SCIENCE SET
OPEN ACCESS PUBLISHERS

Research Article

Journal of Medical Physics and Biophysics Simulations

Dimensions of the Breast Lesion: Imaging Results vs Pathological Results

Laura Martins Segura

Estudante de Imagem Médica e Radioterapia da Universidade do Algarve (UALG)

***Corresponding author:** Laura Martins Segura, Estudante de Imagem Médica e Radioterapia da Universidade do Algarve (UALG).

Submitted: 12 February 2026 **Accepted:** 21 February 2026 **Published:** 28 February 2026

Citation: *Martins Segura, L. (2026). Dimensions of the Breast Lesion: Imaging Results vs Pathological Results. J of Med Phys Biopsy's Simul, 2(1), 01-09.*

Abstract

Introduction: *To verify the correlation between the measurement of the dimensions of the same tumor in MGM, US and MRI, and the dimensions of the tumor referred to in the anatomopathological report of the surgical specimen.*

Materials and methods: *A retrospective study was carried out on 56 women diagnosed with breast cancer, between January 2021 and November 2022, at the CHUA Radiology Service, at the Portimão E.P.E. where the size of the main tumor was evaluated by MGM, US and breast MRI and later compared with the anatomopathological examination.*

Results: *It was found that at the level of MGM, US and MRI an overestimation of 34/56 (60.7%), 18/56 (32%) and 31/56 (55%) respectively, and an underestimation of 18 /56 (32%), 34/56 (60.7%) and 19/56 (33%), respectively.*

Conclusion: *It was concluded that there were no significant differences in the size of the tumors measured in MGM and MRI when compared with the pathological anatomy, nor based on the histological type or breast density, demonstrating that the factors do not influence the accuracy of the measurement. MRI was the technique that obtained the best correlation with size in the anatomopathological examination.*

Keywords: Lesion Size, Histological Type, Pathological Anatomy, Ultrasonography, Mammography, Magnetic Resonance, Breast Cancer.

Introduction

The measurement of the tumour in the various imaging modalities is an important piece of data that aims to verify which is close to the size obtained in pathological anatomy. In this way, we intend to carry out the measurement of the tumour in radiology and find out whether this correlates with the measurement of the tumour in pathological anatomy. To verify whether factors such as breast density, post-biopsy complications, histological type and size influence the measurement of tumour size and how to overcome them.

Preoperative assessment of tumour size is important at the surgical level, especially in breast conservation, as there are studies suggesting that MRI may increase mastectomy rates, probably by overestimating the extent of local disease.

That said, and after evaluating the accuracy of tumour size estimation in different imaging examinations, it has been suggested to use MRI as a complementary method in selective, high-risk patients with dense breasts and invasive lobular breast cancer [1].

In Iceland, preoperative MRI changed the type of surgery performed in 14% of cases, where 8.9%, performed excision and 5.1% performed mastectomy instead of breast conservation. Approximately 89% of patients, have agreement between the size of the tumour on MRI and the size of the pathological anatomy. Tumour size is the main prognostic indicator and one of the most important factors in the clinical and pathological evaluation of breast cancer, being related to lymph node involvement, tumour grade and overall survival rate [2].

Therefore, it is vital to accurately measure the size of the tumour by imaging examinations at the time of diagnosis, in order to be the most appropriate for the patient. This avoids underestimation of the tumour size which can lead to close or positive surgical margins, or overestimation which can prevent patients from receiving breast-conserving therapy [3].

At the level of pathological anatomy, the histological characterisation of the tumour is based on morphological characteristics. It allows us to differentiate carcinomas in situ (affecting the epithelial component of the breast tissue) from invasive carcinomas (invading the stromal component). And it can also identify the main types of tumours, namely invasive ductal and invasive lobular (around 80% of tumours), ductal/lobular, mucinous, tubular, medullary and papillary carcinomas [4].

This study proves to be revealing, since there are studies carried out in other countries which reveal "no significant alterations" between the measurements taken of the tumour in the imaging exams and the postoperative specimen, however it is important to carry out here in Portugal, namely at the CHUA-Portimão, since the health professionals and the methods approached are not the same.

The general aim of this study is to study the correlation between the measurement of the dimensions of the same tumour in MGM, US and MRI, and the effective dimensions of the tumour, referred by the anatomopathological report of the surgical specimen.

