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Study of the location of maximum point breast density at different thicknesses of the compressed breast

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1. Introduction

Breast cancer is the most common oncologic disease that causes death in women worldwide [1] [2]. When detected at an early stage, this pathology has a good prognosis and this is due to screening programs for breast cancer [3] [4]. Breast density, defined as the percentage of fibroglandular tissue in the breast, has the potential to be used as a predictor of breast cancer risk. [5]. Although elevated breast density is associated with a subsequent higher risk of breast cancer, it is not known whether breast density is directly related to risk, in tumors arising within the radiodense tissue itself, or a simple marker of susceptibility. However, demonstrated that higher density breasts correspond to higher rates of breast cancer development. [6]
Several methods have been developed to measure mammographic density, including visual methods such as BIRADS and automated methods. Automated ones are mostly volumetric or area methods [7]. However, all of these methods measure global breast density. According to recent results, such as in Ali et al. [8] and Holland et al. [9], indicate that the maximum point breast density, which is a poorly explored measure, is a factor that has a greater link with breast cancer than the global breast density.
This study aims to identify whether the point breast density, with an area of 1 cm^2, is located in different regions of the breast and if some localization pattern is followed for different compressed breast thicknesses (CBT).

2. Methodology

In this retrospective study, mammographic images in the lateral-medial oblique (LMO) and caudal cranium (CC) view of 1192 women aged between 25 and 89 years and CBT between 30 and 89 mm were analyzed. The study was approved by the Ethics Committee of the Faculty of Medical Sciences of Minas Gerais in accordance with the CAAE protocol: 18934019.2.0000.
The Volpara software (Volpara Solutions, Version 1.1, Wellington, New Zealand) was used to perform the analysis of mammographic images, resulting in an electronic spreadsheet, with numerous information about the composition of the breast, at the end of the analysis. In this study, the information used was: CBT (mm) and distance from the posterior edge of the breast (DPEB) (mm), distance from the superior edge of the breast (DSEB) (mm), and distance from the medial edge of the breast (DMEB) (mm) to the maximum breast density point (MBDP) (1cm^2).
To calculate the DPEB up to the MBDP, Volpara used images from both the CC and LMO views. For the calculation of DSEB up to MBDP, it used only images in the LMO view, and for the calculation of DMEB up to MBDP, the software used only images in the CC view. Therefore, to have only one information per patient, for each of the distances from the breast edges to the MBDP, the average of the information on the right and left breasts of both views, LMO and CC, for DPEB were performed, and for DSEB and DMEB was performed only the mean of the values of the right and left breasts.

The information from the three distances from the breasts to the MBDP was separated into six CBT intervals: 30 - 39 mm; 40 - 49 mm; 50 - 59 mm; 60 - 69 mm; 70 – 79 mm and 80 - 89 mm, thus forming 6 samples for each of the distances. Using tests of statistical significance for mean difference, it was verified whether there was a statistically significant difference between the six samples in each of the distances from the breast edges to the MBDP. For the DPEB samples, the parametric ANOVA test with post hoc Tukey was used, because according to the Levene test there was homogeneity between the samples of the different CBT's and all samples had $n > 50$. For the DSEB and DMEB samples, it was used the non-parametric Man Whitney test, since, although all samples had $n > 50$, there was no homogeneity between the samples of the different CBT's.

3. Results and Discussion

The sample of this study consisted of 4,768 patient images, which had a mean CBT of 60.67 ± 11.93 mm and a mean age of 53.40 ± 11.10 years.

The average of the DPEB, DSEB, and DMEB values up to the MBDP for each of the samples corresponding to the different CBT intervals are shown in Table I

Table I - Distance from the superior posterior and medial breast borders to the MBDP.

Intervals CBT (mm)	DPEB (mm)	DSEB (mm)	DMEB (mm)
30 - 39	41.89	131.96	137.26
40 - 49	39.89	136.99	139.27
50 - 59	47.36	132.21	141.67
60 - 69	48.75	135.83	141.79
70 - 79	48.73	140.59	149.81
80 - 89	37.48	138.4	153.53

As shown in Table I, for DPEB and DSEB, a pattern that corresponds to the increase in CBT's was not found. As for DMEB, distances gradually increased along with CBT.

In the tests of statistical significance for mean difference, concerning DPEB, the ANOVA test resulted in $p < 0.05$ only between samples of the CBT intervals of 40 - 49 mm and 50 - 59 mm. For the DMEB, the Man Whitney test resulted in $p < 0.05$ only in the samples of the CBT intervals of 60 - 69 mm and 70 - 79 mm. For DSEB, the Man Whitney test did not obtain any p-value < 0.05

These results demonstrate that between the samples from the 40 - 49 mm and 50 - 59 mm CBT intervals there is a statistically significant difference in the distance between the point of greater breast density to the posterior edge of the breast and between the samples from the 60 - 69 mm and 70 - 79 mm CBT intervals there is a statistically significant difference in the distance between the point of greater breast density to the medial edge of the breast. Therefore, the TBC proved to be an influencing factor in the difference in the location of the point of greater breast density only in these two situations.

Even though breast density is a well-established factor regarding the risk of developing breast cancer, the relationship between masking and breast density is more complex than a simple dependence on the amount of glandular tissue. One of the factors currently pointed out is the way glandular tissue is distributed in the breast, and when distributed in localized points of maximum density, the risk of masking is even greater [8] [9]. Thus, the relevance of this work is to demonstrate how the point of greatest breast density is located at different CBT's.

4. Conclusions

Based on the analyzes carried out in this study, it is concluded that there is little evidence that CBT is a factor that influences the location of the point of greater breast density. However, other studies are needed to have more grounding on this subject. We are not aware of any other study that analyzed the location of the point of greatest density in the breast.

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