

PhiΦBreast New Diagnostic Techniques for Breast Cancer Detection

Ersilio Trapanese ^{1,2}, Giulio Tarro ^{3*}

¹ Director from Division of Diagnostic Imaging & Interventional Ultrasound - CMM Diagnostic Center - Cava de' Tirreni, Italy

² Member of the Board of Directors T. & L. De Beaumont Bonelli Foundation for Cancer Research - Naples, Italy

³ President Foundation T. & L. De Beaumont Bonelli for Cancer Research - Naples, Italy

***Corresponding Author:** Giulio Tarro, President Foundation T. & L. De Beaumont Bonelli for Cancer Research - Naples, Italy.

Received date: January 11, 2024; **Accepted date:** January 31, 2024; **Published date:** February 08, 2024

Citation: Ersilio Trapanese, Giulio Tarro, (2024), Research Article: PhiΦBreast New Diagnostic Techniques for Breast Cancer Detection, *Clinical Research and Clinical Trials*, 9(2); DOI:10.31579/2693-4779/178

Copyright: © 2024, Giulio Tarro. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract:

Background:

Today, breast cancer is one of the most aggressive cancers in women and new cases continue to increase worldwide. In order to reduce mortality, we need to detect this life-threatening disease at an earlier stage.

For two years, we have conducted a study for the identification and characterization of suspicious breast lesions using a new diagnostic technique applied to ultrasonography and mammography called "PhiΦBreast."

Methods:

We have conducted a study for the identification and characterization of suspicious breast lesions using a new diagnostic technique applied to mammography and ultrasonography.

Ultrasound systems with high frequency probes was used, 10-15 MHz, and Digital Breast Tomosynthesis (DBT).

Identification and characterization of category C4-C5 lesions of the breast with high Predictive Positive PPV value, with a new innovative method called "PhiΦBreast" using the Golden Ratio (Phi, or Φ 1.618...) Fibonacci sequence and a Predictive Algorithm, applied to the ultrasonography and mammography with subsequent deepening with cytological examination using Fine Needle Aspiration Cytology (FNAC), according to evaluation criteria of the Breast Imaging Report Data System (BI-RADS) and the American College of Radiology (ACR).

Usefulness of this research and the use of this new diagnostic technique is to detect the breast cancer in early stage. In addition to develop a classification model of the histological type identified in the section areas and the percentage of probability in relation between the Golden Ratio (Φ) and Fibonacci sequence.

Results:

With the use of Golden Ratio and Fibonacci sequence, applied to ultrasonography and mammography, we have experimented and developed a diagnostic map with characteristics of high probability of identifying suspicious lesions at an early stage.

We examined 987 women, 55 lesions detected with PhiΦBreast pattern were classified according to BI-RADS descriptors for US-imaging, including morphologic features that had a high predictive value for the malignancy ($p < 0.001$)

This innovative diagnostic technique has shown a sensitivity of 95%, a specificity of 97%, a positive predictive value (PPV) of 97%, and negative predictive value (NPV) of 96%.

Furthermore, with a Predictive Algorithm associated with malignant cytology after FNAC, we have classified different types of potentially life-threatening cancers for patients.

Conclusion:

PhiΦBreast could be an important new model diagnostic technique to be applied mammography and ultrasound for detection of malignant lesions of category C4-C5.

In diagnostic imaging is fundamental to recognize predictively the characteristics of a potentially aggressive tumor. This new model could represent the cornerstone as an important contribution for early diagnosis of breast cancer.

Keywords: phiφbreast, predictive algorithm, golden ratio, fibonacci sequence, breast cancer

Introduction

Breast cancer is the most commonly diagnosed cancer among US women, with an estimated 268,600 newly diagnosed women with invasive disease (48,100 cases of ductal carcinoma in situ [DCIS]) in 2019, accounting for

approximately 15.2%-30% of all new cancer cases among women, depending on the data sources [1-2].

In Europe, every year more than 200,000 women are affected by breast cancer every year, with an incidence ranging from 5 to 10% depending on the country.

There are several risk factors that contribute to the development of breast cancer. Most relevant non-changeable risk factors are: gender, age, genetic predisposition, mutations in the BRCA1, BRCA2 genes [3] (which carry a 60-90% risk of developing a breast cancer over the course of life), Li Fraumeni syndrome [4], mutation of the gene that codes for p53 [5], Lynch syndrome [6]. Ethnic group [7], atypical mammary hyperplasia, high breast density. Environmental factors: exposure to ionizing radiation in childhood and / or juvenile age (for example in women with previous Hodgkin lymphoma). Hormonal therapies: HRT-estrogenic [8], which involve a minimum increased risk.