The specific objectives are to analyse which imaging study has the closest tumour measurement value to the one presented in the pathological anatomy report and to determine whether factors such as histological classification, size, breast density and post-biopsy complications may influence the accuracy of the tumour measurement obtained in imaging studies.

Materials and Methods

The target population consists of patients diagnosed with breast cancer, who underwent breast MRI, breast MGM and breast US, whose primary treatment consisted of tumourectomy or mastectomy and who belong to the senology group of the CHUA, at the Portimão E.P.E Hospital Unit, coming from the Barlavento Algarvio region.

The sample corresponded to a total of 56 patients, in which it is composed of patients with breast cancer who have undergone breast imaging examinations (mammography, ultrasonography and magnetic resonance imaging). Followed by the primary surgical treatment with respective anatomopathological evaluation of the lesion, where the histological type and the largest measured axis are verified.

For this study, the exclusion criteria were defined as patients whose breast MRI exam reports non-mass lesions, due to their difficulty in performing measurements, patients whose primary treatment consisted of QTNA, patients coming from abroad and whose exams are not on file at the CHUA-Portimão and patients whose lesion was not visible on mammography.

The ethical considerations present consisted of preserving the patients' privacy. No information about the patients' personal data will be used, and there will always be confidentiality of these.

Data will be collected in person and information will be selected retrospectively from cases of breast cancer present in the database provided by the Senology Unit of the CHUA-Portimão. All cases will be included in the time window January 2021 to November 2022, where the radiological images are of breast lesions in the three radiological modalities and of pathological anatomy.

The measurement started with the MGM examination, followed by breast US, breast MRI and finally the result of the pathological anatomy report of the surgical specimen. The exams with the closest date to the surgery were selected, and most of them correspond to the day before or on the day of the surgery, because the users were subjected to preoperative marking by harpoon of the lesion.

Subsequently, the measurements of the GMM and breast MRI were performed by the student and confirmed by the TST specialist in the area of Radiology with more than 20 years of experience in the area of Senology, and in situations where there was no agreement the measurement was performed by another TST with the same experience. In the case of US, the data mentioned in the exam report was used.

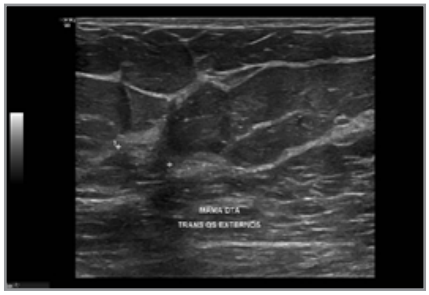

Figura 1: Ultrassonografia, Demonstrando O CDIS.

Fonte: CHUA, Portimão, 2022.

The measurements were performed on a 2 Megapixel (MP) monitor (1600x1200 pixels), 19 inches, with 1 image display, with image magnification and window adjustment.

For the measurement by MGM, the medio-lateral oblique incidence was initially selected with visualisation of the longest axis, magnified, measured, then confirmed with the craniocaudal incidence, magnified, measured and collected.

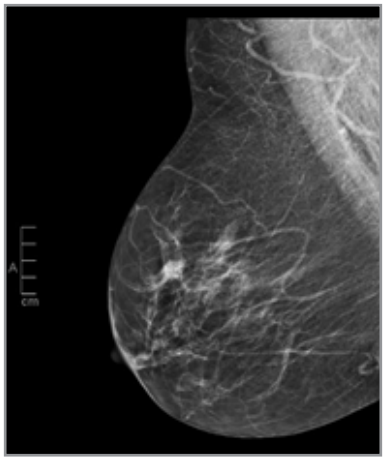

Figura 2: Mamografia, Incidência Obliqua Medio Lateral, Demonstrando O CDIS.

Fonte: CHUA, Portimão, 2022.

In breast MRI the sagittal reformatting corresponding to the first dynamic acquisition after administration of intravenous contrast medium was used, T1-weighted with fat suppression and image subtraction, the measurement was then rectified in the same acquisition sequence used.

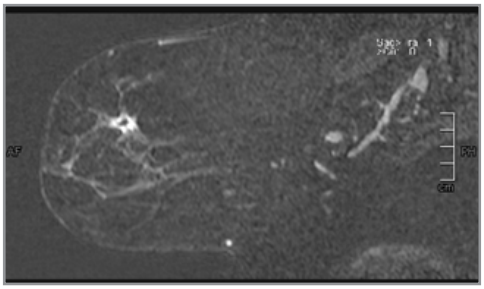

Figura 3: RM, Demonstrando O CDIS.

