Case 420

Eurorad

Breast calcifications – Part 1 of 2

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Authors: Ilie I.Craciun MD
Clinical History:

Female patient
Imaging Findings:

Female patient Mammography
Discussion:

CALCIFICATIONS OF BREAST are the smallest structures identified on a mammogram and are always a sign of a past or ongoing breast tissue alteration.
Extremely common, seen in up to 86% of the mammograms, they are usually benign and their frequency increases with age. They may be located anywhere in the breast structures, including skin and interstitial stroma.

Active cell secretion, cellular necrotic debris, inflammation, foreign body reaction, trauma and radiation are the most usual reasons for their formation. Their exact composition remains uncertain. Apatite, calcite, calcium oxalate, oxalic acid, aragonite and traces of aluminium, iron, magnesium, silicon, copper, gold, silver, titanium and some other elements have been identified. Some studies attempted to connect certain compositions or individual elements within calcifications to malignant or benign changes, in order to allow in vivo spectroscopy differentiate malignant from benign breast changes.

Microcalcifications are best-visualized using high-resolution imaging techniques, vigorous compression and radiographic magnification. <> In order to standardize mammographic reporting, reduce confusing breast imaging interpretations and facilitate outcome monitoring, the American College of Radiology implemented the Breast Imaging Reporting and Database System, known as BIRADS (http://www.breastbiopsy.com/birads.html). While dealing with breast calcifications, BIRADS takes into account distribution of the calcifications within a breast and patterns of calcifications, dealing less with basic morphological characteristics of calcifications.

While attempting to analyse breast calcifications, their characteristics have to be taken into account, combinationsof these characteristics leading finally to a safe management of a given case. <> However, calcifications may be a sign of benign changes they may also disclose a yet nonpalpable malignant process. When attached to an otherwise “benign-looking” finding, they may reveal, through their characteristics, the true malignant nature of the whole

process and on the contrary, by their benign attributes, an otherwise “suspicious-looking” finding may get a less invasive work-up. There are calcifications whose characteristics denote a benign process and other calcifications whose characteristics hint a malignant one. Regardless of the final diagnosis, calcifications should be assessed according to well-established attributes. Shape – Size – Density – Number – Distribution – Location – Associated findings.

SHAPE – The shape of the microcalcifications is probably the most important element in their analysis (fig. 1). They may be punctate, linear, spherical, coarse, cylindrical, smooth, jagged, regular, casting, branching or heterogeneous, with the last three being the most alarming ones.

The erratic growth of a mass and the resulting lack of sufficient blood supply, are the original causes of their emergence. They are in most of the cases, situated within the ductal framework of a cancer and might represent the central primordial structures involved by the neoplastic process. The unpredictable growing process cause the heterogeneity of their shapes by building, dissipating and moulding them, throughout changing the densities and the local pressures of the tissues around them. <> In some cases, the calcifications are secreted within cribriform spaces generated by some cancers, accounting for less characteristic patterns of deposition. As a rule, irregular, comma shaped, angular or branching calcifications, with or without irregular margins are usually due to a malignant process. SIZE – The conditions that favour the appearance of microcalcifications within a malignant process control their size. Being the result of localized randomly distributed and continuous micro-modifications, their size cannot reach large dimensions (fig. 2). Calcifications are often microscopic and seen only by the pathologists but the visible ones may be as small as 0.2 mm. The usual ones, mostly seen on mammograms are not larger than 0.5 mm. but sometimes and especially the casting type may reach sizes up to 1-2 mm. Heterogeneity of their size should be a cause of concern, especially when associated with other suspicion raising elements. DENSITY – Size, shape and chemical composition of the calcifications may influence their radiographic density (fig. 3). Benign processes are usually producing homogeneous, high-density calcifications, while malignancies, by their random evolution, create inhomogeneous, mostly low-density calcifications. NUMBER – A very large number of calcifications may be present within the breast, some having indeterminate characteristics and some clearly benign. The trait we are searching for is aggregation. Aggregation of indeterminate microcalcifications may indicate disease. The rule that five or more microcalcifications within 1 cubic cm. of breast tissue should raise suspicions, may seem arbitrary (fig. 4). Statistically has been proved that less than five microcalcifications grouped together and having benign morphology, have practically no value in indicating a neoplastic process, unless additional suspicious modifications are present. To be suspicious, an isolated cluster of five or more microcalcifications has to be seen within one cubic cm. of breast tissue, on a contact, non-magnified mammogram. There are instances when thousands of microcalcifications may be seen diffusely spread within the breast tissue. The smallest calcifications, forming a cluster or the most densely packed ones are the ones indicating a probably malignant growth. DISTRIBUTION – Calcifications may be distributed in clusters, may fill a segment or may be diffusely scattered over a region, over the entire breast or bilaterally over both breasts (fig. 5, 6). Grouped or clustered calcifications, BIRADS categories 4 or 5 are the most common distribution raising suspicion, although only 25% of them prove to be the result of a malignant process. <> Segmental microcalcifications are distributed within a segmental unit of the breast, including a main duct opening onto the nipple and its branches spreading into the breast. Segmental calcifications may be included in BIRADS categories 2 or 3 if their morphology suggests a past or an ongoing inflammatory process while a suspicious morphology should include them in BIRADS categories 4 or 5. <> Microcalcifications may be the only sign of an intraductal malignant process involving an entire segment, as well as of a multifocal cancer developing as multiple foci of disease within the same ductal unit. Although breast segments are not regular, fixed anatomical structures, contiguous distribution of the calcifications, seen in at least two projections should raise the suspicion of segmental distribution.