In our research, nodular lesions of the breast category C4-C5 with high positive predictive value (PPV), were identified and characterized with a new method called PhiPhiBreast using the Golden Ratio, Fibonacci sequence and a Predictive Algorithm, applied to ultrasonography and mammography with subsequent study with cytological examination using fine needle aspiration cytology (FNAC) in respecting the criteria of the American College of Radiology (ACR) and Breast Imaging Report Data System (BI-RADS).

Methods

For two years, we have conducted a study for the identification and characterization of suspicious breast lesions using a new diagnostic technique applied to ultrasonography and mammography called "PhiPhiBreast."

All patients underwent to two-dimensional ultrasound examination (2 DUS).

Dynamic imaging sequences were acquired using ultrasound system with a 10-15 MHz high-frequency linear probes and Digital Breast Tomosynthesis procedure.

High-resolution real-time ultrasonography (US) can detect characteristics of breast nodules.

Characterization of the mammary nodules was performed according to the following criteria: shape, echostructure, level of echogenicity, margins, size and topographical area.

Using the method of PhiPhiBreast ultrasonographic study, on 55/987 patients were identified solid lesions markedly hypoechoic echostructure, round shape, with irregular and infiltrative margins and cuneiform shape with blurred margins (**Figure 1**).

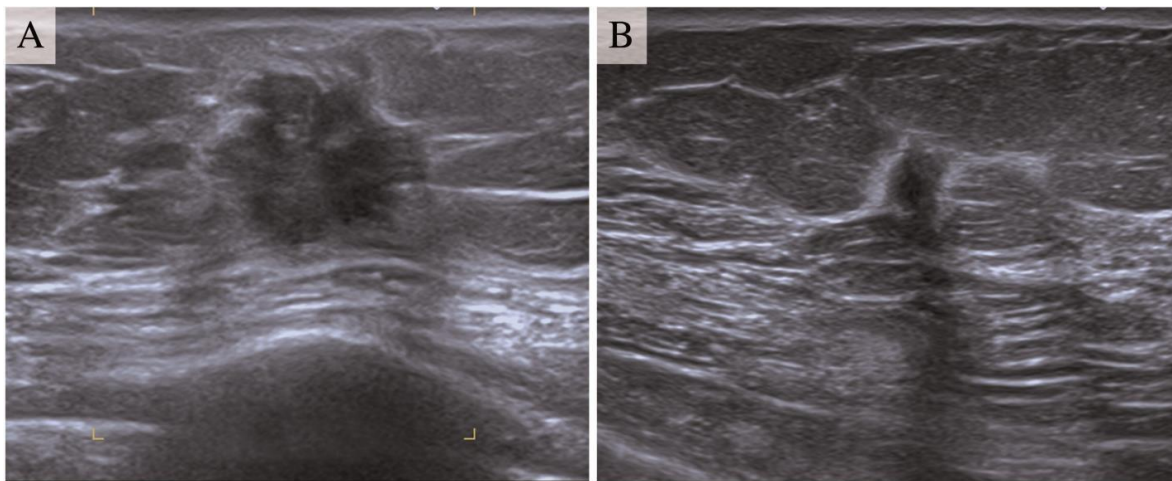


Figure 1. Ultrasonography Image of Suspicious Nodular Lesions Identified with PhiPhiBreast Model.

Panel A solid lesion, round shape, markedly hypoechoic echostructure with irregular and infiltrative margins. Panel B solid lesion, cuneiform shape, markedly hypoechoic echostructure with blurred margins.

After having their consent, 55 selected patients underwent a mammography examination with subsequent diagnostic deepening Fine Needle Aspiration Cytology (FNAC) procedure under ultrasonography guidance.

PhiPhiBreast imaging applied to the mammography in the craniocaudal (CC) view and mediolateral oblique (MLO) view has given rise to a mapping of neoplastic nonpalpable breast lesions (Figure 2 and Figure 3).

