

**American College of Radiology
ACR Appropriateness Criteria®**

Clinical Condition: Breast Microcalcifications

Variant 1: Pleomorphic, fine, linear, branching in any distribution.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	9	CC and 90 degree lateral views preferred.	Min
INV core biopsy breast	9		IP
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications. They will also be useful for pre-stereotactic localization or localization procedure.	Min
Excisional biopsy breast	6	If discordant needle biopsy results or concerned about sampling error. If image guided percutaneous biopsy not available.	None
US breast	4	May be useful in dense breast to look for mass component in lesion.	None
MRI breast	3	Specific indications are still being investigated.	None
X-ray diagnostic mammography 6-month follow-up	2		Min
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
INV fine needle aspiration breast	2		IP
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 2: Documentation of skin calcification.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography tangential views dermal localization exam	8	Only if calcifications are not typically dermal in appearance.	Min
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
INV fine needle aspiration breast	1		IP
INV core biopsy breast	1		IP
Excisional biopsy breast	1		None
MRI breast	1		None
NUC sestamibi scan breast	1		High
X-ray mammography magnification views	1		Min
US breast	1		None
X-ray diagnostic mammography 6-month follow-up	1		Min
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Clinical Condition: Breast Microcalcifications

Variant 3: Milk of calcium, any distribution.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications.	Min
X-ray diagnostic mammography 6-month follow-up	2		Min
INV fine needle aspiration breast	2		IP
Excisional biopsy breast	2		None
INV core biopsy breast	2		IP
US breast	2		None
MRI breast	1		None
NUC sestamibi scan breast	1		High
Physical examination breast	1	Physical examination does not play a role in the evaluation of calcifications.	NS
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 4: Amorphous, single cluster.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	9	CC and 90° lateral views preferred.	Min
INV core biopsy breast	8		IP
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications. They will also be useful for pre-stereotactic localization or localization procedure.	Min
Excisional biopsy breast	6	If discordant needle biopsy results or concerned about sampling error. If image guided percutaneous biopsy not available.	None
X-ray diagnostic mammography 6-month follow-up	3	If present in retrospect and stable, 6-month follow-up can be considered.	Min
MRI breast	2	Specific indications are still being investigated.	None
US breast	2		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
INV fine needle aspiration breast	2		IP
NUC sestamibi scan breast	1		High
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Clinical Condition:**Breast Microcalcifications****Variant 5:****Amorphous, multiple clusters, one breast.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	9	CC and 90° lateral views preferred.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications. They will also be useful for pre-stereotactic localization or localization procedure.	Min
INV core biopsy breast	7	Sampling of representative grouping is recommended with further management dependent on histology.	IP
Excisional biopsy breast	3		None
MRI breast	2	Specific indications are still being investigated.	None
INV fine needle aspiration breast	2		IP
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
US breast	2		None
NUC sestamibi scan breast	1		High
X-ray diagnostic mammography 6-month follow-up	No Consensus	Some would only follow-up after work-up complete and biopsy of dominant cluster benign. Others would be more conservative. If no dominant cluster, they would do 6-month follow-up.	Min
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Clinical Condition: Breast Microcalcifications

Variant 6: Amorphous, multiple bilateral clusters.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications.	Min
X-ray diagnostic mammography 6-month follow-up	7	Once work-up demonstrates uniform, probably benign appearance of all calcifications.	Min
MRI breast	2	Specific indications are still being investigated.	None
Excisional biopsy breast	2		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
INV fine needle aspiration breast	2		IP
US breast	2		None
INV core biopsy breast	2		IP
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 7: Amorphous in a regional distribution.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications. They will also be useful for pre-stereotactic localization or localization procedure.	Min
INV core biopsy breast	6		IP
MRI breast	2	Specific indications are still being investigated.	None
INV fine needle aspiration breast	2		IP
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
Excisional biopsy breast	2		None
X-ray diagnostic mammography 6-month follow-up	2		Min
US breast	2		None
NUC sestamibi scan breast	1		High
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Clinical Condition: Breast Microcalcifications

Variant 8: Amorphous in a linear or segmental distribution.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	9	CC and 90° lateral views preferred.	Min
INV core biopsy breast	8		IP
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications. They will also be useful for pre-stereotactic localization or localization procedure.	Min
Excisional biopsy breast	6	If discordant needle biopsy results or concerned about sampling error. If image guided percutaneous biopsy not available.	None
US breast	4	May be useful in dense breast to look for mass component in lesion.	None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
X-ray diagnostic mammography 6-month follow-up	2		Min
INV fine needle aspiration breast	2		IP
MRI breast	2	Specific indications are still being investigated	None
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 9: Coarse (popcorn), large rod-like, dystrophic, suture, lucent-centered, egg shell rim.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	2		Min
X-ray mammography orthogonal views	2		Min
US breast	2		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
X-ray diagnostic mammography 6-month follow-up	2		Min
INV fine needle aspiration breast	2		IP
INV core biopsy breast	2		IP
Excisional biopsy breast	2		None
MRI breast	2	Specific indications are still being investigated.	None
NUC sestamibi scan breast	1		High
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Clinical Condition: Breast Microcalcifications

Variant 10: Round or punctate, clustered.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
X-ray diagnostic mammography 6-month follow-up	8	Biopsy if increasing.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications.	Min
INV core biopsy breast	4	Only if increasing.	IP
Excisional biopsy breast	3		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
INV fine needle aspiration breast	2		IP
US breast	2		None
MRI breast	2	Specific indications are still being investigated.	None
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 11: Round or punctate, regional.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications.	Min
X-ray diagnostic mammography 6-month follow-up	6	If magnification views show calcifications that are probably benign.	Min
Excisional biopsy breast	2		None
US breast	2		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
INV fine needle aspiration breast	2		IP
INV core biopsy breast	2		IP
MRI breast	2	Specific indications are still being investigated.	None
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Clinical Condition:**Breast Microcalcifications****Variant 12:****Punctate calcifications in a linear or segmental distribution.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
INV core biopsy breast	8		IP
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications. They will also be useful for pre-stereotactic localization or localization procedure.	Min
Excisional biopsy breast	6	If discordant needle biopsy results or concerned about sampling error. If image guided percutaneous biopsy not available.	None
US breast	4	May be useful in dense breast to look for mass component in lesion.	None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
X-ray diagnostic mammography 6-month follow-up	2		Min
INV fine needle aspiration breast	2		IP
MRI breast	2	Specific indications are still being investigated.	None
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 13:**Punctate and amorphous, diffuse, bilateral.**

Radiologic Procedure	Rating	Comments	RRL*
INV fine needle aspiration breast	2		IP
INV core biopsy breast	2		IP
Excisional biopsy breast	2		None
MRI breast	2	Specific indications are still being investigated.	None
X-ray mammography magnification views	2		Min
X-ray mammography orthogonal views	2		Min
X-ray diagnostic mammography 6-month follow-up	2		Min
US breast	2		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

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Clinical Condition: Breast Microcalcifications

Variant 14: Coarse heterogeneous, single cluster.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications. They will also be useful for pre-stereotactic localization or localization procedure.	Min
INV core biopsy breast	6	If new or increasing.	IP
X-ray diagnostic mammography 6-month follow-up	5	If magnification views demonstrate the calcifications to be probably benign.	Min
Excisional biopsy breast	4	If suspicious and core not available.	None
INV fine needle aspiration breast	2		IP
MRI breast	2	Specific indications are still being investigated.	None
US breast	2		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 15: Coarse heterogeneous, multiple clusters, one breast.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications.	Min
X-ray diagnostic mammography 6-month follow-up	7	If magnification views demonstrate the calcifications to be probably benign.	Min
Excisional biopsy breast	2		None
MRI breast	2	Specific indications are still being investigated.	None
US breast	2		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
INV fine needle aspiration breast	2		IP
INV core biopsy breast	2		IP
NUC sestamibi scan breast	1		High
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Clinical Condition: Breast Microcalcifications

Variant 16: Coarse heterogeneous, multiple bilateral clusters.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	2		Min
X-ray mammography orthogonal views	2		Min
US breast	2		None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
X-ray diagnostic mammography 6-month follow-up	2		Min
INV fine needle aspiration breast	2		IP
INV core biopsy breast	2		IP
Excisional biopsy breast	2		None
MRI breast	2	Specific indications are still being investigated.	None
NUC sestamibi scan breast	1		High
Rating Scale: 1=Least appropriate, 9=Most appropriate			*Relative Radiation Level

Variant 17: Coarse heterogeneous, in regional distribution.

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications.	Min
X-ray diagnostic mammography 6-month follow-up	7	If magnification views demonstrate the calcifications to be probably benign.	Min
INV core biopsy breast	4	If new or increasing.	IP
US breast	3	If biopsy is contemplated and tissue is dense, may be useful to look for mass component in lesion.	None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
INV fine needle aspiration breast	2		IP
Excisional biopsy breast	2		None
MRI breast	2	Specific indications are still being investigated.	None
NUC sestamibi scan breast	1		High
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Clinical Condition:**Breast Microcalcifications****Variant 18:****Coarse heterogeneous, in linear or segmental distribution.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray mammography magnification views	8	CC and 90° lateral views preferred.	Min
INV core biopsy breast	8		IP
X-ray mammography orthogonal views (90° lateral and CC views if not readily available)	7	Orthogonal views may be useful in positioning for the spot compression magnification views to be sure to include the calcifications. They will also be useful for pre-stereotactic localization or localization procedure.	Min
US breast	4	May be useful in dense breast to look for mass component in lesion.	None
Physical examination breast	2	Physical examination does not play a role in the evaluation of calcifications.	NS
X-ray diagnostic mammography 6-month follow-up	2		Min
INV fine needle aspiration breast	2		IP
Excisional biopsy breast	2		None
MRI breast	2	Specific indications are still being investigated.	None
NUC sestamibi scan breast	1		High
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BREAST MICROCALCIFICATIONS

Expert Panel on Women's Imaging–Breast Work Group: Carl D'Orsi, MD¹; Lawrence W. Bassett, MD²; Wendie A. Berg, MD, PhD³; Marcela Bohm-Velez, MD⁴; W. Phil Evans III, MD⁵; Dione Marie Farria, MD, MPH⁶; Carol Lee, MD⁷; Ellen Mendelson, MD⁸; Steven Goldstein, MD.⁹

Summary of Literature Review

Currently, ductal carcinoma-in-situ (DCIS) represents 25%-30% of all reported breast cancers. Approximately 95% of all DCIS is diagnosed because of mammographically detected microcalcifications [1]. Prior to the widespread use of screening mammography, DCIS, detected as a mass on physical examination, was an uncommon disease representing less than 3% of all breast cancers. Screening mammography is the only reliable tool available for the detection of breast microcalcifications and DCIS [2].

Breast microcalcifications are detected commonly on screening mammograms. Most breast calcifications are benign and can be classified accordingly without any additional work-up [3, 4]. In women with indeterminate or malignant calcifications on screening studies, micro-focus (0.1 mm focal spot) magnification views in orthogonal projections are useful [1,4].

On magnification images, additional calcifications may be apparent, the morphology of individual calcifications can be characterized, and the distribution of calcifications can be better determined. In women with malignant calcifications, magnification images may be helpful in establishing the extent of disease [1].

Currently, the role for computer-aided detection (CAD) of calcifications [5-11] as not yet been determined. However, recent studies indicate that CAD can be clinically useful to avoid false negatives when used properly [12-14].

Stereotactically guided core biopsy using a variety of devices can sample areas of microcalcifications [15]. Stereotactically guided fine needle aspiration (FNA) of microcalcifications has been shown to be inaccurate [16]. Core biopsy specimen radiographs should be done to

establish the presence of calcifications in the core, as is done with surgically excised specimens.

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Appendix I.

B. CALCIFICATIONS	
Analysis of calcifications includes a description of both morphology and distribution. Calcifications may be divided into those that are typically benign, those of intermediate concern, and those with a higher probability of malignancy. Distribution may be characterized as grouped or clustered, linear, segmental, regional, or diffuse/scattered.	
TYPES AND DISTRIBUTION OF CALCIFICATION:	
1. Typically Benign	
<i>Skin Calcifications:</i>	These are usually lucent-centered and often pathognomonic in their appearance. Skin calcifications are most commonly seen along the intramammary fold parasternally, and in the axilla and areola. Unusual forms may be confirmed as skin deposits by performing mammographic magnification views tangential to the overlying skin.
<i>Vascular Calcifications:</i>	Parallel tracks, or linear tubular calcifications that are clearly associated with blood vessels.
<i>Coarse or (“Popcorn Like” Calcifications):</i>	These are the classic large (>2-3 mm in greatest diameter) calcifications produced by an involuting fibroadenoma.
<i>Large Rod-Like Calcifications:</i>	These benign calcifications with ductal ectasia may form solid or discontinuous smooth linear rods ≥ 1 mm in diameter. They can have lucent centers; if the calcium is in the wall of the duct and will generally be solid when secretions calcify in the lumen of ectatic ducts. These follow a ductal distribution, radiating toward the nipple, are occasionally branching and usually bilateral. Secretory calcifications are most often seen in women older than 60 years.
<i>Round Calcifications:</i>	Round calcifications are 0.5-1 mm in size and frequently form in acini of the terminal duct lobular unit. When smaller than 0.5 mm, the term “punctate” is used. An isolated cluster of punctate calcifications may warrant close surveillance or even biopsy if new, increasing, or ipsilateral to a cancer, though further study is warranted.
<i>Lucent-Centered Calcifications:</i>	These are benign calcifications that range from smaller than 1 mm to larger than a centimeter or more. These deposits are round or oval, with smooth surfaces, and have a lucent center. The “wall” that is created is thicker than the “rim or eggshell” type of calcifications. Included are areas of fat necrosis, and calcified debris in ducts.
<i>“Eggshell” or “Rim” Calcifications:</i>	These are very thin, benign calcifications that appear as calcium deposited on the surface of a sphere. These deposits are usually smaller than 1 mm in thickness when viewed on edge. Fat necrosis and calcifications in the wall of cysts are the most common “rim” calcifications.
<i>Milk of Calcium Calcifications:</i>	This is a manifestation of sedimented calcifications in macro- or micro-cysts. On the craniocaudal image they are often less evident and appear as fuzzy, round, amorphous deposits, while on the 90° lateral, they are more clearly defined, semilunar, crescent-shaped, curvilinear (concave up) or linear, defining the dependent portion of cysts. The most important feature of these calcifications is the apparent change in shape of the calcific particles on different mammographic projections (craniocaudal versus oblique or 90° lateral).
<i>Suture Calcifications:</i>	These represent calcium deposited on suture material. They are typically linear or tubular in appearance and when present, knots are frequently visible.
<i>Dystrophic Calcifications:</i>	These usually form in the irradiated breast or in the breast following trauma. Although irregular in shape, they are coarse and usually larger than 0.5 mm in size. They often have lucent centers.
2. Intermediate Concern Calcifications	
<i>Amorphous or Indistinct Calcifications:</i>	These are sufficiently small or hazy in appearance that a more specific morphologic classification cannot be determined. Diffuse scattered amorphous calcifications may be dismissed as benign although baseline magnification views may be helpful. Amorphous calcifications in a clustered, regional, linear or segmental distribution may warrant biopsy [17].
<i>Coarse Heterogeneous Calcifications:</i>	These are irregular, conspicuous calcifications that are generally larger than 0.5 mm and tend to coalesce but are not the size of irregular dystrophic calcifications. They may be associated with malignancy but can be present in areas of fibrosis, fibroadenomas or trauma, representing evolving dystrophic calcifications. Multiplicity and bilaterality of such calcifications favors benign etiology though further study is warranted.

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3. Higher Probability of Malignancy	
<i>Fine Pleomorphic Calcifications:</i>	These are usually more conspicuous than the amorphous forms and are neither typically benign (see above) nor typically malignant (see below). They vary in size and shape and are usually smaller than 0.5 mm in diameter.
<i>Fine Linear, or Fine Linear Branching Calcifications:</i>	These are thin, linear or curvilinear irregular calcifications, which may be discontinuous and are generally smaller than 0.5 mm in width. Their appearance suggests filling of the lumen of a duct involved irregularly by breast cancer.
4. Distribution Modifiers	
These are used to describe the arrangement of calcifications in the breast. Multiple similar groups may be indicated in the report when there is more than one group of calcifications that are similar in morphology and distribution.	
<i>Diffuse/Scattered:</i>	These are calcifications that are distributed randomly throughout the breast. Punctate and amorphous calcifications in this distribution are usually benign and usually bilateral.
<i>Regional:</i>	These are calcifications scattered in a large volume (>2 cc) of breast tissue not conforming to a duct distribution. Since this distribution may involve most of a quadrant or more than a single quadrant, malignancy is less likely. However, evaluation must include element shape as well as distribution.
<i>Grouped or Clustered:</i>	Should be used when at least five calcifications occupy a small volume (<1 cc) of tissue.
<i>Linear:</i>	Calcifications arrayed in a line. This distribution may elevate suspicion for malignancy as it suggests deposits in a duct.
<i>Segmental:</i>	A segmental distribution of calcifications suggests deposits in a duct or ducts and their branches (involving a lobe or segment of the breast). Unless the calcifications are smooth and large rod-like calcifications typical of benign secretory calcifications (see above), a segmental distribution is suggestive of malignancy even if individual calcifications are punctate or amorphous in morphology.
(From the American College of Radiology (ACR). ACR BI-RADS® – Mammography. 4 th Edition. In: <i>ACR Breast Imaging Reporting and Data System, Breast Imaging Atlas</i> . Reston, VA: American College of Radiology; 2003.)	

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