Fonte: CHUA, Portimão, 2022.

Data on the patient's age, histological type, measurements on the longest axis of the lesion size performed on breast US, breast MRI, MGM, and pathological anatomy were recorded. The breast density was recorded according to the ACR classification (table1) described in the mammography report, and the post-biopsy complications according to the visualization of the MR images and the report of the same. Finally, the measurements of the breast lesion both in the requested imaging examinations and in the pathological anatomy will be analysed for eventual correlation, and verification of the measurement accuracy. In the statistical analysis and treatment procedure, tables and graphs will be made with the help of the Excel program and the Statistical Package for the Social Science (SPSS), and inferential statistics will be performed.

Table 1. Categories of breast composition

Breast	Composition Category Code
a)	Breasts with a predominance of adipose tissue
b)	Breasts with dispersed fibroglandular densities
c)	Heterogeneously dense breasts, which may conceal small masses
d)	Dense breasts with decreased sensitivity on mammography

Source: Adapted from ACR, 2013.

Results

The age level (table 2) shows the mean age of 61.75 years. The youngest person to be studied is 42 years old and the oldest person is 83 years old (table 2).

Table 2. Distribution of the sample according to age.

Variable	N	Minimum	Maximum	Average	Standard deviation	Variance
Idade (em anos)	56	42,00	83,00	61,7500	10,49719	110,191

Source: Author's own work, 2022.

Then the lesion size was analyzed in CGM, US, MRI and pathological anatomy. Table 3 shows the mean (CGM:1.53; US:1.38; MR:1.51; pathological anatomy: 1.51), the minimum (CGM: 0.50; US: 0.44; MR: 0.46; Pathological anatomy was 0.30), the maximum (CGM: 4.95; US: 4.48; MR: 4.23; Pathological anatomy was 5.50) of the lesion size measured in each examination and in the pathological anatomy.

Table 3: Sample distribution according to size measured in imaging examinations and pathology.

Variable	N	Minimum	Maximum	Average	Standard deviation	Variance
Lesion Size in MGM	56	,50	4,95	1,5334	,91565	,838
Lesion Size in US	56	,44	4,48	1,3802	,86336	,745
Lesion Size in MRI	56	,46	4,23	1,5146	,83203	,692
Lesion Size in Pathology	56	,30	5,50	1,5125	,96296	,927

Source: Author's own work, 2022.

The most common histological type (table 4) was invasive breast carcinoma (76.9%), followed by non-invasive breast carcinoma with (7.7%), and finally phylloid tumour, with a percentage of 1.5%.

Table 4: Sample distribution according to histological type

Histological Type	Frequency	Percentage
Invasive breast carcinoma	50	76,9
Non-invasive breast carcinoma	5	7,7
Phyllodes tumor	1	1,5

Source: Author's own work, 2022.

At the level of breast density, we can observe in table 6, that the most common category was category b (49.2%), followed by category c (24.6%), and the least common categories were category a and d (6.2%) each.

Table 5: Sample distribution according to breast density

Breast Density Category	Frequency	Percentage
Category a	4	6,2
Category b	32	49,2
Category c	16	24,6
Category d	4	6,2

In terms of post-biopsy complications, it was found that 52.3% had undergone BAV, which suggests that they may or may not have suffered complications, and that 33.8% had not undergone BAV.

Tabela 6: Distribuição da amostra consoante a realização de BAV

Category	Response	Frequency	Percentage
Valid	Yes	34	52,3
Valid	No	22	33,8
Valid	Total	56	86,2
Missing	System	9	13,8
Total	—	65	100,0

Source: Author's own work, 2022.

Relationship Between Mammographic Lesion Size and Pathological Anatomy

By means of Wilcoxon's test, the relationship between the lesion size at mammography and pathological anatomy is observed on table 7, where in a total of 56 lesions, 18 presented lower size, 34 presented higher size and 4 presented the same value as compared with the pathological anatomy.