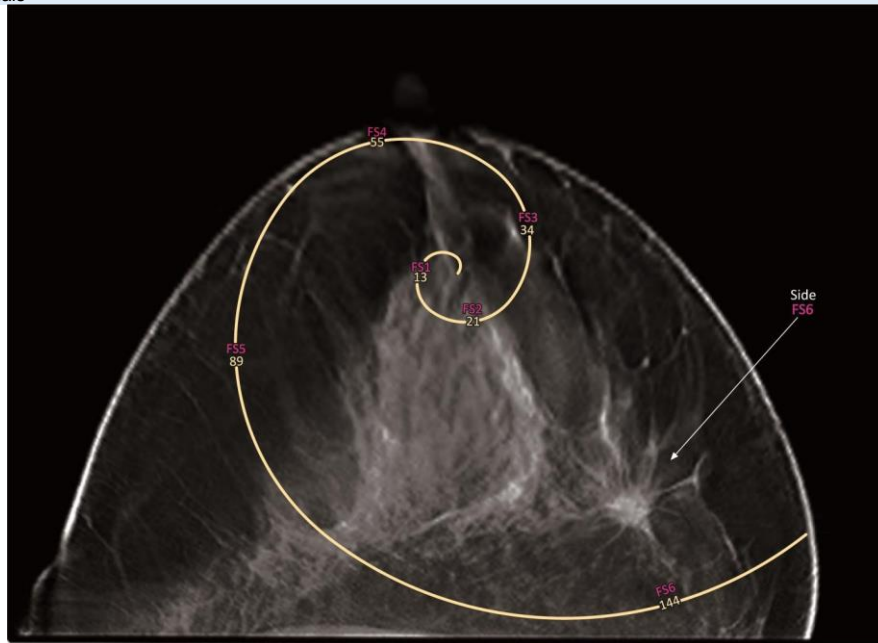


Figure 2. Golden Ratio (Φ) Breast Cancer Detection and Fibonacci Sequence

Cranial-caudal view (CC) show Fibonacci Spiral approximates the Golden Ratio (Φ) using mammogram inscribed in squares of integer Fibonacci number side, shown for square size (13,21,34,55,89,144) making use the following nomenclature "Fibonacci- number Side" (FS1, FS2, FS3, FS4, FS5, FS6). The arrow show extraordinary X-ray vision of the cancer accurately detected in FS6 side.

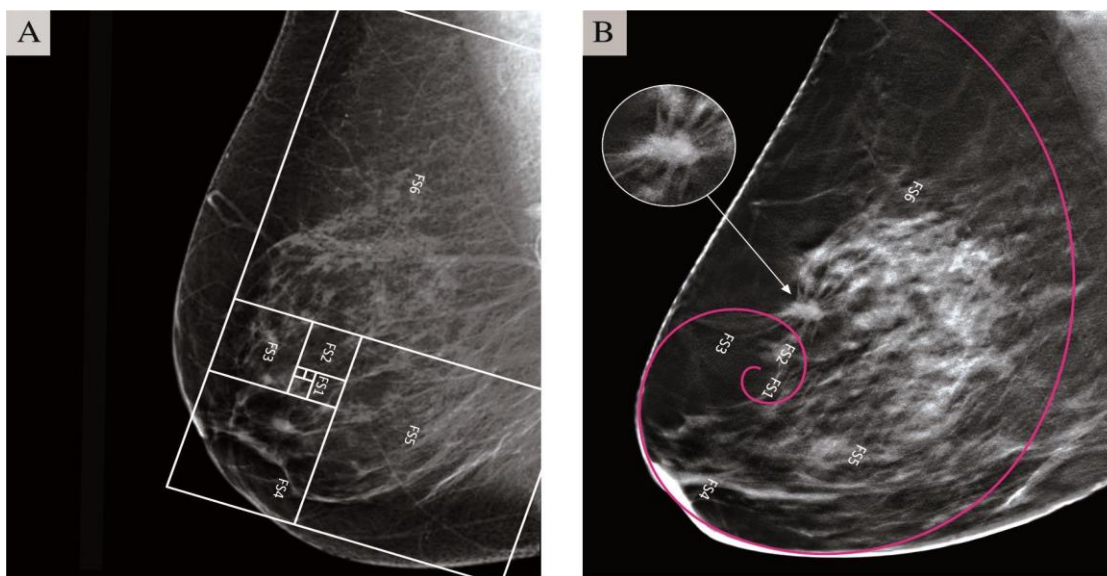


Figure 3: PhiPhiBreast A New Diagnostic Technique for Breast Cancer Detection

Panel A show mediolateral oblique view (MLO) of the breast at mammographic X-ray with applied Golden Ratio and Fibonacci numbers of healthy individual. No nodules were detected along the Golden Ratio. Panel B PhiPhiBreast imaging applied to the mammogram has provided a mapping of neoplastic lesion. White arrow highlights cancerous tumor detected in FS6 side of the Golden Spiral. Cancerous mass appears as a bright centrally dense and irregular image with borders spiculated edges.