Diffusely, scattered calcifications, over a region or the entire breast, have to be at first differentiated from segmental calcifications. True regional and diffusely scattered bilateral microcalcifications are benign, BIRADS categories 2 or

3. <> Linear calcifications are arrayed in a line that may have branching points, but is heading toward the nipple. They may represent an intraductal malignancy spreading through the ductal system and should be included in BIRADS category 4.

It has to be remembered that a focal cluster may be easily overlooked within a breast filled with microcalcifications. When discovered, it has to be separately evaluated starting with spot compression views combined with magnification, until as much information as possible is retrieved and a safe management path is documented.

Multiple groups of microcalcifications spread over the breast are most probably benign, unless there are other characteristics associated with any of the groups that may change the level of suspicion. LOCATION – In order to avoid unnecessary interventions on the breast, the true intramammary location of the calcifications have to be established (fig. 7). Except for cosmetic powders, tattoos and artefacts, dermal calcifications may sometimes have bizarre shapes that may simulate suspicious clusters of microcalcifications. ASSOCIATED FINDINGS – Although calcifications alone are an important sign revealing changes within breast tissue, they may be connected with certain findings that will strengthen or weaken the possibility that they suggest a localized malignant process. Calcifications are usually associated with masses sometimes only with densities or asymmetric breast tissue, all of which may be benign or malignant. They may accompany malignant, benign or post-operative architectural distortion, they may also be associated with dilated ducts or small, invisible cysts. <<>> Analysing breast calcifications may be a laborious process, because all of their characteristics have to be simultaneously taken into account before a conclusion concerning their significance might be reached. <> Morphology alone can in some well-defined instances (popcorn, eggshell or tram-track) point out the benign nature of a breast process. On the other extreme, certain morphologies (branching and casting type) will always be highly suspicious. However, in between there are many morphological possibilities which may not be relied upon to decide whether a certain calcification is the product of a malignant or a benign process. The features of this last category of microcalcifications should be analysed and correlated with the number of elements, their location and distribution within the breast as well as any associated finding, before attempting to include them in a malignant or benign category.

Learning to analyze the individual characteristics of the breast calcifications may be of great help in deciding thereal nature of ongoing or past changes within the breast tissue.

The results of this analysis, corroborated with a thorough understanding of other elements or changes within a breast, will usually guide one to a correct decision, allowing a rapid management of a breast finding with a minimum of financial and emotional strain.

