USE OF 3D MAMMOGRAPHIES/ THOMOSYNTHESIS AS A GUIDE TO DETERMINE THE VASCULAR PEDICLE FOR USE IN MAMMOPLASTIES

Uso de la mamografía 3D/tomosíntesis como guía para determinar el pedículo vascular por usar en mamoplastias

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Summary

Introduction: The necrosis of the nipple areola complex is one of the most feared complications in mammoplasties. We propose that the use of thomosynthesis constitutes the ideal method for the evaluation of the vascular pedicle, and thus determine the best surgical technique, in order to avoid this complication. Objective: To evaluate the usefulness of the use of thomosynthesis as part of the preoperative protocol for secondary mammoplasties, from January 2015 to December 2016. *Methods*: The study is a retrospective, descriptive study. The sample consisted of 67 patients, of whom two were excluded because they did not record all the data. Breast ultrasound and thomosynthesis were performed in 100% of the patients. *Results*: Only one patient presented partial nipple areola complex necrosis. *Conclusions*: The use of thomosynthesis alone as an imaging method in the preoperative evaluation of mammoplasties helps to plan the surgical technique to be used as well as to reduce complications.

Resumen

Introducción: La necrosis del complejo areola-pezón constituye una de las complicaciones más temidas en mamoplastias. Se plantea que el uso de la tomosíntesis constituye el método ideal para la valoración del pedículo vascular, con el fin de establecer la mejor técnica quirúrgica, para evitar esta complicación. *Objetivo*: Evaluar la utilidad del uso de la tomosíntesis como parte del protocolo preoperatorio para mamoplastias, en el periodo enero de 2015 a diciembre de 2016. *Métodos*: El estudio es de tipo retrospectivo, descriptivo. La muestra fue de 67 pacientes, de las cuales dos fueron excluidas por no tener registro de todos

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los datos. Se realizó tomosíntesis y ultrasonido mamario al 100 % de las pacientes. *Resultados*: Solo una paciente presentó necrosis parcial del complejo areola-pezón. *Conclusiones*: El uso de la tomosíntesis por sí sola, como método de imagen en la evaluación preoperatoria de mamoplastias, ayuda a planificar la técnica quirúrgica por emplear y a disminuir las complicaciones.

Introduction

Aesthetic breast surgery has the essential objective of correcting the different glandular anomalies; it allows for aesthetic modification with augmentation through the placement of implants or by reducing the volume; in all cases the various complications that may present must be taken into account, due to the tissue damage involved, of which one of the most fearsome is the necrosis of the areola nipple complex (ANC).

ANC necrosis is caused by a failure in the vascularization of the nipple to manipulate the flap that must be formed in order to move the nipple several centimeters when it is fallen and is intended to place in a correct position. It is the most serious complication with the greatest aesthetic and functional damage, but also the least frequent. In cosmetic surgery, adequate preoperative planning is essential to successfully achieve the final objective. The anatomical variability of the perforating vessels of the breast and the modifications provoked by previous surgeries, allow to have a reliable system of preoperative localization of the vessels that is of enormous utility to choose the best surgical technique to use.

The tomosynthesis is a technique that uses low doses of radiation to create a three-dimensional image of the breast, since its approval has been useful for the early detection of breast cancer, also allows to visualize the vessels that carry blood supply to the ANC. For this reason, the use of diagnostic images in breasts by tomosynthesis during the preoperative evaluation in mammoplasties is proposed, in order to identify the vascular anatomy beforehand and with the latter to help the surgeon plan a surgical approach that contributes to reducing the risk of post-operative complications, including ANC necrosis.

1. Background

In this point, a series of works related to the anatomical vascular configuration of the breast, its study by means of imaging methods and the different surgical techniques of the upper and lower pedicle in mammoplasties are described in chronological order, which will be useful for the understanding of the proposed topic.

Bacaran and collaborators (1) presented an investigation titled "Ultrasound determination of the pedicle in breast reduction for severe gigantomastia". The authors concluded that the use of ultrasound to determine the pedicle technique can be considered as a "guide" in reduction mammoplasty.

Fesinger and colleagues (2) published in Radiographics, in 2011, "Vascular abnormalities of the breast: Arterial and venous disorders, vascular masses, and mimic lesions with radiologic- pathologic correlation," in which they describe normal vascular anatomy, as well as its anatomical variants and imaging appearance in mammography, ultrasound, and magnetic resonance imaging (MRI) studies. A similar study was published in 2014 by Sánchez y González (3), in the Spanish Society of Medical Radiology (SERAM) entitled "Vascular anomalies of the breast. Multimodal radiological approach".

Villamizar and collaborators (4), 2015, conducted an investigation entitled "Use of 3D mammography and Doppler ultrasound as a guide for determining the pedicle technique to be used in mammoplasties". The authors concluded that the use of tomosynthesis, by itself, as an imaging method in the preoperative evaluation of mammoplasties helps to plan the surgical technique to be used, as well as to reduce complications.

Rincón and collaborators (5), 2017, conducted research on the use of tomosynthesis to determine the vascular pattern in revision breast surgery. They concluded that its use as an imaging method in the preoperative evaluation of vascularization in mammoplasties helps plan the surgical technique and decrease complications.

2. Theoretical framework

The mammary gland is irrigated by an arterial circuit formed medially by the internal mammary artery, direct branch of the subclavian. Laterally this circuit is the lateral thoracic artery, branch of the axillary artery. These two, internal and external mammary arteries, provide the lateromedial circulation of the gland, as well as the skin that covers it. This vascular network linked to nerve fillets that ensure the innervation of the areola nipple complex, determines the presence of neurovascular pedicles in the surgery of the mammary gland (3,6).

Van Deventer (7) performed breast dissections on 15 cadavers, and concluded that the internal thoracic artery is the most constant and important source of blood supply for the nipple areola complex. Calderón (8), from Chile, dissected 12 corpses, demonstrating the reliability of the lower pedicle technique in reduction mammoplasty.

The aesthetic surgery of the breast is denominated mammoplasty, this can be of increase by means of the placement of mammary implants or of reduction for correction of ptosis or mammary hypertrophy (7). The main surgical procedures for reduction mammoplasty are: pedicle method, free nipple graft. The pedicle method is the most used in this type of interventions, including the technique of lower pedicle, upper pedicle and bipediculata (9).

Mammoplasties, like any surgical procedure, can present complications, the most important being the loss or necrosis of the CAP, the latter occurs in approximately 2% of patients with no surgical history (10). Previous breast surgeries are also a risk factor for CAP necrosis, due to the fact that during the surgical procedure there is a section of arterial vessels in one of the vascular pedicles of the breast (11).

On occasions when the results of the aesthetic surgery are not as expected, a second intervention is necessary called secondary aesthetic surgery or repair. The problem lies in the lack of knowledge in most cases of the surgical technique performed in the first surgery and in the fact that the type of skin scar (inverted T) is the same for the different pedicle techniques. For this reason, breast imaging techniques are beginning to be used in order to identify the dominant vascular pedicle.

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The study method most commonly used is Doppler color ultrasound; however, it has limitations due to the difficulty in detecting very small caliber vessels, which implies a longer evaluation time, as it is operator-dependent (12).

3D mammography/tomosynthesis is a complementary tool to digital mammography and differs from conventional mammography basically by a mobile X-ray tube that is continuously mobilized in an arc that varies in degrees and number of cuts and makes multiple shots of low doses of radiation, which are later reconstructed with algorithms similar to those of tomography in cuts of 1 mm10. The first breast tomosynthesis images were demonstrated by Niklason and colleagues in 1997 (13). Since its approval by the FDA in 2011, tomosynthesis has been used primarily for the detection of breast cancer. By means of the tomosynthesis it is possible to see the path of the vascular structures including those of small caliber (1 mm) (Figure 1) that reach the ANC (14).

3. Methodss

3.1 Type of study

The study is a retrospective, descriptive type that evaluates the usefulness of 3D mammography/tomosynthesis in preoperative mammoplasty in patients with or without a history of cosmetic breast surgery and submitted to this study as part of the preoperative protocol for mammoplasty, in the period from January 2015 to December 2016.

3.2 Population and sample

The population was made up of female patients who went to the Radiodiagnostic Service of the La Trinidad Teaching Medical Center-IDACA, to perform 3D mammography/tomosynthesis studies as part of the preoperative protocol for mammoplasty and presented or not as a history of cosmetic breast surgery, in the period from January 2015 to December 2016. The sample consisted of 67 patients who met the inclusion and exclusion criteria during this data collection period.

3.3 Inclusion criteria

Patients who went to the Radiodiagnostic Service to perform 3D mammography/tomosynthesis as part of the preoperative mammoplasty. Over 25 years of age.

3.4 Exclusion criteria

Patients with a history of oncological surgery.

3.5 Clinical Methodology

This research was carried out between January 2015 and December 2016, with 3D mammography/tomosynthesis studies in the patients who attended the aforementioned Radiodiagnosis Service. These studies were obtained thanks to a mammograph (Hologic Selenia 3D Dimensions) (Figure 2), which is part of the equipment of the Radiology Service of the CMDLT-IDACA.

First, the radiologist technician performed the 3D mammography/tomosynthesis, the images were sent to the workstation, which consists of high-resolution monitors (5 and 8 Megapixel screens for

mammograms, BARCO) (Figure 3), to be evaluated by the specialist physician and to determine the distribution of the perforating blood vessels in both breasts (Figure 4). The results were sent to the plastic surgeon to determine the type of surgical technique or pedicle for the mammoplasty. Patients were followed to evaluate the final outcome (Figures 5 to 8). The data obtained in the investigation were recorded in a data collection instrument (Figure 9).

3.6 Statistical analysis

This is a retrospective, descriptive study that evaluates the use of 3D mammography/tomosynthesis in preoperative mammoplasty in patients undergoing 3D mammography/tomosynthesis studies as part of the preoperative protocol for mammoplasty, whether or not they have a history of cosmetic breast surgery, in the period from January 2015 to December 2016. Two types of analysis were used, the first is the descriptive analysis in which position and dispersion measurements are calculated, the second is the graphical analysis, which is based on bar graphs, sector diagrams, frequency histograms.

Figure 1. Mammography study 3D/tomosynthesis in MLO projection: small caliber vessels are observed (arrows).

Figure 2. Selenia® 3D Digital Mammography System Dimensions®, Hologic®.

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Figure 3. High resolution monitors (5 and 5.5 Megapixels). Screens for mammograms, BARCO®.
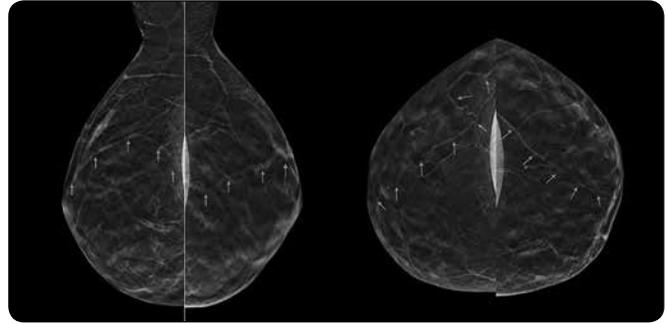
Figure 4. Perforating blood vessels in both breasts (arrows).

Figure 5. Mammoplasty without implants managed by lower pedicle. Courtesy of Dr. Linda Rincon.

Figure 6. Mammoplasty with implants preserving upper pedicles. Courtesy of Dr. Linda Rincon.

Figure 7. Mammoplasty with implants managed with superomedial pedicle. Courtesy of Dr. Linda Rincon

Figure 8. Mammoplasty with implants managed with bipediculata technique. Courtesy of Dr. Linda Rincon.

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Número del paciente

Centro Médico Docente
La Trinidad

Título del trabajo de Investigación: Uso de la mamografía 3D/Tomosíntesis como guía para determinar la técnica del pedículo a usar en mamoplastias secundarias. **Investigadoras:** Dra. Alcira Capecchi / Dra. Exaida Molero / Dra. Patricia Villarreal

REGISTRO DE DATOS

Iniciales del paciente:		Edad:
Cédula:		Teléfono:

				Hábitos		
Diabetes:	Si ☐	No ☐				
Hipertensión:	Si ☐	No ☐	Tabaco:	Si ☐	No ☐	
Otros:			Alcohol:	Si ☐	No ☐	
			Otros:			

Datos Clínicos

Cirugías previas en las mamas: Si ☐ No ☐	Cuál:
Cuantas veces:	Tipo de cicatriz:

Datos por Imágenes (para ser llenado por el Radiólogo)

Tomosíntesis

Vascularización predomina en:

C.SUP.EXT ☐

C.SUP.INT ☐

C.INF.INT ☐

C.INF.EXT ☐

Otros hallazgos: Quistes ☐ Nódulos ☐ Quistes de contenido espeso ☐

BI-RADS:

Datos quirúrgicos (para ser llenado por el Cirujano)

Tipo de intervención:	Abordaje:
Pediculo:	
Colocación de implantes: Si ☐ No ☐	Complicaciones: Necrosis del pezón ☐ Otras:
Resultados:	

Figure 9. Data collection instrument.

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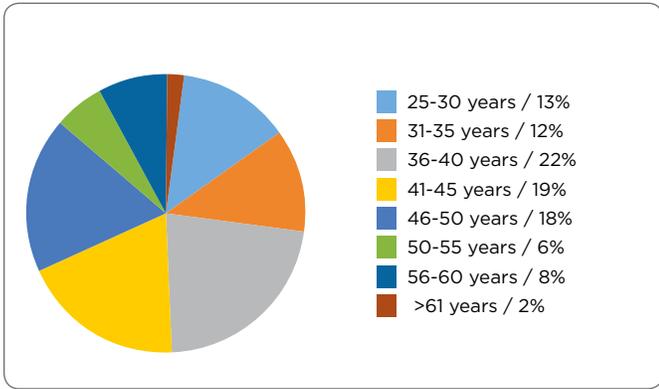
Figure 10. Percentage distribution of patients by age groups.

Legend:
- 25-30 years / 13%
- 31-35 years / 12%
- 36-40 years / 22%
- 41-45 years / 19%
- 46-50 years / 18%
- 50-55 years / 6%
- 56-60 years / 8%
- >61 years / 2%
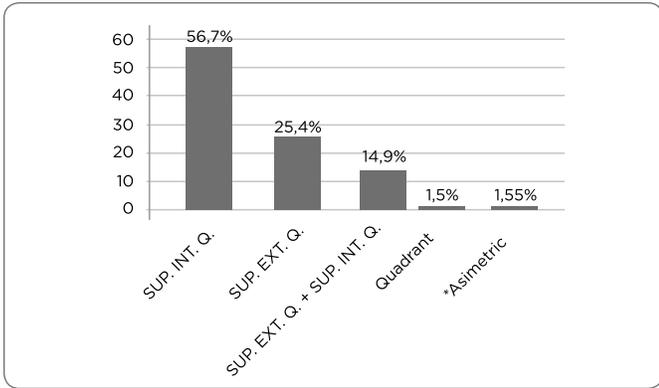
Figure 11. Distribution of the vascular pattern according to quadrants. *Asymmetrical: Right breast, upper external quadrant and left breast, upper internal quadrant.

Figure 12. Perforating blood vessels in both breasts. 3D mammography/ tomosynthesis. MLO projection. Vessels from upper and inner pedicle (arrows) are observed.
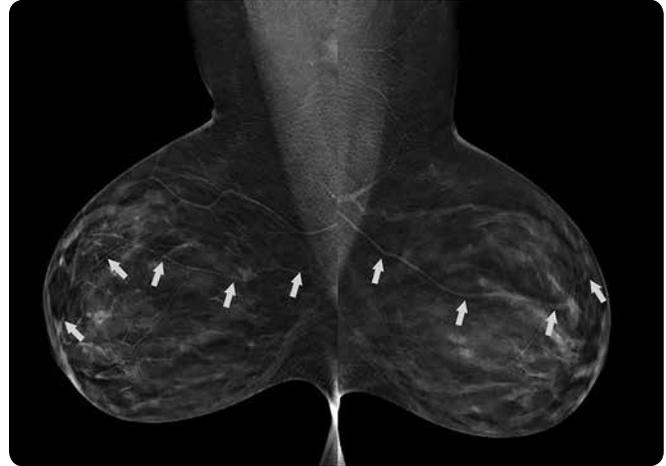
Figure 13. Perforating blood vessels in both breasts. 3D mammography/ tomosynthesis. MLO projection and CC. Vessels from upper and external pedicle (arrows) are observed.
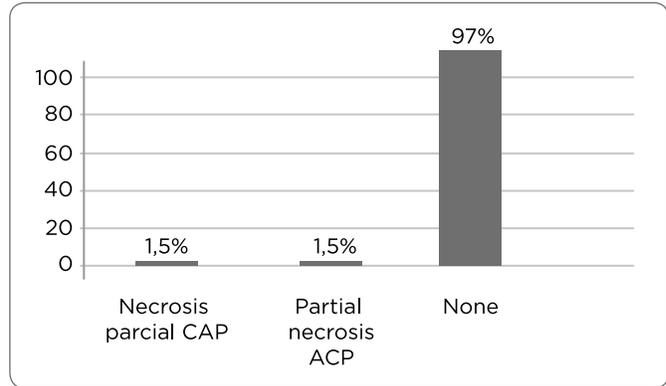
Figure 14. Complications in the current surgery.

Figure 15. Patient with peripheral epidermolysis with spontaneous ree-pithelialization. Courtesy of Dr. Linda Rincón.

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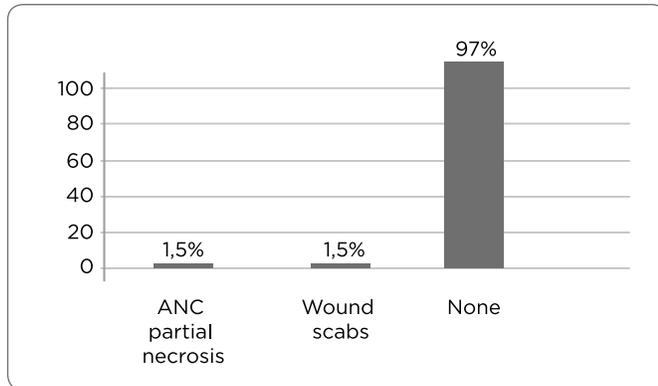
Figure 16. Types of previous surgery.

4. Results

Figure 10 shows that the highest percentage of patients are between 36-40 years of age, the youngest was 25 years of age and the oldest was 66 years of age.

As described in Figure 11, the dominant vascular irrigation of the ANC is from the internal mammary artery, with 38 patients, followed by external mammary with 17 patients, internal and external mammary in 10 patients, and one patient from a lower quadrant artery. One patient presented asymmetry with predominance of vasculature in the upper and external quadrant of the right breast and upper internal quadrant of the left breast, so that in this case also used the bipediculata technique (Figures 12 and 13).

As shown in Figure 14, the complications observed were: one patient with partial ANC necrosis and one patient with wound scab (Figure 15). The remaining 65 patients had no complications.

Figure 16 shows that 35 patients had a history of augmentation mammoplasty, 18 patients had augmentation mammoplasty, one patient had augmentation augmentation mammoplasty and 13 patients did not report any surgical history.

5. Discussion

The continuous advance and implementation of new technologies has allowed the development of diagnostic images; however, it is necessary to evaluate the results of these new techniques, to insist on their use in cases that merit it. For this reason, we propose the use of the tomosynthesis technique in the preoperative evaluation in patients who will undergo mammoplasties, to identify the vascular anatomy beforehand, and with this offer the surgeon the planning of the surgical approach.

6. Conclusions

The tomosynthesis is a new tool of the digital mammography, it is a safe and useful method for the plastic surgery, since it allows to identify the blood vessels of small caliber and helps to the planning of the surgical technique to use, with the purpose of diminishing the possible complications, as the necrosis of the ANC, that is one of the most fearsome, as much for the surgeon as for the patient who requires aesthetic surgery of breasts. So far there are more than 130 surgeries guided by tomosynthesis without ANC necrosis. In some cases, very thin vessels have been described that have been preserved, with only one case of peripheral epidermolysis that has regenerated spontaneously. Without the use of tomosynthesis, the technique would have been performed blindly, with a greater risk of failure.

References

1. Bacaran K, et al. Ultrasonographically determined pedicle breast reduction in severe gigantomastia. Plast Reconstr Surg Glob Open. 2011;128(4): 252-9.
2. Fesinger R, et al. Vascular abnormalities of the breast: Arterial and venous disorders, vascular masses, and mimic lesions with radiologic-pathologic correlation. Radiographics. 2011;31:117-36.
3. Sánchez C, González C. Anomalías vasculares de la mama. Enfoque multimodal. SERAM [internet]. 2014.
4. Villamizar M, Capecchi A, Rincón L, Cemborain M. Uso de la mamografía 3D/ultrasonido Doppler como guía para determinar técnica del pedículo a usar en mamoplastias secundarias. Centro Médico Docente La Trinidad. Departamento de Radiología. Venezuela. Boletín Electrónico de la Dirección de Educación e Investigación [internet]. 2016 [citado 2018 jul. 2]. Disponible en: http://www.cmdlt.edu.ve/educacion/pdfs_revistas/PD2016_9.1.pdf
5. Rincón L, Cemborain M, Gil B, Bookam A. Uso de tomosíntesis como determinación del patrón vascular en cirugía mamaria de revisión. Revista de Cirugía Plástica Iberoamericana. 2017;43:331-9.
6. Kube L, Zapata R. Cirugía plástica de la mama. 1er ed. Venezuela: Amolca; 2014.
7. Van D, Graewe F. Vascular anatomy of the breast and nipple areola complex. Plastic Reconst Surg. 2008;121(5):1860-1.
8. Calderón W, et al. Anatomía y clínica de las mamoplastias de reducción según técnica del pedículo inferior. Arch Soc Cir Chile. 1992;44(4):437-41.
9. Aguillar V, Bauad S, Maranhao N. Mama diagnóstico por imagen. Brasil: Amolca; 2010.
10. Burns J, Blackwell S. Plastic surgery. Editores Sabiston Textbook of Surgery. Edición 18. Philadelphia. Saunders Elsevier; 2008, capítulo73.
11. Horvath E, et al. Doppler color en el estudio de la mama. ¿Cómo lo hacemos nosotros? Revista Chilena de Radiología. 2011(1):19-27.
12. Chevalier M. Nuevas tecnologías en mamografía y su impacto en los valores de dosis. Radiología [internet]. 2013 [citado 2018 jul. 2]. Disponible en: https://www.sciencedirect.com/science/article/pii/S0033833813002105?via%3Dihub
13. Niklason L, Christian B, et al. Digital tomosynthesis breast imaging. Radiology. 1997;205(2):399-406.
14. Jesinger R. Breast anatomy for the interventionalist. Radiology. 2014;17(1):3-9.

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