PhiPhiBreast produced important data for the elaboration of a Predictive Algorithm on the probability of development of various histological types of tumors and the percentage detectable in the areas of the Golden Ratio and the Fibonacci numbers, when applied in the breast (13,21,34,55,89,144) using the following nomenclature "Fibonacci-number Side" (FS1, FS2, FS3, FS4, FS5, FS6) (Table 1).

Table 1. Predictive Algorithm Breast Cancer.		
Histological types and percentage tumors detected in the Golden Ratio (Φ) and Fibonacci sequence		
Φ Section Area 13	*FS1 Ductal Carcinomas in Situ	[3%]
Φ Section Area 21	*FS2 Ductal Carcinomas in Situ	[7%]
Φ Section Area 34	*FS3 Invasive Ductal Carcinomas	[13%]
Φ Section Area 55	*FS4 Invasive Ductal Carcinomas	[8%]
Φ Section Area 89	*FS5 Invasive Lobular Tumors	[14%]
Φ Section Area 144	*FS6 Invasive Carcinomas not Otherwise Specified	[55%]
Φ Golden Ratio	*Fibonacci-number Side	

Table 1. Φ Golden Ratio and The Nomenclature *Fibonacci-number Side

Percentage of tumors detected in the Fibonacci-number Side: FS1-FS2 10% of ductal carcinomas in situ; FS3-FS4 21% of invasive ductal carcinomas; FS5 14% invasive lobular tumors and FS6 55% invasive carcinomas not otherwise specified.

The results of cytology identified 55 tumors:13 ductal carcinomas in situ, 10 invasive ductal carcinomas, 6 invasive lobular tumors and 26 invasive carcinomas not otherwise specified.

The surgery was established based on the type of tumor identified in patients in the preoperative phase.

The histological diagnosis confirmed the tumor nature of the cells of the analyzed tissues, performed according to the criteria established by the American College of Radiology (ACR) and Reporting Breast Imaging and Data System (BI- RADS).

Patients underwent blood chemistry controls and tumor markers. The follow up period lasted about 1 year.

Results

The Golden Ratio (Phi, or Φ 1.618...) is a potentially unifying quantity of structure and function in nature, as best observed in phyllotactic patterns in plants. For centuries, Phi (Φ) has been identified in human anatomy, and in recent decades, Φ has been proved in human physiology as well with scientific studies of some authors [9-10]. With the use of Golden Ratio [11] and Fibonacci sequence [12] applied to ultrasonography and mammography, we have experimented and developed a diagnostic map with characteristics of high probability of identifying suspicious lesions at an early stage.

We examined 987 women, 55 lesions detected with Phi Φ Breast pattern were classified according to BI-RADS descriptors for US-imaging, including morphologic features that had a high predictive value for the malignancy ($p < 0.001$).

This innovative diagnostic technique has shown a sensitivity of 95%, a specificity of 97%, a positive predictive value (PPV) of 97%, and negative predictive value (NPV) of 96%. Furthermore, with a Predictive Algorithm associated with malignant cytology after FNAC, we have classified different types of potentially life-threatening cancers for patients.

Discussion

Fascinated by golden ratio and Fibonacci sequence, we have devised a new diagnostic imaging model called Phi Φ Breast applied to ultrasonography and

mammography to early detection nodular lesions with echostructural features of malignancy.

The National Cancer Institute (NCI) recommends five categories for diagnosis of breast aspiration cytology [13] in order to bring a degree of uniformity to the diagnostic reporting. These categories are unsatisfactory (C1), benign lesion (C2), atypical, probably benign (C3), suspicious, probably malignant (C4), and malignant (C5).

However, some authors believe that C3 and C4 should be categorized in the same category [14-15].

The analyzed cytological samples were classified according to NBSBSP into the following categories: C4-C5 [16].

A modern predictive algorithm has been elaborated.

This diagnostic technique called Phi Φ Breast in ultrasonography and mammography, respecting the criteria of the American College of Radiology (ACR) [17] & Breast Imaging Report Data System (BI-RADS) [18] proved to be reliable. Having compared our research with important magnetic resonance imaging (MRI) studies performed by various researchers [27,28,29,30,31], the early identification of malignant lesions was confirmed, with a high positive predictive value (PPV) with a sensitivity (95%) specificity (97%) value positive predictive (97%) negative predictive value (96%).