Differential Diagnosis List: Breast Calcifications

Final Diagnosis: Breast Calcifications

References:

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In Kopans DB (ed) Breast Imaging
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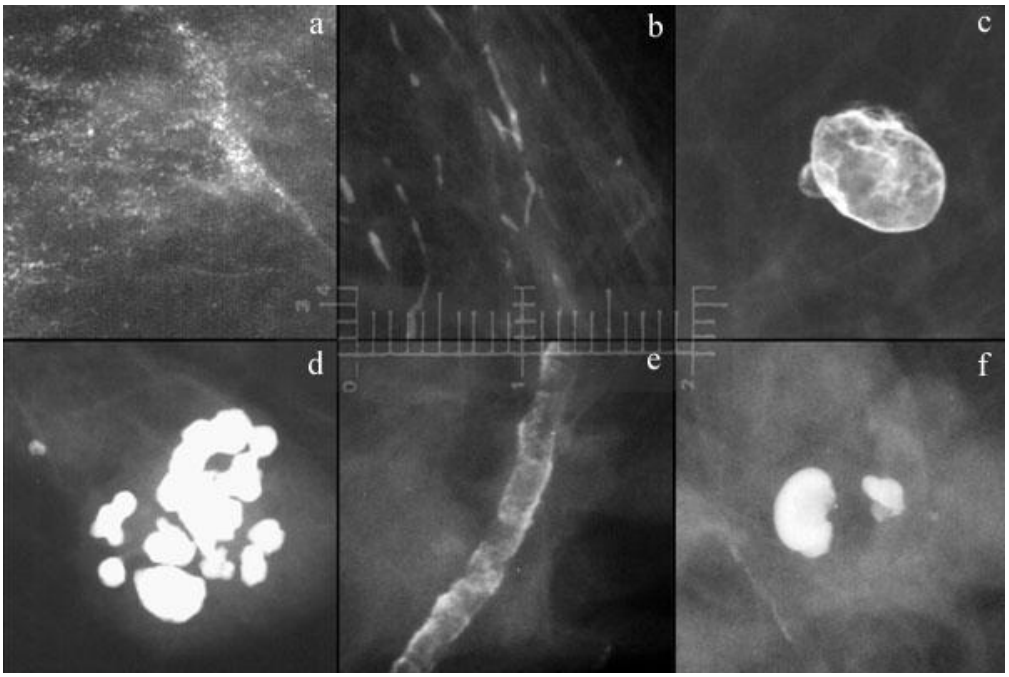
Breast Tumors: Composition of Microcalcifications
Radiology; 169:325-327. (PMID: 2845471)

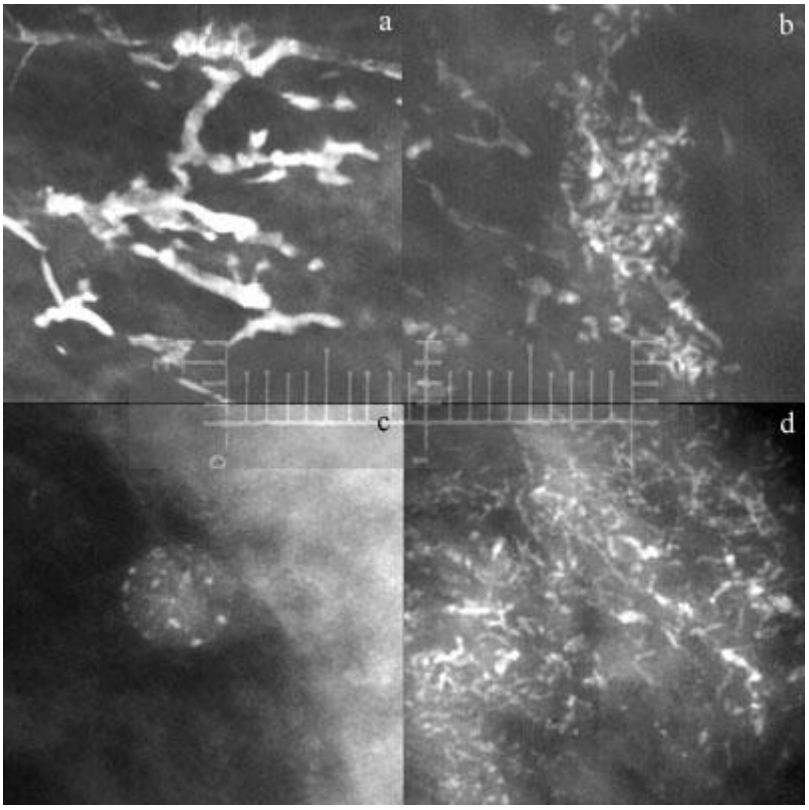
Figure 1

a



Description: {a}-Punctate. Small grains of calcium, round, regular, dense, fairly equal in size, benign microcalcifications. {b}-Linear. Long, dense, smooth, calcifications, outlining the ductal system, usually the result of ductal inflammatory changes. {c}-Spherical. Round or oval, having lucent centers, may be the result of fat necrosis as exemplified here, but may also represent small calcified cysts. {d}-Coarse (popcorn). Large, irregular, very high density, pathognomonic for calcified fibroadenomas. {e}-Cylindrical. Calcium deposits within walls of tubular structures might be vascular as illustrated here or past periductal inflammatory changes. {f}-Smooth. Dense, round, smoothly bordered, medium sized, isolated, benign grains of calcium. **Origin:**