Table 7: Relationship between lesion size on mammography and pathological anatomy

Comparison (Lesion Size in MGM / Pathological Anatomy)	Classification	N	Mid-level position	Sum of Ratings
Lesion Size in MGM < Lesion Size in Pathology	Negative Ratings	18[a]	32,67	588,00
Lesion Size in MGM > Lesion Size in Pathology	Positive Ratings	34[b]	23,24	790,00
Lesion Size in MGM = Lesion Size in Pathology	Draws	4[c]	—	—
Total	—	56	—	—

Source: Author's own work, 2022.

Table 8 shows that the level of significance for the two-sided test is 0.357, (p-value>0.05), i.e., there are no significant differences, and therefore we accept the null hypothesis (H0), which states that there is a relationship between lesion size on mammography and pathological anatomy.

Table 8: Test statistics for the relationship between lesion size on mammography and pathological anatomy.

Test Statistics	Lesion Size in MGM - Lesion Size in Pathological Anatomy
Z	-,920[b]
Significance Sig. (2 ends)	,357[a]

Notes: a. Wilcoxon Signed Rank Test.
b. Based on negative ranks.
Source: Author's own work, 2022.

Relation Between The Lesion Size At Ultrasonography and Pathological Anatomy

Table 9 shows the relationship between the size of the lesion at ultrasonography and the pathological anatomy, where in a total of 56 lesions, 34 presented a lower size, 18 a higher size and 4 the same value when compared with the pathological anatomy.

Table 9: Relationship between lesion size on ultrasound and pathological anatomy

Comparison (Lesion Size on Ultrasound / Pathological Anatomy)	Classification	N	Mid-level position	Sum of Ratings
Ultrasound Lesion Size < Pathology Lesion Size	Negative Ratings	34[a]	26,97	917,00
Ultrasound Lesion Size > Pathology Lesion Size	Positive Ratings	18[b]	25,61	461,00
Ultrasound Lesion Size = Pathology Lesion Size	Draws	4[c]	—	—
Total	—	56	—	—

Notes: a. Lesion size on ultrasound < Lesion size on pathology.
b. Lesion size on ultrasound > Lesion size on pathology.
c. Lesion size on ultrasound = Lesion size on pathology.
Source: Author's own work, 2022.

In table 10, it was found that the significance level for the two-sided test is 0.038, (p-value<0.05), there are significant differences, we reject the hypothesis H0, and conclude that there is no relationship between lesion size at US with pathological anatomy.

Tabela 10: Estatística de teste entre o tamanho da lesão na ultrassonografia com a anatomia patológica

Test statistics	Lesion Size on Ultrasound - Lesion Size in Pathological Anatomy
Z	-2,077
Significance Sig. (2 ends)	0,038

Notes: a. Wilcoxon Signed Rankings Test
b. Based on positive ranks.
Source: Author's own work, 2022.

Relationship Between the Size of the Lesion at Mri with the Pathological Anatomy

Table 11 shows the relationship between the size of the lesion at MRI and the pathological anatomy, where in a total of 56 lesions, 19 presented a smaller size, 31 a larger size and 6 the same value when compared with the pathological anatomy.

Table 11: Relationship between lesion size on magnetic resonance imaging and pathological anatomy

Lesion Size on MRI - Lesion Size in Anatomical Pathology	N	Mid-level position	Sum of Ratings
Negative Ratings	19	27,24	517,50
Positive Ratings	31	24,44	757,50
Draws	6	—	—
Total	56	—	—

Notes: a. Lesion size on MRI < Lesion size on pathology
b. Lesion size on MRI > Lesion size on pathology
c. Lesion size on MRI = Lesion size on pathology
Source: Author's own work, 2022.

Table 12 shows that the level of significance for the two-sided test is 0.246, (p-value>0.05), that is to say, there are no significant differences, so we accept the null hypothesis (H0), which states that there is a relationship between the size of the lesion on MRI and the pathological anatomy.

Table 12: Test statistics between lesion size on magnetic resonance imaging and pathological anatomy.

Test statistics	Lesion Size on MRI - Lesion Size in Anatomical Pathology
Z	-1,159
Significance Sig. (2 ends)	0,246

Notes: a. Wilcoxon Signed Rank Test
b. Based on negative ranks.
Source: Author's own work, 2022.

Correlation Between Lesion Size at Mammography and Pathological Anatomy With Density

According to Spearman's correlation test, we observed in table 13 the correlation coefficient, between the variables lesion size in mammography and density rs = -0.144 and the variables lesion size in pathological anatomy and density rs = -0.157 there is an inverse correlation, and weak. And according to the significance value (p-value>0.05), p=0.277 and p=0.236, respectively, we accepted the null hypothesis, so density does not affect the measurements of the lesion in mammography or in pathological anatomy.

