Santa Isabel Livraria e Editora, 1(1):666–679
7. Danilla S, Dominguez C, Cuevas P et al (2014) The Body-QoL_: measuring patient reported outcomes in body contouring surgery patients. Aesth Plast Surg 38:575. https://doi.org/10.1007/s00266-014-0302-x
8. Usher FC, Ochsne J, Tuttle LL (1958) Use of Marlex mesh in the repair of incisional hernias. Am J Surg 24:969–974
9. Rives J, Lardennois B, Pire JC, Hibon J (1973) Les grands eventration. Mem Acad Chir 99:547–552
10. Caldeira AML, Nieves PA, Oliveira AL (1990) Cirurgia do Contorno Corporal –2 parte Reflexões sobre um novo enfoque da cirurgia plástica do abdome. Rev Brasileira de Cirurgia 80 (3):169–186
11. Pitanguy I (1967) Abdominoplastias. O Hospital 71(6):35–49
12. Psillakis JM (1978) Abdominoplasty: Some ideas to improve results. Aesth Plast Surg 2(1):205–210. https://doi.org/10.1007/bjs.1800590134
13. Anson BJ (1985) Chapter 14: abdominal wall. In: Mc Vay (ed) vol 1, No. 6, pp 484–584. Surgical Anatomy Editorial Saunders Co., Philadelphia
14. Anson BJ, Mc Vay CB (1964). Surgical Anatomy In: Davis-Christopher (ed) Textbook of Surgery Hernia. vol. 1 No. 5, p 537. W.B. Saunders Co, Philadelphia
15. Jacobs E, Blaisdell WF, Hall AD (1965) Use of knitted marlex mesh in the repair of ventral hernias. Am J Surg 110(6):897–899

16. Usher FC (1959) A new plastic prosthesis for repairing tissue defects of the chest and abdominal wall. Am J Surg 97(5):629–634
17. Carreirão S, Lessa S, Correa WE, Hercules HC (1981) Reconstrução da parede abdominal com tela de Marlex. Estudo experimental. Rev Bras Cir 71(2):125–136
18. Carreirão S, Lessa S, Correa WE, Carvalho L, Pitanguy I (1984) Treatment of abdominal eventrations associated with abdominoplasty techniques. Aesth Plast Surg 8(3):173–179
19. Carreirão S, Pitanguy I, Correa WE, Caldeira AML (1983) Abdominoplastia vertical. Uma técnica a ser relembrada. Rev Bras Cir 73(3):184–188
20. Caldeira AML (2002) Flacidez Músculo-Aponeurótica Abdominal de Grande Porte e seu Tratamento. Rev Brasileira de Cirurgia 92(1):16–20