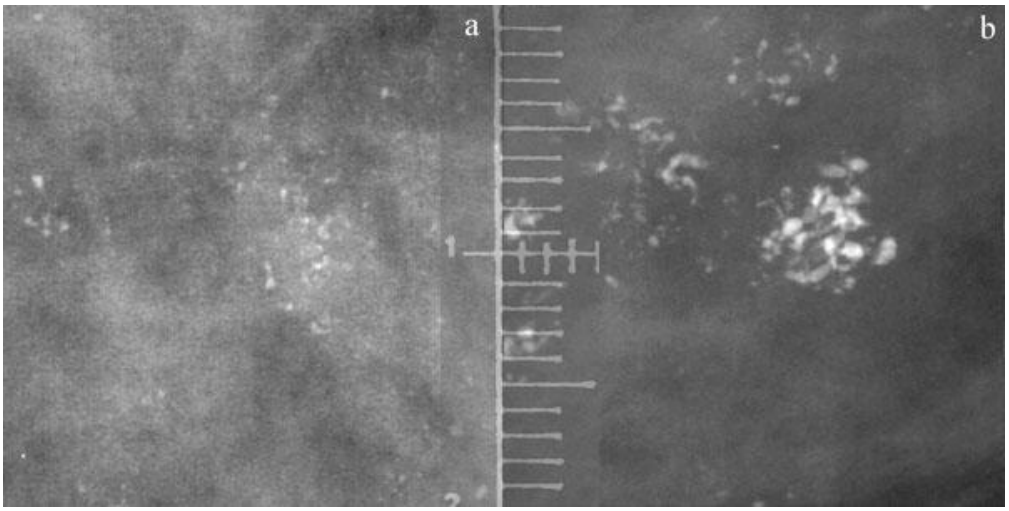
b



Description: {a}-Jagged. Coarse, dense, large, branching calcium deposits following inflammation or irradiation therapy. Dermatomyositis depicted here. {b}-Heterogeneous. Very small < 0.5 mm. variable sizes, shapes and densities, highly suspicious. Ductal Carcinoma in Situ {c}-Regular. Small, dense, round, benign microcalcifications located at the periphery of a small calcifying cyst {d}-Branching. Heterogeneous microcalcifications, filling the ductal system with its dichotomic distribution, highly suspicious, representing here, High Grade DCIS, Comedo type. **Origin:**

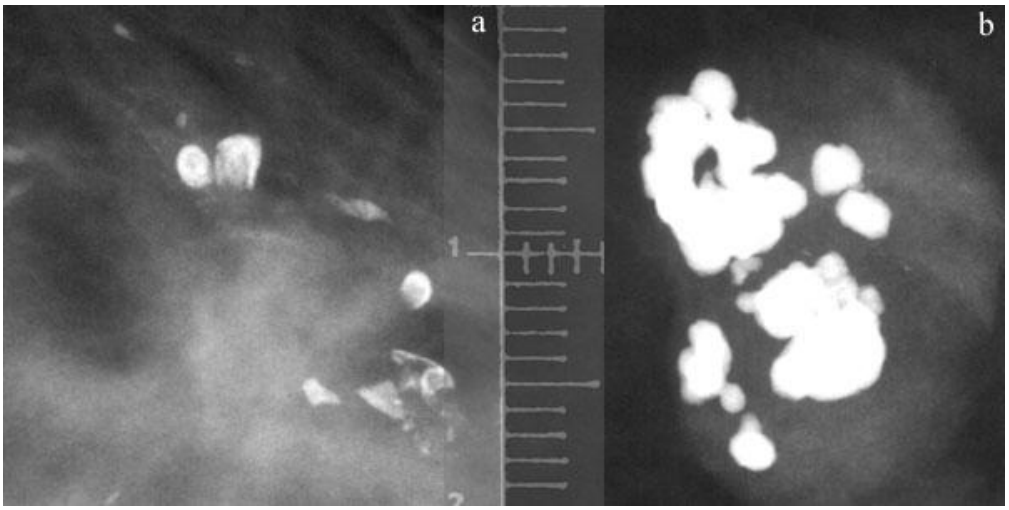
Figure 2

a



Description: Calcifications as small as 0.2 mm may be seen, if carefully searched for. While microcalcifications under 2 mm. in size are suspicious, the size by itself is not enough to decide whether an abnormality represents malignancy or not. The pictures shown here represents a.-Sclerosing Adenosis <> b.-Comedocarcinoma. **Origin:**