Table 13: Correlation between lesion size on mammography and pathology with density. Correlations (Spearman's ρ).

Variable	Measurement	Lesion Size in MGM	Lesion Size in Pathological Anatomy	Density
Lesion Size in MGM	Correlation Coefficient	1,000	,870**	-,154
	Sig. (2 ends)	—	<,001	,243
Lesion Size in Pathological Anatomy	N	59	59	59
	Correlation Coefficient	,870**	1,000	-,157
Density	Sig. (2 ends)	<,001	—	,236
	N	59	59	59
	Correlation Coefficient	-,154	-,157	1,000
	Sig. (2 ends)	,243	,236	—
	N	59	59	59

Note: **. The correlation is significant at the 0.01 level (2 extremes).
Source: Author's own work, 2022.

Correlation Between Lesion Size on Mri and Pathological Anatomy with Histological Type

According to table 14 the correlation coefficient, rs = -0.098 and rs = 0.113 there is an inverse correlation but very strong. And according to the significance value (p-value>0.05), p = 0.472 and p = 0.405, we accept the null hypothesis, therefore the histological type does not affect the measurements of the lesion on MRI nor on pathological anatomy.

Table 14: Correlation between lesion size on magnetic resonance imaging and pathology with histological type Correlations (Spearman's ρ)

Variable	Measurement	Histological Type	Lesion Size on MRI	Lesion Size in Pathological Anatomy
Histological Type	Correlation Coefficient	1,000	-,098	-,113
	Sig. (2 ends)	—	,472	,405
	N	56	56	56
Lesion Size on MRI	Correlation Coefficient	-,098	1,000	,951**
	Sig. (2 ends)	,472	—	<,001
	N	56	56	56
Lesion Size in Pathological Anatomy	Correlation Coefficient	-,113	,951**	1,000
	Sig. (2 ends)	,405	<,001	—
	N	56	56	56

Note: **. The correlation is significant at the 0.01 level (2 extremes).
Source: Author's own work, 2022.

Correlation Between Lesion Size at Mammography, Ultrasonography and Mri With Pathological Anatomy

Through Spearman's test it was correlated the variables of lesion size in CGM, US and MRI with lesion size in pathological anatomy, (table 15) where the correlation coefficient, rs = 0.937, rs = 0.837 and rs = 0.952, presents a direct correlation, and very strong when correlating the lesion size in CGM and MRI with pathological anatomy and strong when correlating the lesion size in US with pathological anatomy. And according to the significance value (p-value<0.05), p<0.01, we reject the null hypothesis, so there is correlation between measurements.

Table 15: Correlation between lesion size on mammography, ultrasound, and magnetic resonance imaging with pathological anatomy. Correlations (Spearman's ρ)

Variable	Measurement	Lesion Size in MGM	Lesion Size on Ultrasound	Lesion Size on MRI	Lesion Size in Pathological Anatomy
Lesion Size in MGM	Correlation Coefficient	1,000	,823**	,947**	,937**
	Sig. (2 ends)	—	<,001	<,001	<,001
	N	59	59	59	59
Lesion Size on Ultrasound	Correlation Coefficient	,823**	1,000	,868**	,837**
	Sig. (2 ends)	<,001	—	<,001	<,001
	N	59	59	59	59
Lesion Size on MRI	Correlation Coefficient	,947**	,868**	1,000	,952**
	Sig. (2 ends)	<,001	<,001	—	<,001
	N	59	59	59	59
Lesion Size in Pathological Anatomy	Correlation Coefficient	,937**	,837**	,952**	1,000
	Sig. (2 ends)	<,001	<,001	<,001	—
	N	59	59	59	59

Note: **. The correlation is significant at the 0.01 level (2 extremes).
Source: Author's own work, 2022.

Discussion

Is there Agreement Between the Measurement of Tumour Size on Different Imaging Examinations and the Actual Size of the Lesion?

Initially it was observed that the mean size of tumours at histopathology was 1.51 x 0.96 mm while at GMM it was 1.53 x 0.92 mm, at US it was 1.38 x 0.86 mm and at MRI it was 1.51 x 0.83, presenting an overestimation at GMM and an underestimation at US.