We selected 55 patients, which were subjected to a diagnostic deepening with mammography exam and used as a reading interpretation to mammogram the Phi Φ Breast imaging method and subsequent FNAC [19] under ultrasound guidance with a 19-gauge needle by execution of three passages through the nodular lesion.

Suspicious lesions detected from topographic mapping were classified category C4-C5 (NCI guidelines) [20].

Patients were treated with different surgical techniques.

The Veronesi quadrantectomy [21] represents a milestone in the treatment of breast cancer, currently the first scientifically validated conservative protocol.

The Nipple Sparing Mastectomy (NSM) [22], the Skin-Sparing Mastectomy that includes the Nipple-Areolar Complex (SSM+NAC) [23] with lymphadenectomy and Intraoperative Radiation Therapy (IORT) [24].

Post-operative histological results were all classified as carcinomas.

We paid special attention to the ability of PhiΦBreast to offer an innovative topographic diagnostic imaging of suspicious lesions and using a predictive algorithm.

Different types of tumors were detected in the Golden Section areas, using Fibonacci numbers for mapping and classify the percentage of cancers identified in the different sections.

Percentage of tumors detected in the Fibonacci-number side was as follows: FS1-FS2 (10%) of ductal carcinomas in situ; FS3-FS4 (21%) of invasive ductal carcinomas; FS5 (14%) invasive lobular tumors and FS6 (55%) invasive carcinomas not otherwise specified.

These new diagnostic techniques have been discussed in previous studies [25-26].

Described by other authors, irregular and spiculated margins have been shown to be associated with an increased likelihood of malignancy.

Liberman et al. [27] described in a study that a spicular margin was the most suspicious characteristic identified with a high PPV.

Wedegärtner et al. [28] reported an irregular margin of the lesion to be the most reliable morphological feature to indicate malignancy.

Schnall and colleagues [29] identified spiculated margins to be a highly predictive feature of the cancer image and Gutierrez et al. [30] found irregular or spiculated margins conferring the highest probability of malignancy by BI-RADS classification.

In a retrospective study, Tozaki and collaborators [31] found irregular shape (97%) and spiculated margins (100%) among the features with higher predictive value for carcinoma.

Conclusion

Availing Golden Ratio (Φ), Fibonacci sequence and Predictive Algorithm applied to ultrasonography and mammography, we have given rise to a new diagnostic imaging model called PhiΦBreast for the identification of category C4-C5 lesions with high PPV in respecting the criteria of the American College of Radiology (ACR) and Breast Imaging Reporting Data System (BI-RADS).

This original scientific paper could bring progress in science, an important advancement and discovery which could save more lives from despair and in the worst-case scenario of the patient's death.

PhiΦBreast could have important diagnostic imaging applications as a new strategy for thwart breast cancer.

Reference

- (2019). National Cancer Institute, Surveillance, Epidemiology, and End Results Program (SEER). Cancer stat facts: female breast cancer.
- DeSantis CE, Ma J, Gaudet MM et al. (2019). Breast Cancer Statistics. CA Cancer J Clin. Nov. 69 (6):438-51.
- Narod SA, Salmena L. (2011). BRCA1 and BRCA2 mutations and breast cancer. Discov Med 12:445-53.
- Ariffin H. (2014). Whole-genome sequencing analysis of phenotypic heterogeneity and anticipation in Li-Fraumeni cancer predisposition syndrome Proc. Natl. Acad. Sci. USA, 111, 15497-15501.
- Leroy B (2013). The TP53 website: an integrative resource centre for the TP53 mutation database and TP53 mutant analysis. Nucleic Acids Res. 41, 962-969.
- Barrow E, Hill J, Evans DG. (2013). Cancer risk in Lynch