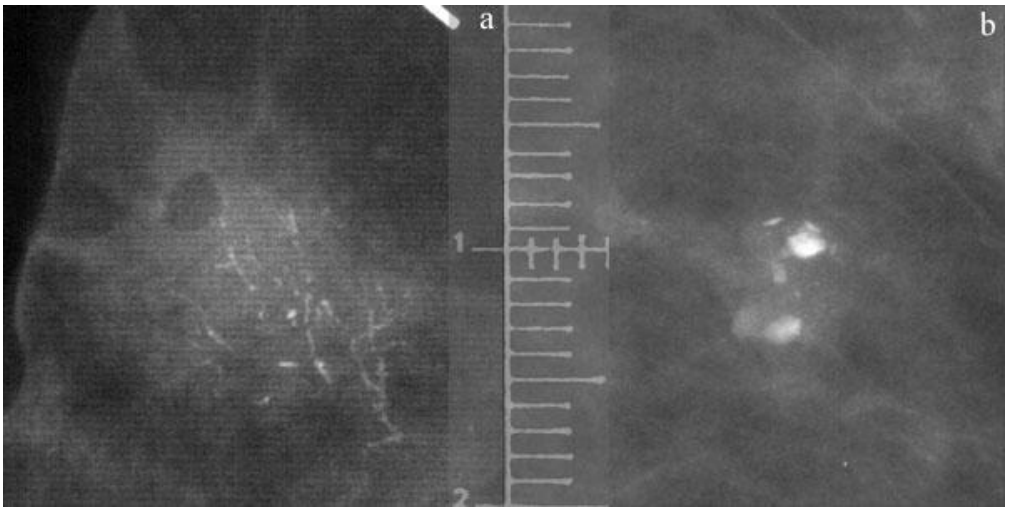
b



Description: Calcifications as large as 20 mm. may be found within a breast. It is agreed that the larger the calcifications the more likely they are to be attached to, or the result of an ongoing or past benign alteration. In order to get closer to the cause that generated them, their size has to be interpreted in combination with their shape, number, density, distribution and other associated findings. On the a. side of the picture, there are some 1-2.5 mm. dense, fragmented, eggshell, benign calcifications representing small cysts or fat necrosis. On the b. side of the picture, large, popcorn calcifications associated to a smooth, larger mass, are characteristic of a calcifying fibroadenoma. **Origin:**

