



Breast reconstruction with TRAM: abdominal tomographic evaluation

Reconstrução mamária com TRAM: avaliação tomográfica abdominal

IGOR MOURA SOARES^{1*}

ARMANDO DOS

SANTOS CUNHA¹

SAULO FRANCISCO DE ASSIS

GOMES¹

VÍRGÍNIA GUTMACHER

GALVÃO BUENO WADHY

REBEHY¹

MARCELA SANTOS VILELA¹

EDUARDO NATAL BATISTA¹

■ ABSTRACT

Introduction: The transverse rectus abdominis muscle flap (TRAM) is a method of breast reconstruction with good aesthetic results and does not require the use of silicone implants for better body contouring. It was originally described by Holmstrom in 1979 as an ellipse of skin and fat based on an isolated muscle on its vascular pedicle. The systematic reconstruction of the wall defect installed after flap transposition using polypropylene mesh was described in a previous study by Cunha. The article aims to evaluate changes in the abdominal wall, after the systematization of polypropylene mesh placement during TRAM reconstruction surgery. **Method:** This is a retrospective cohort study that evaluates possible changes in the abdominal wall of patients undergoing the TRAM flap with pre- and postoperative abdominal computed tomography. **Results:** A reduction in the size of the abdominal cavity of, on average, 14.5% and 14.2% in the thickness of the abdominal wall subjected to TRAM was evidenced. The greatest reduction in abdominal wall thickness was in a patient who underwent a bipediced flap, with 50.7%. The complications presented were umbilical hernia, late seroma, perithellal fibrosis, and thread granuloma. **Conclusion:** In this study, tomography after surgery demonstrated a reduction in the volume of the abdominal cavity and thickness of the abdominal wall, which did not statistically influence the appearance of abdominal hernia, bulging, mesh extrusion, or other deformities. **Keywords:** Mammoplasty; Abdominal wall; Abdominal cavity. Myocutaneous flap. Abdominal muscles.

■ RESUMO

Introdução: O retalho transverso do músculo reto abdominal (TRAM) é um método de reconstrução mamária com bons resultados estéticos e dispensa o uso de próteses de silicone para melhor contorno corporal. Foi originalmente descrito por Holmstrom em 1979, como uma elipse de pele e gordura com base em um músculo isolado no seu pedículo vascular. A reconstrução sistematizada do defeito da parede instalado após a transposição do retalho com o uso de tela de polipropileno foi descrita em estudo prévio por Cunha. O artigo tem como objetivo avaliar as alterações na parede abdominal, após a sistematização da colocação da tela de polipropileno durante a cirurgia de reconstrução com TRAM. **Método:** É um trabalho de coorte retrospectivo que avalia as possíveis alterações da parede abdominal de pacientes submetidos ao retalho TRAM com tomografia computadorizada de abdome pré e pós-operatórias. **Resultados:** Foi evidenciada uma redução do tamanho da cavidade abdominal de, em média, 14,5% e 14,2% na espessura da parede abdominal submetidas ao TRAM. A maior redução da espessura da parede abdominal foi de um paciente submetido ao retalho bipediculado, com 50,7%. As complicações apresentadas foram hérnia umbilical, seroma tardio,

Institution: Hospital Daher Lago
Sul, Brasília, DF, Brazil.

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¹ Hospital Daher Lago Sul, Brasília, DF, Brazil.

fibrose peritela e granuloma de fio. **Conclusão:** Nesse estudo, a tomografia após a cirurgia demonstrou a redução no volume da cavidade abdominal e espessura da parede abdominal, o que não influenciou estatisticamente no aparecimento de hérnia abdominal, abaulamentos, extrusão da malha ou outras deformidades.

Descritores: Mamoplastia; Parede abdominal; Cavidade abdominal; Retalho miocutâneo. Músculos abdominais.

INTRODUCTION

The transverse rectus abdominis muscle flap (TRAM), described by Holmstrom in 1979¹, is a breast reconstruction method composed of an ellipse of skin and fat based on an isolated muscle in its vascular pedicle¹.

The use of autologous tissue allows breast reconstruction with good aesthetic results and eliminates the need for silicone implants for better body contouring². It is known that bulges and hernias arise mainly in the lower abdomen due to the absence of posterior aponeurosis of the rectus abdominis muscle inferior to the arcuate line of Douglas, making this region with high rates of complications³. TRAM is beneficial for the patient when it can ensure a strong abdominal wall that allows the resumption of work activities⁴. Given several established techniques, Cunha et al., in 2021⁵, described the technique for systematizing the reconstruction of the abdominal wall with polypropylene mesh, due to its easy reproduction and applicability⁶, and can be effective in preventing the occurrence of high rates of abdominal hernias and bulges in the postoperative period described in the literature.

Due to different techniques, studies indicate difficulties in comparing hernia and abdominal bulging. For Mizgala et al.⁶, among 150 patients, none had a hernia, but 3 unipedicled and 8 bipediculated patients had a visible protuberance. Kroll & Marchi⁷ reported a bulge or hernia in 21% of cases and a reduction to 5% when fascial closure in two layers of the anterior rectus sheath was performed.

Some authors understand that mesh is necessary when primary synthesis is not possible, due to the risk of infection and extrusion⁸. A suitable synthetic mesh must have the following characteristics: not produce foreign bodies, not be carcinogenic or allergenic, and be able to resist mechanical stress. Furthermore, the thread must be inert, non-absorbable, and monofilament⁷.

OBJECTIVE

To evaluate tomographically the behavior of the abdominal structure and the incidence of complications

in the abdominal wall in patients undergoing the same type of post-TRAM abdominal reconstruction.

METHOD

The cohort and prospective study are based on the selection of patients who underwent TRAM in the plastic surgery service of the *Hospital Regional de Sobradinho*, DF, from January 2019 to December 2020 and who had preoperative abdominal tomography scans performed 1 year after postoperative. There were 14 patients operated on during this period, but only eight participants met the inclusion factors. The patients underwent a monopedicled or bipedicled TRAM flap, and the donor area was repaired using the technique described and standardized in the previous work by Cunha et al.⁵.

Among the 14 patients operated on during the period by the same plastic surgery team at the *Hospital Regional de Sobradinho*, two were excluded due to changes in pre-operative tomography scans; two did not undergo postoperative CT scans, one did not sign the Consent Form and one was lost to follow-up. After the exclusion factors, eight patients remained for the research.

The evaluation of pre- and postoperative tomography scans was performed by the same radiologist and reviewed by another assistant radiologist. In addition, all patient demographic data were evaluated based on a review of medical records by the responsible researcher, and authorization for research was approved by all patients, through the Informed Consent Form.

The patients underwent the procedure and a minimum follow-up of 12 months with the same surgical team. All of them had computed tomography scans of the abdomen without contrast in the preoperative evaluation, and outpatient follow-up was done 15 days, 1 month, 3 months, 6 months, and 1 year after surgery, and after 12 months new tomographic images were requested.

Assessments of abdominal hernia, bulging, or other deformities in the abdominal wall were analyzed using computed tomography. The parameters evaluated in comparative tomography scans before and after surgery were the presence of hernia, abdominal

cavity volume, abdominal wall thickness, bulging, mesh extrusion, and the presence of granuloma.

The reference points used to measure the volume of the abdominal cavity in the CT scans were the following: longitudinal diameter in the midline of the upper limit of the pubic symphysis and units of measurement in centimeters, transverse, and anteroposterior (AP) at the height of L3 (vertebral column) and measurement unit in cm; the final volume in cubic centimeters from the formula:

Longitudinal x transverse x AP x 0.56.

The reference point used to evaluate wall thickness was the paramedian to the right at the height of the navel and measurement unit in millimeters.

The study inclusion factors were patients undergoing polypropylene mesh placement in unilateral or bilateral breast reconstruction with a monopedicled or bipedicled TRAM flap, patients with preoperative tomography, and 12 months after surgery.

RESULTS

During the preoperative consultation, the demographic profile of the patients undergoing surgery was assessed: two patients were hypertensive, and none were diabetic or smokers (Table 1). The average age of the eight patients was 42 years (Table 1).

Of the eight patients, seven (87.5%) received bipedicled flaps and one (12.5%) received monopedicled flaps (Table 1). The left breast was operated on in four patients (50%), the right breast in three patients (37.5%), and one patient (12.5%) underwent bilateral surgery (Table 1). Furthermore, four patients underwent immediate reconstruction (50%), three patients underwent delayed reconstruction (37.5%) and one patient (12.5%) underwent immediate reconstruction on the left side and delayed reconstruction on the right side (Table 1). When asked about the degree of satisfaction with the aesthetic appearance of the breasts, seven patients responded that they were satisfied and one was dissatisfied.

Patients who underwent delayed reconstruction had a waiting time between mastectomy and breast reconstruction of approximately 18 months. All patients were diagnosed with invasive ductal carcinoma (IDC) on pathological examination and only one patient presented metastasis to the axillary lymph node (Table 2). Furthermore, two patients underwent only adjuvant radiotherapy (25%), one patient (12.5%) underwent adjuvant radiotherapy and neoadjuvant chemotherapy, three patients (37.5%) underwent

Table 1. Demographic data.

Number of patients	8 (100%)
Age range	32 - 54
Average Age	42
Smoking	0 (0%)
Hypertension	2 (25%)
Diabetes	0 (0%)
Monopedicled TRAM	1 (12.5%)
Bipedicled TRAM	7 (87.5%)
Immediate reconstruction	4 (50%)
Late reconstruction	3 (37.5%)
Mixed reconstruction	1 (12.5%)
Right breast	3 (37.5%)
Left breast	4 (50%)
Right and left breast	1 (12.5%)
Degree of satisfaction	7 (87.5%)

TRAM: transverse rectus abdominis muscle flap

Table 2. Oncological treatments and anatomopathological results.

Oncological profile	Patients
Adjuvant RT	2
Adjuvant RT + neoadjuvant CT	1
Adjuvant QT + adjuvant RT	3
Anatomopathological (IDC)	8

IDC: invasive ductal carcinoma; QT: chemotherapy; RT: radiotherapy

adjuvant chemotherapy and radiotherapy (Table 2), and two patients did not undergo additional treatments.

Furthermore, one patient (12.5%) presented pulmonary thromboembolism (PTE) after the first day of surgery, which was evidenced by chest CT angiography, and was therefore hospitalized for 3 days. Only two patients (25%) required a new operation, and the patient who presented PTE also developed an infection of the flap on the right, requiring successive debridement. The other patient required hematoma drainage.

In general, a reduction in the size of the average abdominal cavity of 14.5% was evidenced in patients undergoing TRAM and 17.9% in patients undergoing monopedicled TRAM (Table 3). Furthermore, an average reduction of 14.2% in the thickness of the abdominal wall overall was demonstrated, and the greatest reduction was in a patient with late bilateral

breast reconstruction, using a bipedicled flap, with 50.7% (Table 3). No patient presented bulging.

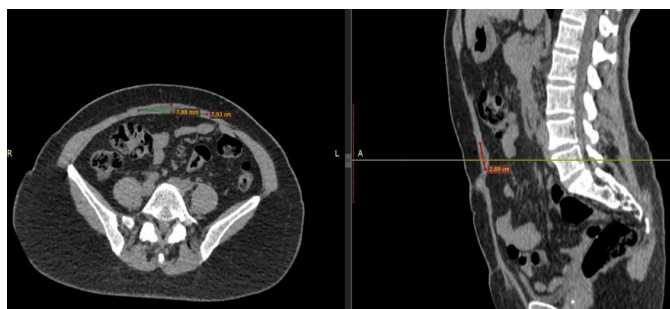
Only one patient had an umbilical hernia measuring 2.04 cm on postoperative tomography (Figure 3). Another patient presented with a seroma 11 months after surgery in the supraumbilical region between the aponeurosis and the mesh, measuring 9.55ml (Figures 1 and 2). Another patient presented

Table 3. Comparison of pre- and postoperative abdominal computed tomography scans with their respective total variations (TV); total average reduction (TAR); patient with greater variation (GV), and patient with lower variation (LV).

	Variation	Reduction Average
Volume of the abdominal cavity (VAC)	23.8% - 8.9% (TV) 1165cm ³ - 476cm ³	14.5% (TAR)
Thickness of the abdominal wall (TAW)	50.7% - 5.6% (TV) 7.1mm - 0.4mm	14.2% (TAR)
Monopedicled (VAC)	6249cm ³ - 5125cm ³	17.9%
Monopedicled (TAW)	7mm - 6.5mm	7.1%
Bipedicled (VAC), (GV)	4880cm ³ - 3715cm ³	23.8%
Bipedicled (TAW), (GV)	14mm - 6.9mm	50.7%
Bipedicled (VAC), (LV)	5331cm ³ - 4855cm ³	8.9%
Bipedicled (TAW), (LV)	7.1mm - 6.7mm	5.6%

Table 4. Comparison of the type of pedicle with the parameters evaluated in tomography.

	Patients	Hernias	Bulging	Extrusion of the mesh	Granuloma wire	Complications
Bipedicled	7	12.5%	0%	0%	12.5%	0%
Monopedicled	1	0%	0%	0%	0%	12.5% - Late seroma
Total	8	12.5%	0%	0%	12.5%	12.5%



Figures 1 and 2. Computed tomography without contrast: Late seroma.

fibrosis around the mesh (Figures 5 and 6). Thread granuloma was revealed in one patient (12.5%) by tomography at 6 months, without clinical repercussions (Figure 4).



Figure 3. Computed tomography showing umbilical hernia.

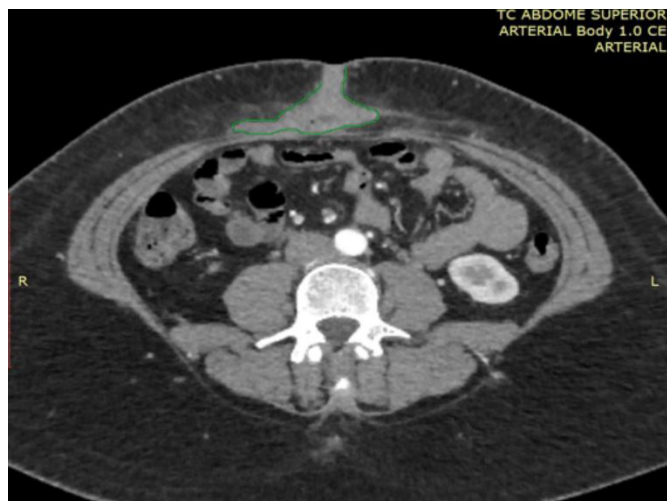
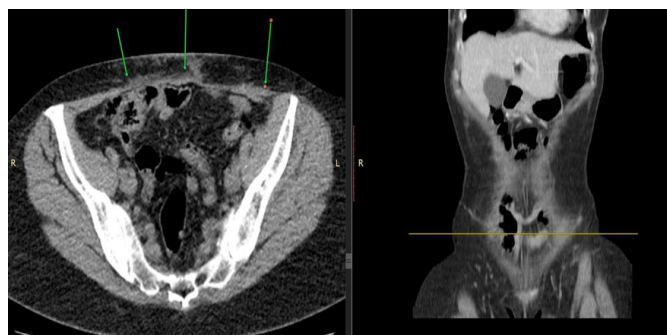


Figure 4. Computed tomography: Granuloma.



Figures 5 and 6. Computed tomography: Perithellal fibrosis.

DISCUSSION

The rectus abdominis muscle originates from the pubis (between the pubic tubercle and the symphysis) and is inserted into the fifth to seventh costal cartilage and the xiphoid process of the sternum⁹. It has 3 to 4 horizontal tendinous insertions that are adhered to the anterior layer of the rectum¹⁰, and its irrigation is classified as type III by Mathes and Nahai (superior and inferior epigastric artery), it has 6 to 10 perforators^{11,12}.

Although breast reconstructions with TRAM are generally successful, there is some concern among surgeons when using TRAM, due to the need to maintain the competence of the abdominal wall postoperatively. In 1976, D. Ralph Millard pioneered the idea of reconstructing the female breast from a vertically oriented island of abdominal skin, that is, with a vertical musculocutaneous flap from the rectus abdominis¹³.

The patients participating in this study are heterogeneous and, ideally, were compared with the same type of pedicle, reconstruction time, and no changes in the abdominal wall preoperatively. Only one patient had a small umbilical hernia and only one had thread granuloma with inflammatory signs. Complications were

not evaluated in another study due to the systematization of the technique used having been first applied to these groups of patients after 2019⁵.

In monopedicled flaps, the smaller defect in the donor area and the preservation of the contralateral rectus abdominis muscle influence the lower incidence of hernias and bulging¹⁴. In this study, 1 patient had a late seroma on computed tomography, while another had perithellal fibrosis, but none of the radiological images in this group showed bulging or large deformities in the abdominal wall. The first studies appeared in 1987 with Hartrampf et al.⁴, who evaluated complications in 335 patients undergoing breast reconstruction with TRAM. The general rate of abdominal wall complications was 1.5%, with 0.3% referring to abdominal hernia, 0.6% to abdominal bulging, and 0.6% to a defect in the upper sheath of the rectus abdominis muscle⁴.

The use of polypropylene mesh with systematization of fixation points, corroborated in another study with the same surgical team, provided a low rate of hernia and no bulging or extrusion of the mesh⁵.

This work was innovative, as it analyzed differences in the volume of the abdominal cavity and the thickness of the abdominal wall, before and after surgery. The average reduction in the volume of the abdominal cavity ranged from 8.9% to 23.8%, and the thickness of the abdominal wall ranged from 5.6% to 50.7%.

Due to the inflammatory reaction caused by the mesh, perithellal fibrosis is triggered, which may justify, in some cases, the low rate of average reduction in the thickness of the abdominal wall. The most significant change in the reduction of abdominal wall thickness (50.7%) occurred in one patient, who underwent a bipedicled flap, but there were no complications. However, the patient with an umbilical hernia in the postoperative period presented a variation of 9.2% of the abdominal wall.

Even with these data, there was no correlation between this reduction and changes such as hernias, bulges, mesh extrusions, thread granulomas, or other abnormalities.

Unlike previous published studies, in which they were evaluated primarily by physical examination and, only in cases of doubt about whether to perform an abdominal ultrasound post-operatively, the present study considered it relevant to perform a pre-operative tomography examination, to analyze the existence of previous deformities^{15,16}.

Only two patients showed changes in postoperative CT scans compatible with late seroma and perithellal fibrosis. According to Baroudi & Ferreira¹⁷, abdominal surgeries result in seroma due to the dead space resulting from detachment and resulting in incidences ranging from 2.1 to 9.4%⁷. According to Scevola et al.¹⁸, analyzing

769 breast reconstructions with TRAM, the use of two drains in the abdomen reduces the incidence of seroma. And it has already been shown in several studies that the use of polypropylene mesh to correct any defects in the abdominal wall induces an intense inflammatory reaction, with the formation of fibrosis, and a decrease in the elasticity of the wall^{19,20}.

CONCLUSION

In this study, tomography after surgery demonstrated an average reduction of 14.5% in the volume of the abdominal cavity and 14.2% in the thickness of the abdominal wall. There was no evidence of an abdominal hernia, bulging, mesh extrusion, or other deformities. Furthermore, although bipediced flaps present greater variation in abdominal wall thickness, there was no correlation in the abdominal wall or complications.

Despite the evaluation of a small number of cases, satisfactory tomographic results were found, avoiding the appearance of complications in the reconstructive technique applied.

COLLABORATIONS

IMS	Analysis and/or data interpretation, Conception and design study, Conceptualization, Data Curation, Final manuscript approval, Formal Analysis, Funding Acquisition, Investigation, Methodology, Project Administration, Realization of operations and/or trials, Resources, Software, Supervision, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing.
ASC	Analysis and/or data interpretation, Conceptualization, Final manuscript approval, Funding Acquisition, Methodology, Realization of operations and/or trials, Software, Validation, Writing - Original Draft Preparation.
SFAG	Conception and design study, Data Curation, Formal Analysis, Project Administration.
VGGBWR	Investigation.
MSV	Resources, Validation, Visualization, Writing - Original Draft Preparation, Writing - Review & Editing.
ENB	Review, Editing & Validation.

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*Corresponding author: Igor Moura Soares

Hospital Daher Lago Sul SHIS QI 07 conj. F, Brasília, DF, Brazil.

Zip code: 71615-310

E-mail: igormoura739@gmail.com