- Syndrome. Fam. Cancer 12:229-240.
- Chlebowski RT, Chen Z, Anderson GL, (2005). Ethnicity and breast cancer: factors influencing differences in incidence and outcome. J Natl Cancer Inst 97:439-448.
- Fletcher AS, Erbas B, Kavanagh AM, Hart S, Rodger A, 14:192-200.
- Tamargo R. J, Pindrik J. A. (2019). Mammalian Skull Dimensions and Golden Ratio. J Craniofac Surg 30: 1750-1755.
- Yetkin G, Sivri N, Yalta K, (2013). Golden Ratio is beating in our heart. Int J Cardiol 168:4926-4927.
- Livio M. (2022). The Golden Ratio: The Story of Phi, the World's Most Astonishing Number. New York, NY: Broadway Books, Random House Inc.
- Vajda S. (2008). Fibonacci and Lucas numbers, and the Golden section: theory and applications. Dover Publication New York, NY.
- (1997). The uniform approach to breast fine-needle aspiration biopsy. National Cancer Institute Fine-Needle Aspiration of Breast Workshop Subcommittees. Diagnostic Cytopathology, 16:4295-311.
- Howell L.P. (1999). Equivocal diagnoses in breast aspiration biopsy cytology: sources of uncertainty and the role of, "atypical/indeterminate terminology." Diagnostic Cytopathology 21: 217-222.
- Kanhoush R, Jorda M, Gomez-Fernandez C. (2004.). Atypical and "suspicious" diagnoses in breast aspiration cytology: ¿is there a need for two categories? Cancer, 102(3)164-167,
- Kocjan G. (2008). Needle aspiration cytology of the breast: current perspective on the role in diagnosis and management. Acta Med Croatica 62(4)391-401.
- Mainiero MB, Moy L, Baron P et al. (2017). ACR Appropriateness Criteria Breast Cancer Screening. J Am Coll Radiol. 14(11): 383-390.
- Berg WA, Campassi C, Langenberg P.(2000) Breast Imaging Reporting and Data System Inter-and Intraobserver Variability in Feature Analysis and Final Assessment. AJR Am J Roentgenol.174(6):1769-77.
- Yu YH, Wei W, Liu JL. (2012). Diagnostic value of fine-needle aspiration biopsy for breast mass: A systematic review and meta-analysis. BMC Cancer 12:41.
- Arul P, Suresh M. (2017). Application of National Cancer Institute recommended terminology in breast cytology. J Cancer Res Ther.13(1):91-96.
- Zurrada S. (2001). The Veronesi quadrantectomy: an established procedure for the conservative treatment of early breast cancer. Int J Surg Investig 2(6):423-31.
- Crowe, J.P. Jr., Kim, J.A., Yetman, R., Banbury, J., Patrick, R.J., Baynes, D. (2004). Nipple-sparing mastectomy: technique and results of 54 procedures. Arch Surg 139:148-150.
- Gerber, B., Krause, A., Reimer, T. (2003). Skin-sparing mastectomy with conservation of the nipple-areola complex and autologous reconstruction is an oncologically safe procedure. Ann Surg 238:120-127.
- Sedlmayer, F., Reitsamer, R., Wenz, F. (2017). Intraoperative radiotherapy (IORT) as boost in breast cancer. Radiat Oncol 12-23.
- Trapanese E., Tarro G. (2021). PhiΦBreast New Diagnostic Techniques for Breast Cancer Detection. British Journal of Cancer Research. 4(3): 534-539.
- Trapanese E., Tarro G. (2021). PhiΦBreast & Theory of Spiral Cancer New Diagnostic Techniques for Breast Cancer Detection. Transl Med Commun 6-23.
- Liberman L, Morris EA, Lee MJ-Y, (2022). Breast lesions detected on MR imaging: features and positive predictive value. AJR Am J Roentgenol 179(1):171-178.

28. Wedegärtner U, Bick U, Wörtler K, Rummeny E, Bongartz G.(2001). Differentiation between benign and malignant findings on MR-mammography: usefulness of morphological criteria. Eur Radiol 11(9):1645-1650.
29. Schnall MD, Blume J, Bluemke DA, et al. Diagnostic architectural and dynamic features at breast MR imaging: multicenter study. Radiology 2006;238(1):42-53.
30. Gutierrez RL, DeMartini WB, Eby PR, Kurland BF, Peacock S, Lehman CD. (2009). BI-RADS lesion characteristics predict likelihood of malignancy in breast MRI for masses but not for nonmasslike enhancement. AJR Am J Roentgenol 193(4):994-1000.
31. Tozaki M, Igarashi T, Fukuda K. (2006). Positive and negative predictive values of BI-RADS-MRI descriptors for focal breast masses. Magn Reson Med Sci 5(1):7-15.



This work is licensed under Creative Commons Attribution 4.0 License

To Submit Your Article, Click Here:

[Submit Manuscript](#)

DOI:10.31579/2693-4779/178

Ready to submit your research? Choose Auctores and benefit from:

- fast, convenient online submission
- rigorous peer review by experienced research in your field
- rapid publication on acceptance
- authors retain copyrights
- unique DOI for all articles
- immediate, unrestricted online access

At Auctores, research is always in progress.

Learn more <https://auctoresonline.org/journals/clinical-research-and-clinical-trials>