Figure 3

a

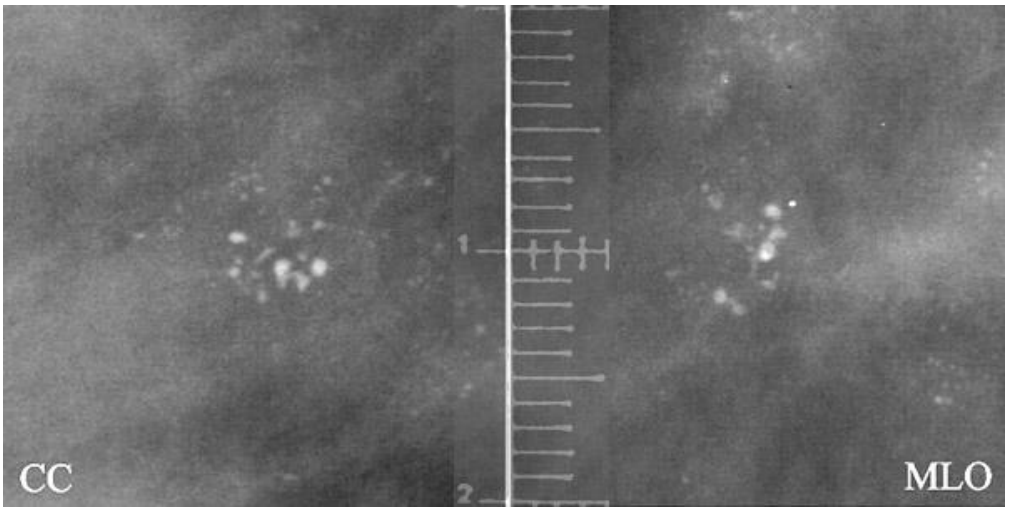


Description: Density of calcifications alone, is not a sufficient criterion to establish the true nature of a breast finding. It is usually agreed that low-density calcifications are suspicious, while high-density calcifications accompany benign lesions. Differences in density might be induced by differences in size and shape, as well as by the thickness of the breast tissue. In order to reach the right diagnosis, all characteristics have to be taken into account. The a. side of the picture represents DCIS radiographed on a postoperative specimen, while the b. side of the picture represents a calcifying fibroadenoma.

Origin:

Figure 4

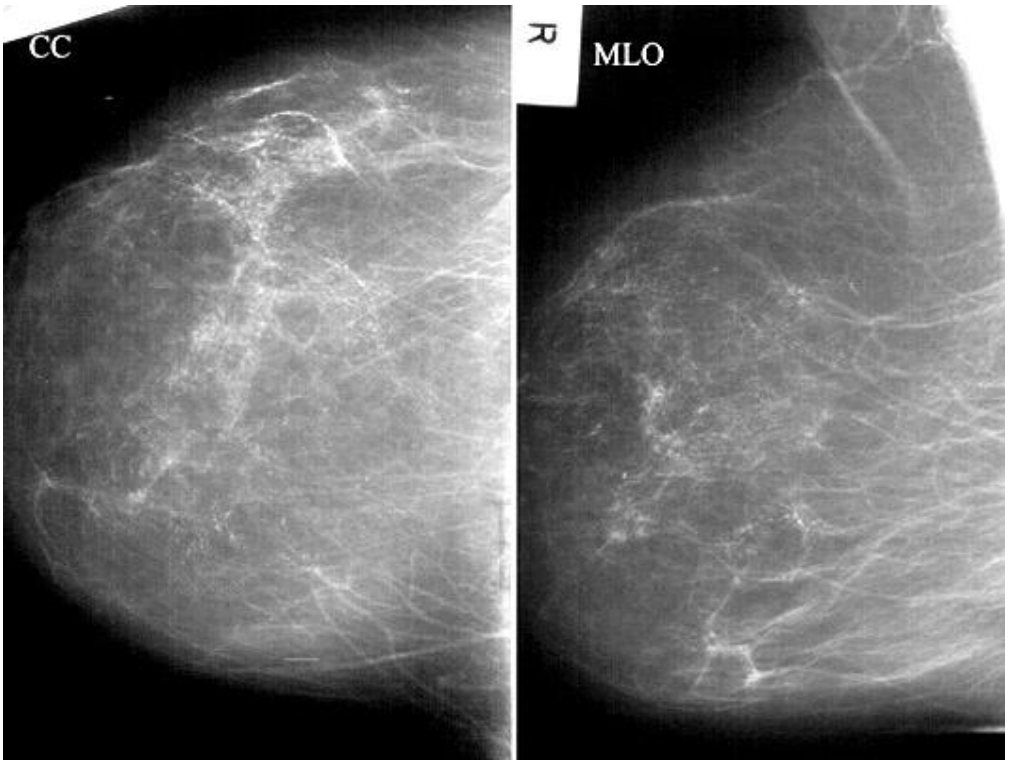
a



Description: "Cluster" is probably one of the most important concept in analyzing microcalcifications in mammography. There are three elements that define a cluster: FIVE microcalcifications; ONE CUBIC CENTIMETER that is 1 square cm. on two projections; NON-MAGNIFIED contact view. **Origin:**