According to the mean tumour size on pathology-anatomy was 24.8 x 19.4 mm, while on MRI it was 29.7 x 20 mm (P < 0.05), with a significant overestimation. The MR-pathology agreement was 44.3%, while MRI overestimated the size by 36.7% [5].

In the present study, according to Wilcoxon's test, an overestimation of 34/56 (60.7%), 18/56 (32%) and 31/56 (55%) respectively, and an underestimation of 18/56 (32%), 34/56 (60.7%) and 19/56 (33%) respectively were observed in MGM, US and MRI.

There is a higher overestimation in CGM, although not significantly, which coincides with the study of, where it is taken into account that accurate measurement of tumour size in CGM may be negatively affected by increased breast density, observed mainly in younger patients.

There was a higher underestimation in US, which according to the study performed by, the underestimation in US of tumour size measurement may be due to difficult visibility of the posterior margin of the lesion due to inadequate penetration of the US wave and inability to detect microcalcifications and very small lesions [6].

According to, US has as disadvantages the visualisation of only half of CDIS lesions, operator dependence and shows a sensitivity of about 50% in the detection of CDIS. However it remains an imaging modality used in most patients undergoing investigation of any breast lesion and commonly used to search for the target for a possible ultrasound-guided core needle biopsy [7].

Next, it was found that there are no significant differences in tumour sizes measured on MGM and MRI when compared with pathology-anatomy.

However, in relation to US, there were significant differences in the relationship between tumour size in this modality and in the pathological anatomy.

Through Spearman's correlation, it was found that there is a direct correlation, and very strong when correlating the size of the lesion in MGM and MRI with the pathological anatomy and

strong when correlating the size of the lesion in US with the pathological anatomy.

Which Test Presents the Tumour Size Measurement Value Closest to the Pathological Anatomy?

The test with the closest tumour size measurement value to the pathological anatomy was MRI, with average values of 1.5126-1.5146, respectively.

According to some authors the tumour measurement at MRI had a better correlation with the size at pathological examination, when compared with MGM (r = 0.872 × 0.710) and with US (r = 0.836 × 0.704) [8].

According to, in Iceland, preoperative MRI changed the type of surgery performed in 14% of cases, where 8.9%, performed excision and 5.1% performed mastectomy instead of breast conservation. Concluding that approximately 89% of patients, presented agreement between the size of the tumour on MRI and the size of the pathological anatomy.

Are there Factors that Influence the Accuracy of Tumour Dimensions in Imaging Examinations?

Through Spearman's correlation, density was correlated with lesion size in CGM and in pathological anatomy, and it was found that there are no significant differences, i.e. density does not affect measurements in the indicated imaging methods. According to the sensitivity of CGM is significantly negatively affected by increasing breast tissue density, being 30-48% for very dense glandular breast tissue (ACR IV) [9].

Other studies, report that density tends to affect measurement when dealing with high density breasts, category d, "Breast density had a negative influence on mammography sensitivity, with sensitivity of 30-48% in very dense breasts".

The values obtained are contradictory according to some studies, since our sample presents as the most common category b, breasts with scattered fibroglandular densities, with 49.2%, and as previously mentioned the measurement is affected in dense breasts, category d, which in our sample is composed of only 6.2%.

Subsequently the histological type was correlated with the size of the lesion on MRI and pathological anatomy, where it was found that there is an inverse correlation, and a very strong one. There are no significant differences, therefore the histological type does not affect the measurements of the lesion in MRI or in pathological anatomy.

This data also contradicts some studies, as we have eliminated non-mass lesions. Second, it was observed that the type of MRI enhancement ($p<0.001$), was significantly correlated with MRI accuracy [10].

This analysis showed that tumour size estimates in patients whose MRI showed non-mass enhancement ($p = 0.030$; OR: 17.2; 95% CI: 1.3-225.9) or mass lesion with non-mass enhancement ($p = 0.001$; OR: 51.0; 95% CI: 5.0-518.4) were more likely to disagree with pathological measurements compared to cases with only mass lesions on their MRI scans.

Limitations

The small sample size conditioned by the number of patients who underwent QTNA can be listed as the main limitation of this study.

Another limitation of the study is that we do not have measurements of all lesions in all available imaging modalities, due to the external provenance of the patients, which would strengthen the statistical calculations. However, this study allowed reflection and the introduction of new procedures for inclusion of external examinations in the PACS (Picture Archiving and Communication System) of the CHUA.

Conclusion

In view of the proposed objectives we conclude that there is correlation between tumour measurement performed on MGM and MRI with tumour measurement on pathological anatomy. That factors such as histological classification, breast size and density do not affect the measurements of the tumor and that MRI is the examination with greater accuracy when correlated with the pathological anatomy. This work may be improved with the increase of the sample or even continued with the inclusion of other variables, such as the evaluation of margins.

Referencias

1. Haraldsdóttir, K. H., Halldórsdóttir, A. B. J., Tranberg, K. G., & Ásgeirsson, K. S. (2017). Tumor size of invasive breast cancer on magnetic resonance imaging and conventional imaging (mammogram/ultrasound): Comparison with pathological size and clinical implications. Scandinavian Journal of Surgery, 106(1), 68–73. https://doi.org/10.1177/1457496916631855
2. Cuesta, A. B. C., Ríos, M. D. M., Meseguer, M. R. N., Velasco, J. A. G., Martínez, M. M., Sotillos, S. B., & Griego, E. A. (2019). Accuracy of tumor size measurements performed by magnetic resonance, ultrasound and mammography, and their correlation with pathological size in primary breast cancer. Cirugía Española, 97(7), 391–396. https://doi.org/10.1016/j.ciresp.2019.04.017
3. Jiang, Y.-Z., Xia, C., Peng, W.-T., Yu, K.-D., Zhuang, Z.-G., & Shao, Z.-M. (2014). Preoperative measurement of breast cancer overestimates tumor size compared to pathological measurement. PLOS ONE, 9(1), e86676. https://doi.org/10.1371/journal.pone.0086676
4. Hormigo, I. R. (2018). Analise comparative das characteristics clinics dos subtypes imunohistoquímicos de cancro da mama (Master's thesis, Faculae de Medicina Lisboa, Clinical Universitario de Chirurgic II). https://repositorio.ul.pt/bitstream/10451/42218/1/InesRHormigo.pdf
5. Mennella, S., Garlaschi, A., Paparo, F., Perillo, M., Celenza, M., Massa, T., Rollandi, G. A., & Garlaschi, G. (2015). Magnetic resonance imaging of breast cancer: Factors affecting the accuracy of preoperative lesion sizing. Acta Radiological, 56(3), 260–268. https://doi.org/10.1177/0284185114524089
6. Siqueira, F. M. D. P., Rezende, C. A. D. L., & Barra, A. D. A. (2008). Correlaçãoentre o exam clinic, a mammographic e a ultrasonographic com o exam anatomopathological determinacies do tamanol tumoral no cancer de mama. Revita Brasileira de Gynecologic e Obstetrician, 30(3), 107–112. https://doi.org/10.1590/S0100-72032008005000005

7. Proulx, F., Correa, J. A., Ferre, R., Omeroglu, A., Aldis, A., Meterissian, S., & Mesurolle, B. (2016). Value of pre-operative breast MRI for the size assessment of ductal carcinoma in situ. British Journal of Radiology, 89(1058). https://doi.org/10.1259/bjr.20150543
8. França, L. K. L., Bitencourt, A. G. V., Paiva, H. L. S., Silva, C. B., Pereira, N. P., Paludo, J., Graziano, L., Guatelli, C. S., de Souza, J. A., & Marques, E. F. (2017). Role of magnetic resonance imaging in the planning of breast cancer treatment strategies: Comparison with conventional imaging techniques. Radiologic Brasileira, 50(2), 76–81. https://doi.org/10.1590/0100-3984.2015.0124
9. Gruber, I. V., Rueckert, M., Kagan, K. O., Staebler, A., Siegmann, K. C., Hartkopf, A., Wallwiener, D., & Hahn, M. (2013). Measurement of tumor size with mammography, sonography and magnetic resonance imaging as compared to histological tumor size in primary breast cancer. BMC Cancer, 13(1), 328. https://doi.org/10.1186/1471-2407-13-328
10. Azhdeh, S., Kaviani, A., Sadighi, N., & Rahmani, M. (2020). Accurate estimation of breast tumor size: A comparison between ultrasonography, mammography, magnetic resonance imaging, and associated contributing factors. European Journal of Breast Health, 17(1), 53–61. https://doi.org/10.4274/ejbh.2020.5888