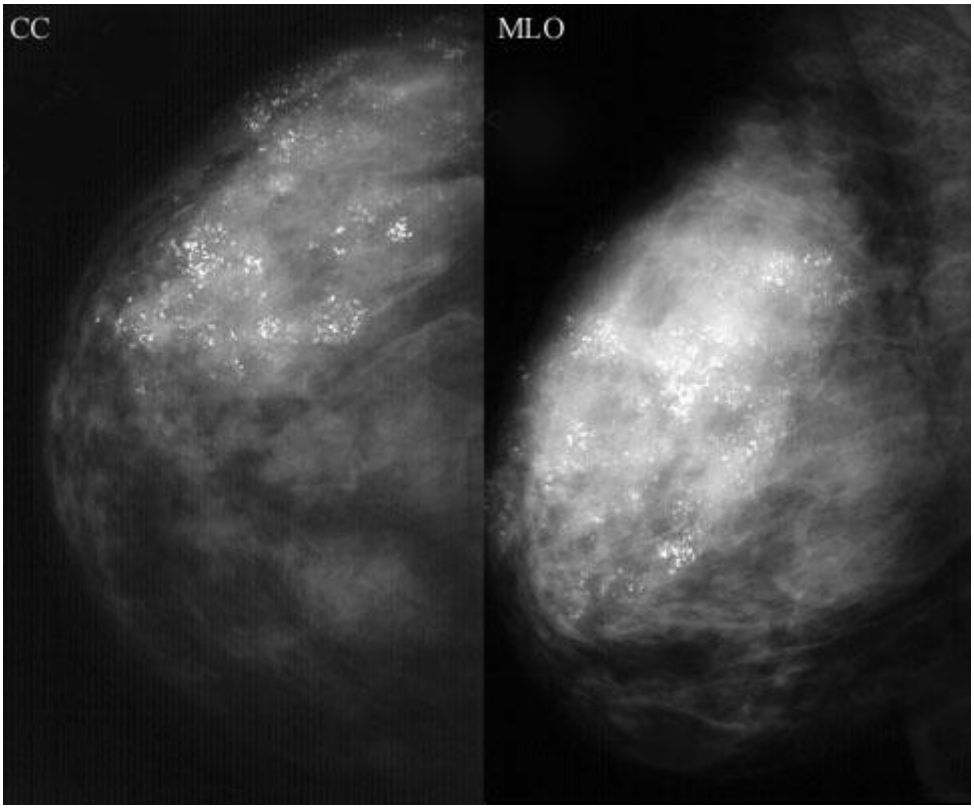
Figure 5

a



Description: The distribution of the calcifications has direct implications on the diagnostic importance of this finding, influencing also the management of the underlying cause. A widespread distribution, even over an entire breast is worrisome if unilateral, while bilateral changes are suggestive of a benign processes. It should be kept in mind that widespread, benign changes might sometimes hide small, significant, suspicious lesions that have to be carefully searched for. In the case shown here, the process is benign, bilateral and symmetric without any additional finding. **Origin:**

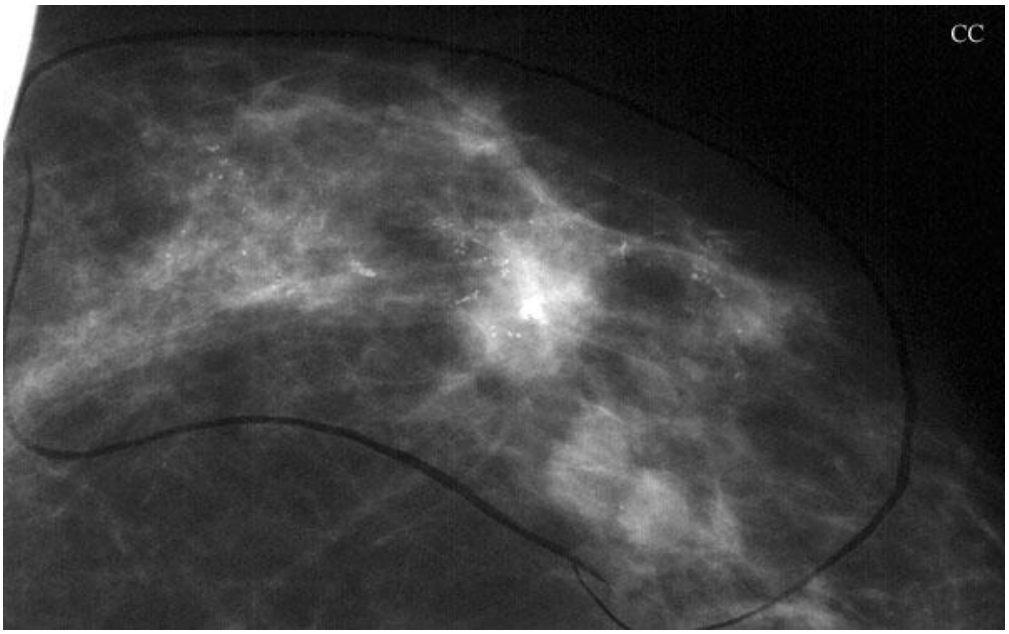
b



Description: A regional distribution, may show microcalcifications occupying a quadrant or more of the breast, with no relation to the underlying segmental structure. A malignant process having this characteristic is in fact a multicentric malignant process, developing simultaneously within a number of segments, in contrast with the multifocal malignancies, developing simultaneously from few foci within the same segment. **Origin:**

Figure 6

a



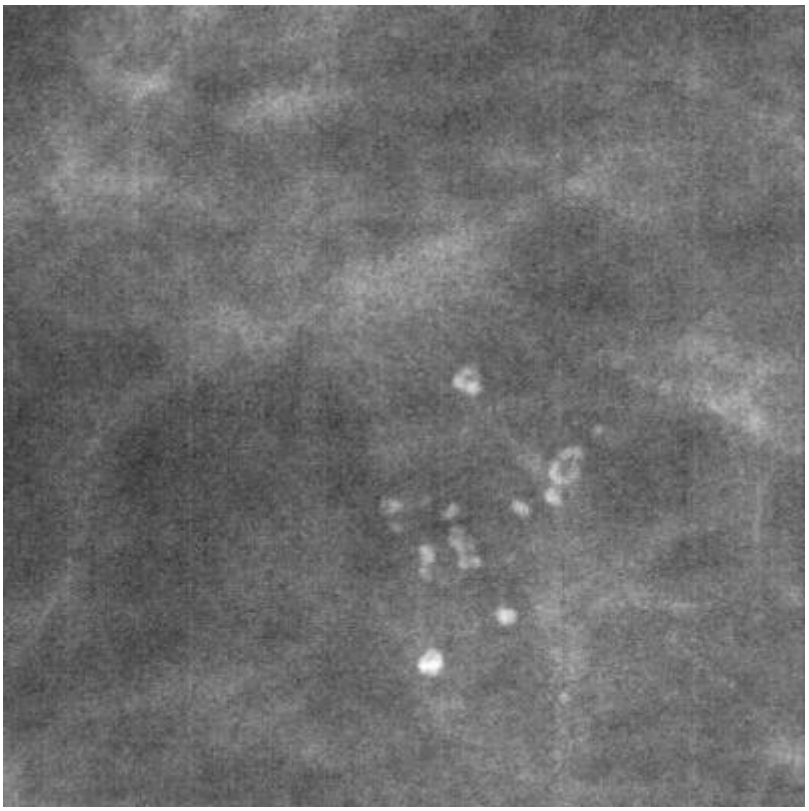
Description: Segmental distribution of microcalcifications is almost always suspicious. A segment, the anatomical unit of the breast formed by a major duct and its tributaries, may be involved in its entirety by a pathologic process propagating throughout the segmental ductal system. Absent anatomical boundaries, make an infectious process unlikely to be confined to a single segment. If such an instance occur, the size, shape and density of the resulting calcifications will reveal the benign nature of the process (cont. fig. 6b). **Origin:**

b

Description: More often, neoplastic cells that do not posses the ability to invade, proliferate erratically within a duct. They propagate contiguously throughout the ductal system, involving ductal branches and even lobules. There are instances though, when cellular clones possessing invasive attributes, develops concomitantly within same intraductal lesion. These clones eventually destroy ductal walls, generating mixed tumors that have large intraductal components, associated with minimal or extensive invasive elements. Pictures a & b shows DCIS spread throughout a segment, accompanied by a 15 mm. poorly defined, dominant mass and some smaller satellites that were diagnosed as Multifocal Invasive Duct Carcinoma. **Origin:**

Figure 7

a



Description: Calcifications may be located anywhere, in the breast tissue, in the fat within the breast or surrounding it, in the subcutaneous tissue or even in the skin. Using this knowledge in the diagnostic process may help reduce the time and the emotional burden of the patient and her family. Although, for technical reasons, we fail to show their location on a tangential view, the smooth, geographic or annular, homogeneous, regular calcifications shown here, should always suggest their dermal location.

Origin: