

# Breast magnetic resonance imaging: non-mass-like enhancement

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Non-mass-like enhancement (NMLE) refers to lesions with abnormal enhancement larger than focus but without space-occupying effect characteristics. Notably, it is often mentioned as “non-mass-like enhancement” rather than “non-mass lesion”. Different from mass, NMLE can have stippled or patchy normal gland tissues or fat inside it. NMLE should be described from its morphology and internal enhancement pattern (*Figures 1,2*).

## Distribution modifiers of NMLE

The distribution modifiers of NMLE include focal area, linear, ductal, segmental, regional, multiple regional, and diffuse (*Figures 3-23*).

**Focal area** A ‘focal’ area of a NMLE would typically be defined as a single, small and confined abnormal enhancing area occupying less than 25% of a given breast quadrant. An area of ‘focal’ NMLE will quite often have fat or normal glandular tissue interspersed between the abnormally enhancing components.

**Ductal** A linear or linear branching which follows one or more ducts. Usually these patterns will radiate towards the nipple. It can be smooth or irregular, usually suggestive of breast cancer.

**Linear** A ‘linear’ enhancement pattern involves enhancement along a ‘line’, but one not conforming to a ductal pattern. A linear enhancement pattern when seen on a three dimensional image will appear as a line on one section and as a ‘sheet’ on another, or may extend across the breast.

**Segmental** A non-mass-like contrast enhanced MRI breast lesion is described as ‘segmental’ when it appears in a cone or triangle shape, with an apex at the nipple. A segmentally enhanced non-mass-like lesion will usually represent the substantial involvement of a single branching

duct system. It may be shown as ductal enhancement on thin-slice high-resolution scan.

**Regional** When a contrast enhanced MRI of a breast lesion is described as ‘regional’, this implies the involvement of a broader area, and typically not conforming to a ductal or segmental distribution. Usually, regional enhancement is patchy or ‘geographic’ (almost like a map) in appearance, and will lack convex borders.

**Multiple regions** Contrast enhanced breast MRIs are described as ‘multiple’ if there are at least two or more large volumes of tissues and are separated by either normal breast tissues or fat. Generally speaking, both diffuse and multiple regions of MRI contrast enhancement will tend to represent benign proliferative changes such as mammary gland hyperplasia. However, it is not uncommon for multicentric breast carcinoma to also show a multiple distribution.

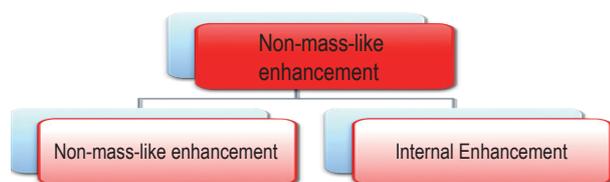
**Diffuse** An enhancement pattern may be described as ‘diffuse’ if there are widely scattered yet more-or-less evenly distributed enhancements appearing through the breast fibroglandular tissue.

## Internal enhancement features

The internal enhancement of NMLE can be divided into homogeneous, heterogeneous, stippled, clumped, and reticular/dendritic (*Figures 24-32*).

**Homogeneous enhancement** refers to confluent uniform enhancement, which is rare in NMLE, because the latter often contains fat or gland tissues, which tend to be **heterogeneous enhancement** that has nonuniform enhancement in a random pattern.

**Stippled enhancement** refers to multiple, punctuate, similar appearing enhancing foci, sand-like or dot-like. They are scattered in the mammary gland, not just confined



**Figure 1** Non-mass-like enhancement.

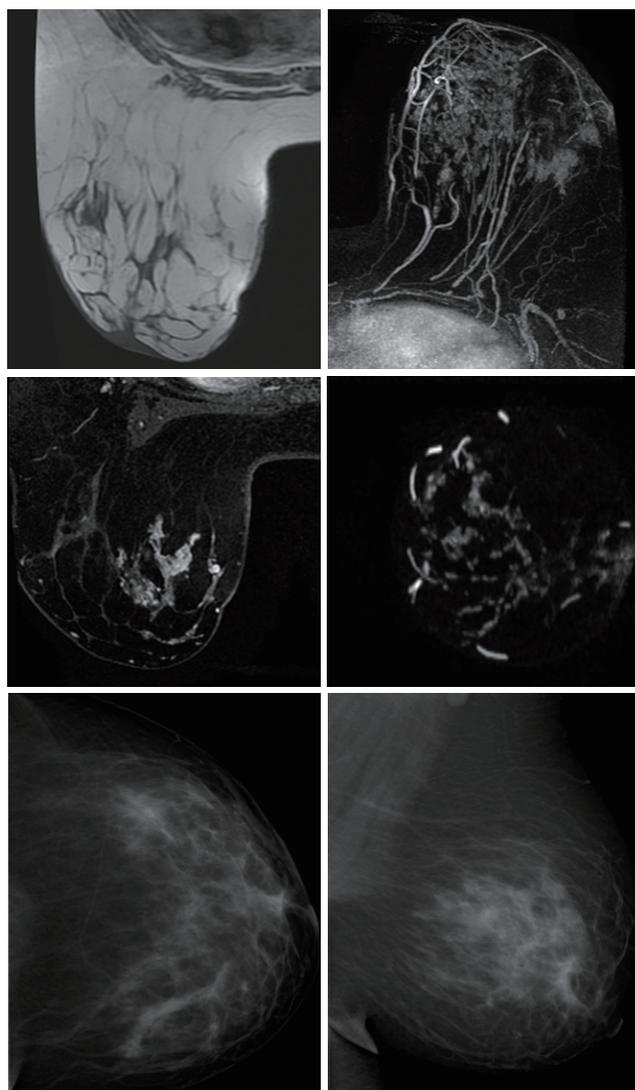
to the ductal system. It is usually characteristic for normal parenchyma or fibrocystic changes.

**Clumped enhancement** refers to cobblestone-like enhancement, with occasional confluent areas. In some parts it can show the grape-like clusters or has beaded appearance, which is often suggestive of DCIS.

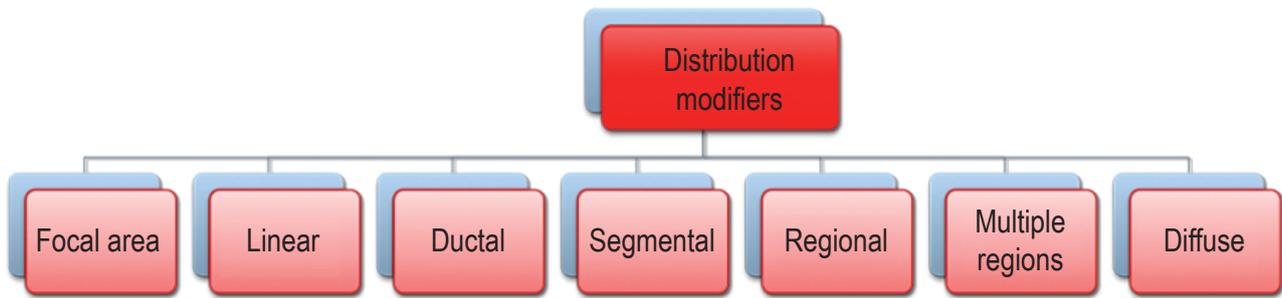
Reticular/dendritic enhancement “Reticular/dendritic” enhancement occurs in the breast that has undergone some glandular tissue involution leaving strands of breast tissue among strands of fat. MRI shows distorted trabecular-like thickening and shortened normal finger-like structures. The Cooper ligaments in the normal breast tissue gradually become thinner, while in breast tissue with the reticular/dendritic enhancement, the fibrous glandular tissue becomes thicker, distorted or shrunk, resulting in the loss of its scalloped border with the surrounding adipose tissue.

NMLE needs to be differentiated from multiple masses; furthermore, the different descriptions for NMLE itself are also confusing. NMLE in many cases can not be easily differentiated from mass, especially multiple masses. According to our experiences, the space-occupying effect can be used as a key indicator in the differential diagnosis: NMLE on T1WI shows no obvious fat or fiber glands suppression; the lesion is confined within certain space, although it may contain adipose tissue or normal glandular tissue.

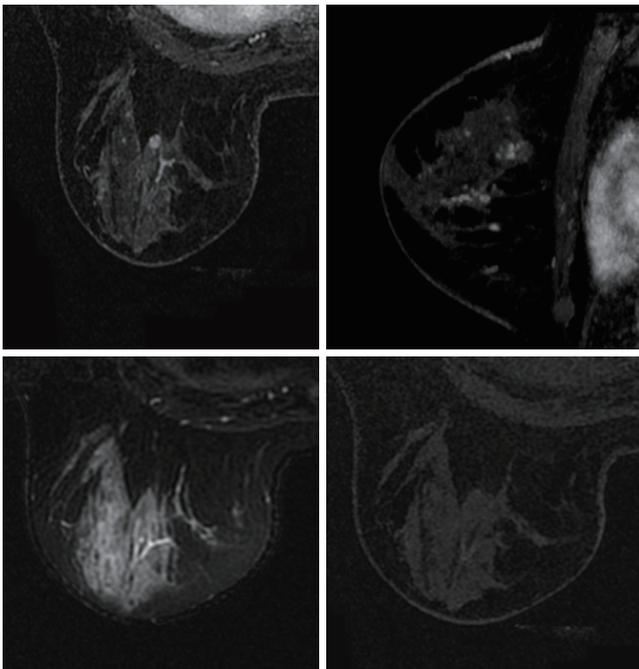
Focus and stippled enhancement have different enhancement phases and sizes; meanwhile, their amount and distribution also show characteristic variations. Focus/foci show obvious enhancement during the early arterial phase, with a diameter of 5mm or less. Stippled enhancement is more obvious during the delayed phase; it is only slightly enhanced or non-enhanced during the early arterial phase. It is hard to different focus/foci from stippled enhancement during the delayed phase because focus/foci show increasingly enlarged enhancement during this phase. Furthermore, focus/foci are more scattered and independent in terms of amount and distribution, while stippled lesions can be distributed in focal, regional, or



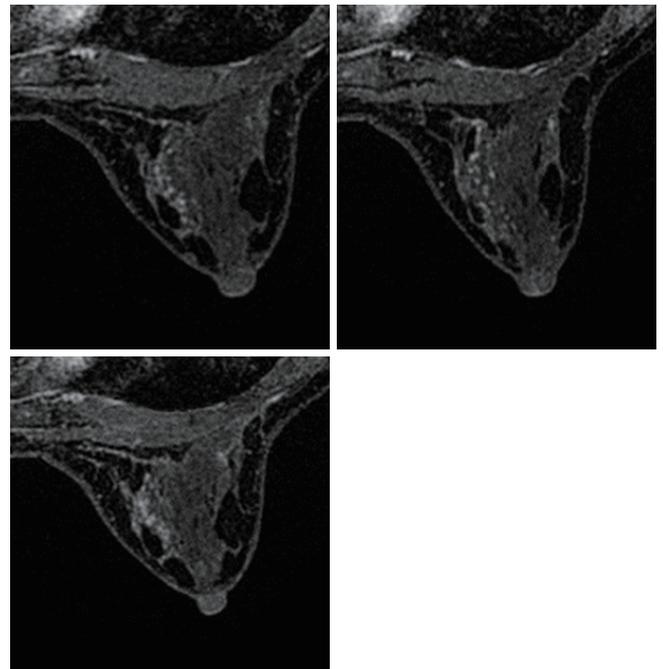
**Figure 2** Features of NMLE T1WI image only displays part of enlarged and distorted glands and no space-occupying effect of the fat is observed. The contrast-enhanced image shows lesion with segmental distribution and clumped enhancement. MG shows local asymmetry behind nipple, within which there are clustered minute calcifications. Comment: the NMLE is featured by the absence of space-occupying effect. The lesion contains fat and gland components on T1WI images. Under most conditions, a lesion can not be identified in an unenhanced image. Most NMLE on mammography present as focal a focal asymmetric or calcification, without any feature of mass. When interpreting NMLE, physicians should firstly rule out highly specific features such as ductal/segmental distribution, and then classify the finding as focal area, regional, reticular, or linear. C710684 clumped enhancement with segmental distribution.



**Figure 3** Distribution modifiers.



**Figure 4** Ductal Contrast-enhanced scan shows enhancements along the ducts; the Dilated ducts can be seen at the corresponding area under the unenhanced scan, while no high T1WI signal is detected during pre-scanning. It is classified as BI-RADS category 4. Since no lesion was located during ultrasound and mammography, follow-up is recommended. C842556; No subtraction.

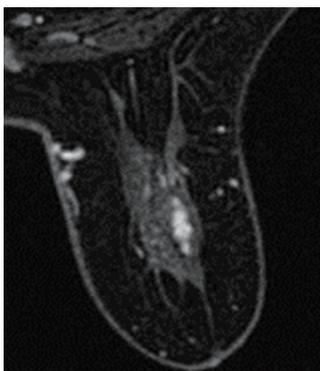


**Figure 5** Ductal enhancement Discontinuous stippled enhancements along the ducts. Follow-up; D347618. Two images obtained from the arterial phase and 1 from the delayed phase. Centrifugal enhancement is found during the delayed phase.

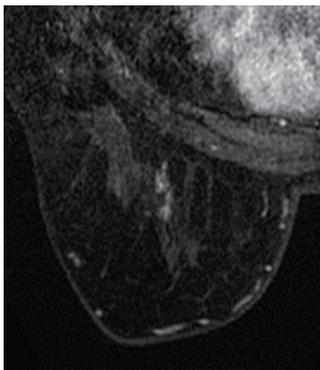
segmental pattern. For example, “a 1 cm FOCAL AREA of STIPPLED enhancement” might describe a small region of fibrocystic change. For management modes, stippled enhancement is classified as BI-RADS-MRI Category 2, whereas focus/foci as Category 3.

BI-RADS-MRI lexicon defines the “clumped enhancement” as “cobblestone-like enhancement of

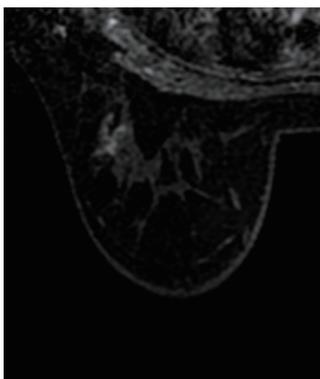
multiple masses, with occasional confluent areas”; therefore, the “clumped enhancement” needs to be differentiated from multiple masses. In our opinion, if the masses are not spatially continuous or independent, they can be treated as “multiple masses”; if the masses present certain spatial continuity and show the grape-like clusters or has beaded appearance in some parts, they can be treated as “clumped



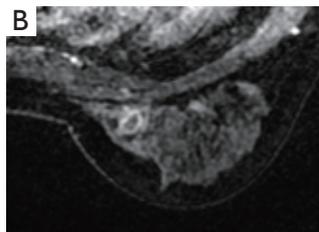
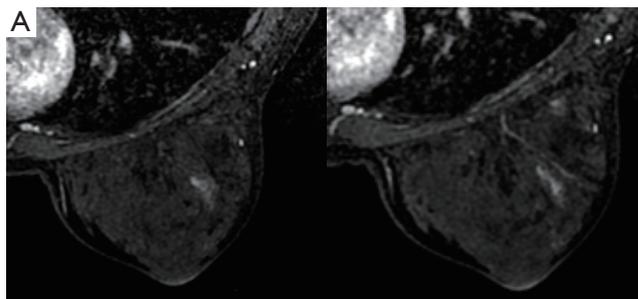
**Figure 6** Ductal enhancement clumped behind the nipple are distributed along the ducts and merge with each other. Pathology: Ductal Carcinoma *In Situ* (DCIS). D352873; (Other images can be utilized; lobular).



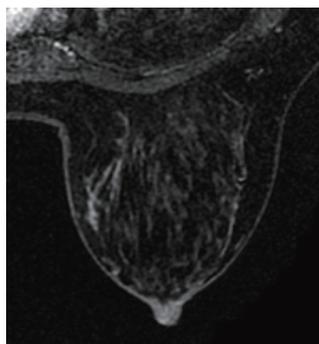
**Figure 7** Focal area Heterogeneous enhancement in a confined area, less than 25% of quadrant. Fat and glands are found within the enhanced areas. Pathology: papilloma without space-occupying effect. B254713.



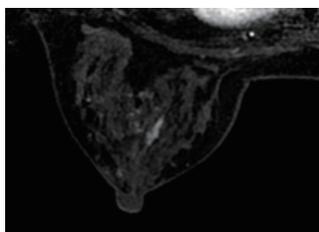
**Figure 8** Focal area Heterogeneous enhancement in a confined area, less than 25% of quadrant. Without space-occupying effect. Pathology: fibroadenosis and the formation of fibroadenoma. B427152.



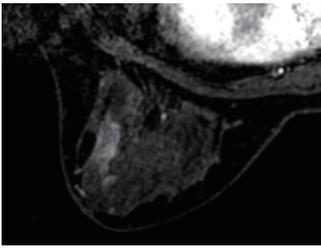
**Figure 9** Focal area. Heterogeneous NMLE, less than 25% of quadrant. Pathology: Remarkable local ductal epithelial hyperplasia, along with a large number of inflammatory cell infiltration and foam cell aggregation in the surrounding tissues. It is considered to be inflammatory disease, but still requires further consideration. A. C128808; B. B710872.



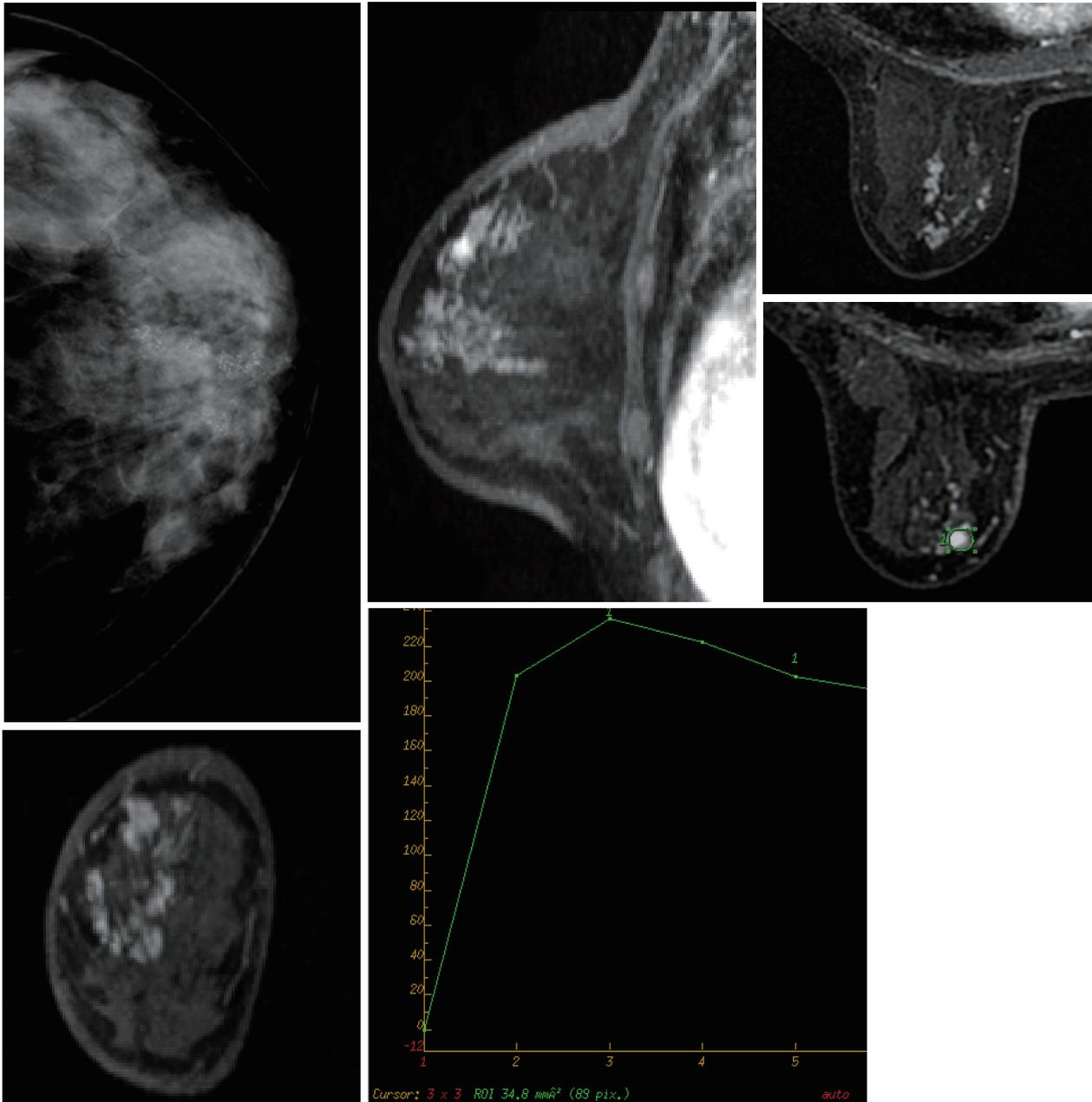
**Figure 10** Oblique linear enhancement that is non-consistent with the ductal distribution is found in the medial quadrant of the right breast. It is not vascular structure. A250067.



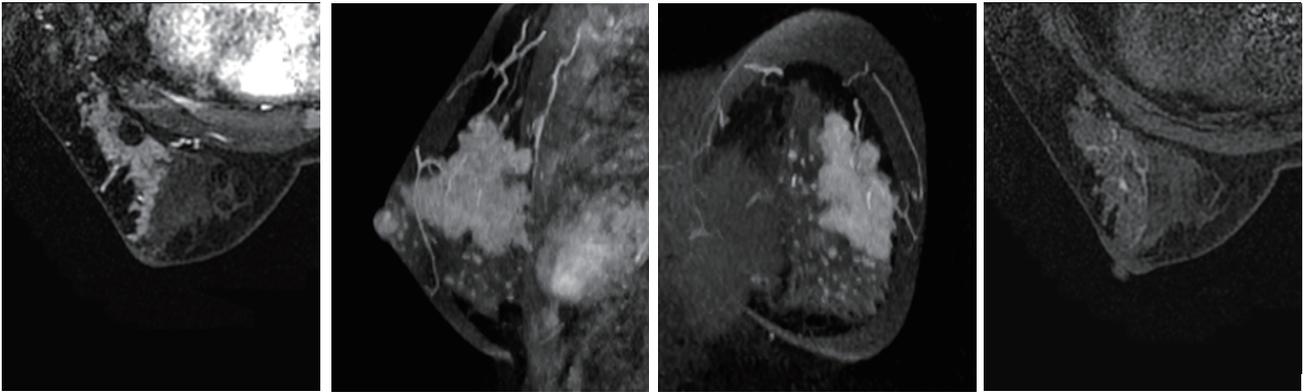
**Figure 11** Ductal enhancement A linear enhancement which follows one or more ducts and radiates towards the nipple. Pathology: breast adenosis, but still requires further investigation. C211719.



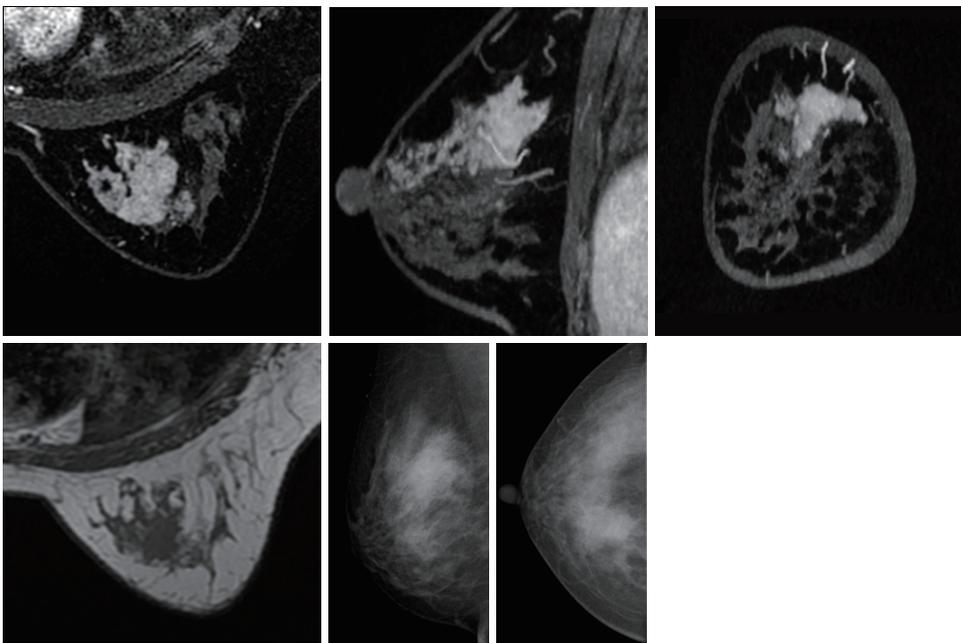
**Figure 12** Regional enhancement The lesion has non-specific shape, without space-occupying effect, and is not conforming to a lobular pattern. Pathology: tubular structures infiltrating fibrous tissue, although cellular atypia was not obvious. It is considered to be tubular adenoma. C033540.



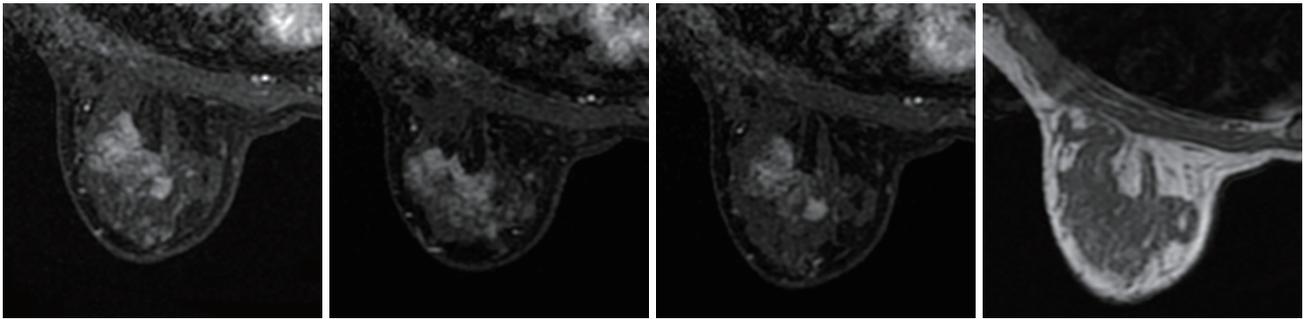
**Figure 13** Segmental distribution, calcification, and IDC + EIC. D177023.



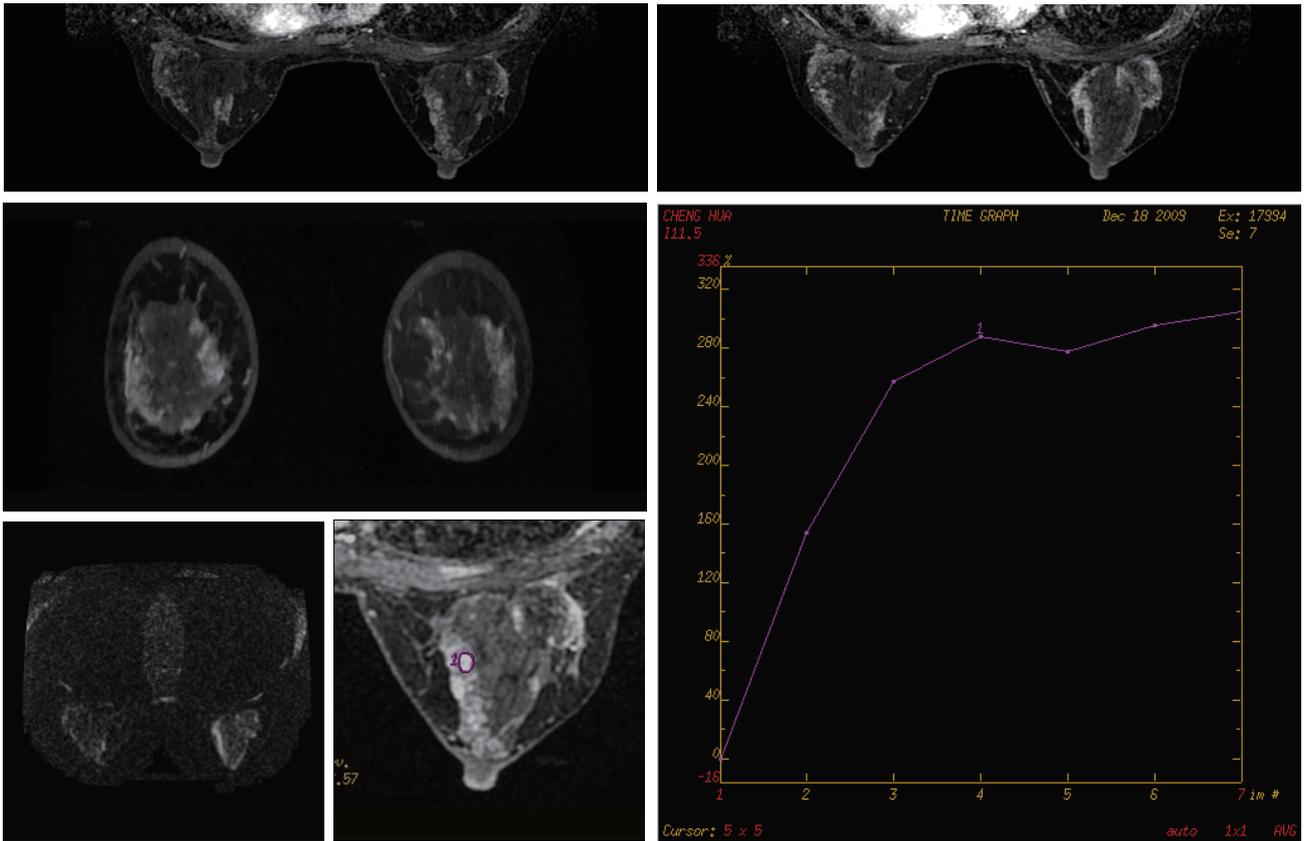
**Figure 14** Segmental Triangular region of enhancement. Apex pointing to nipple, suggesting a duct or its branches from at least two views (usually on axial and sagittal views), suggesting high specificity of malignancy. However, plasma cell mastitis that involves one or more segments can also present segmental distribution, which makes the differential diagnosis even more difficult. Pathology: intraductal carcinoma. B774461.



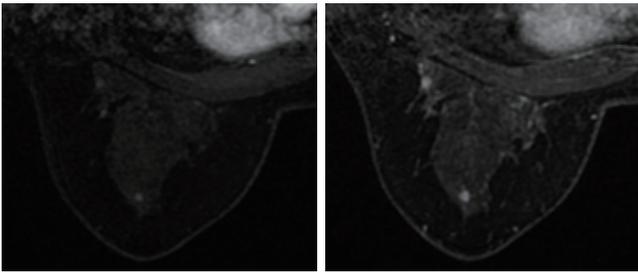
**Figure 15** Segmental distribution Although it shows regional distribution on axial view, Triangular region of enhancement with apex pointing to nipple is found on the reconstructed sagittal and coronal views, suggesting typical segmental distribution. This lesion shows space-occupying effect with fat suppression on T1WI. If it is classified as a “mass”, it is an irregular mass with heterogeneous enhancement, and is therefore non-specific. MG shows irregular features of a mass within the upper inner quadrant (UIQ) of breast. Pathology: Diagnosis was invasive ductal carcinoma with an extensive intraductal component. C686031.



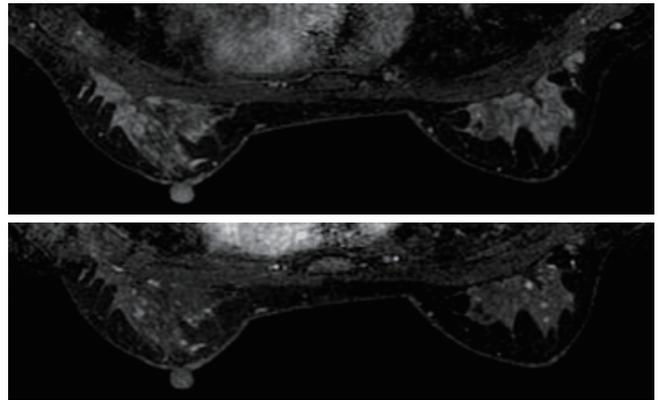
**Figure 16** Regional enhancement The scope of the lesion is larger than 1/4 quadrant, which requires multiple views (axial, sagittal and coronal views) and multi-sectional observations. The abnormally enhancing lesion in the right breast is larger than one quadrant and not conforming to a segmental distribution. The distributions of fat and glands signals in the corresponding area are detected on T1WI. Space-occupying effect (glands and fat suppression) can not be distinguished. The right image shows massive, irregular and heterogeneous enhancements in the same patient. Pathology: Invasive intraductal carcinoma with DCIS. 802637.



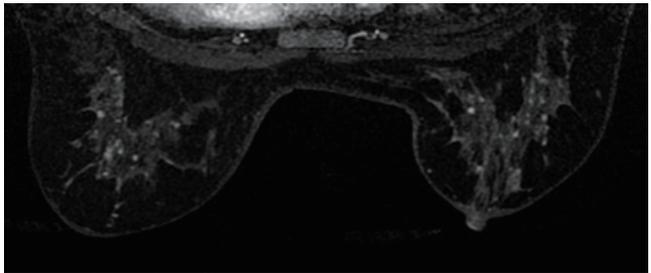
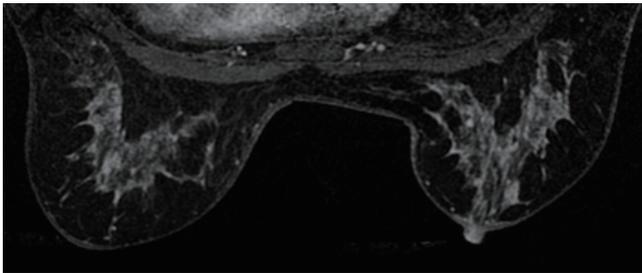
**Figure 17** Multiple regions Multiple patchy areas of NMLE in both breasts, and MG shows no calcification. It is interpreted as BI-RADS MRI category 3. Follow-up is recommended. No segmental distribution is found on coronal view. 860052.



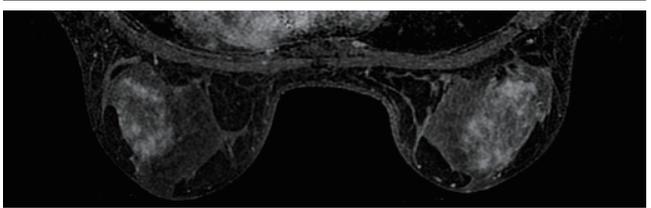
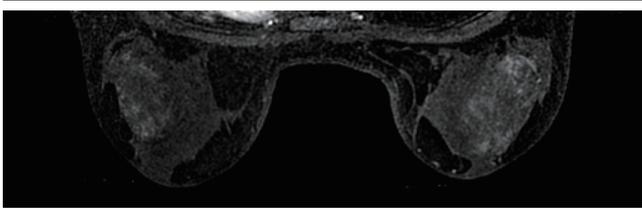
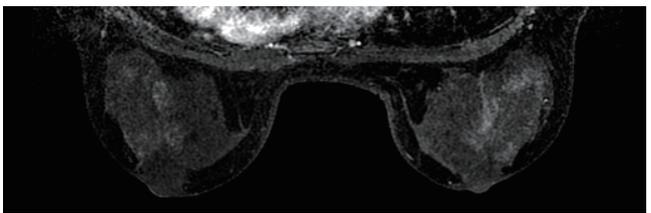
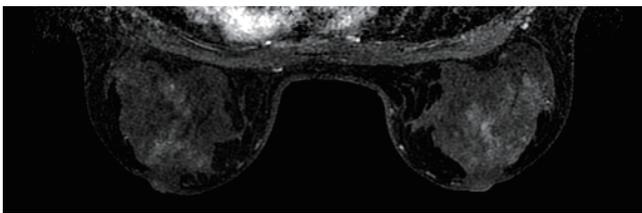
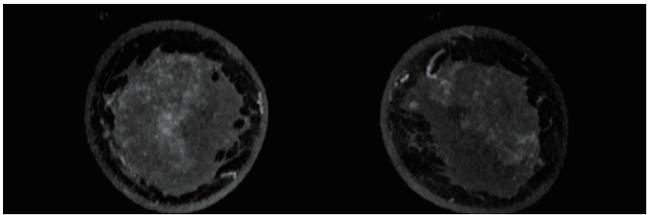
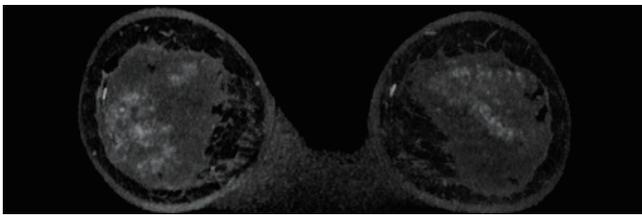
**Figure 18** Stippled lesion Two stippled enhancements present in left breast, with diameters less than 5mm; their margin and internal enhancement are non-specific. Stippled enhancement is detected during the arterial phase, with poorly-defined margin. The scope of enhancement becomes slightly larger in the delayed phase, with slightly irregular margin. BI-RADS-MRI category 3 is considered. Pathology: Fiber adenosis. Centrifugal enhancement. B770501.



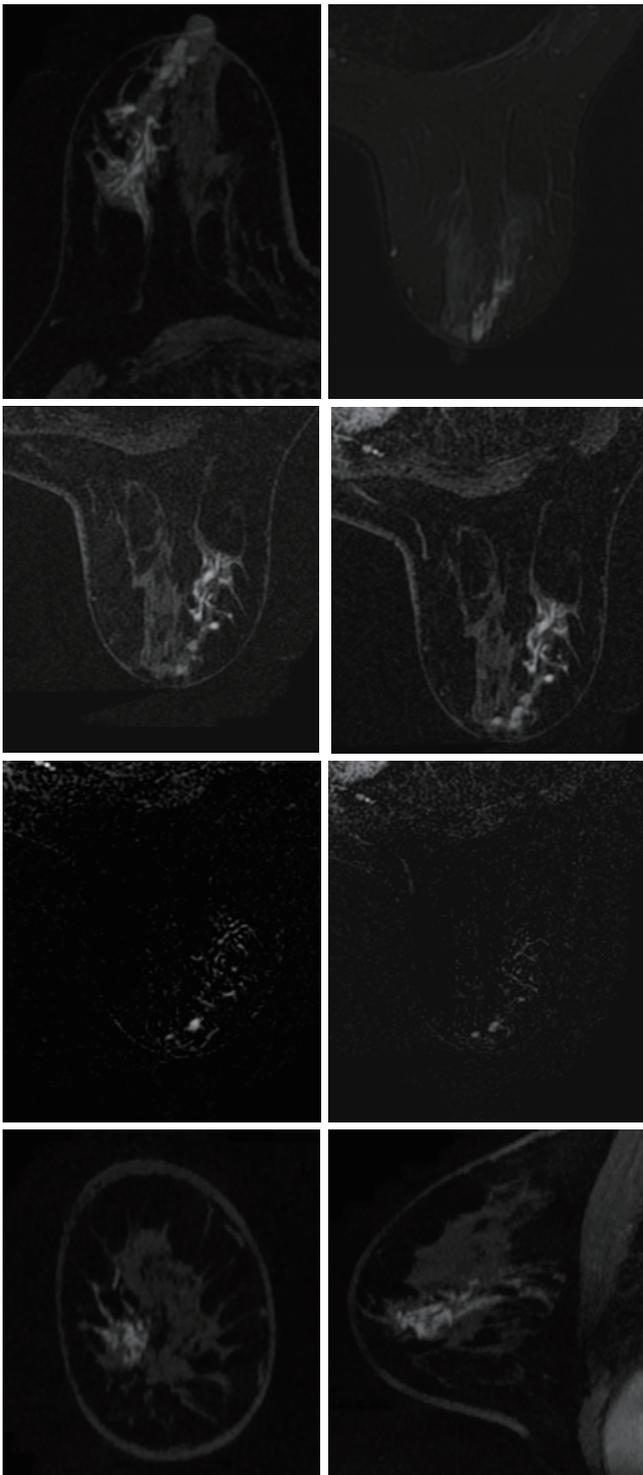
**Figure 19** Multiple stippled lesions. Stippled enhancements are detected during the arterial phase, with non-specific morphological features. Ten minutes after injection of the contrast agent, these enhancements were “lost” into the enhancing surrounding breast parenchyma. BI-RADS-MRI category 3 is considered. F6-30.



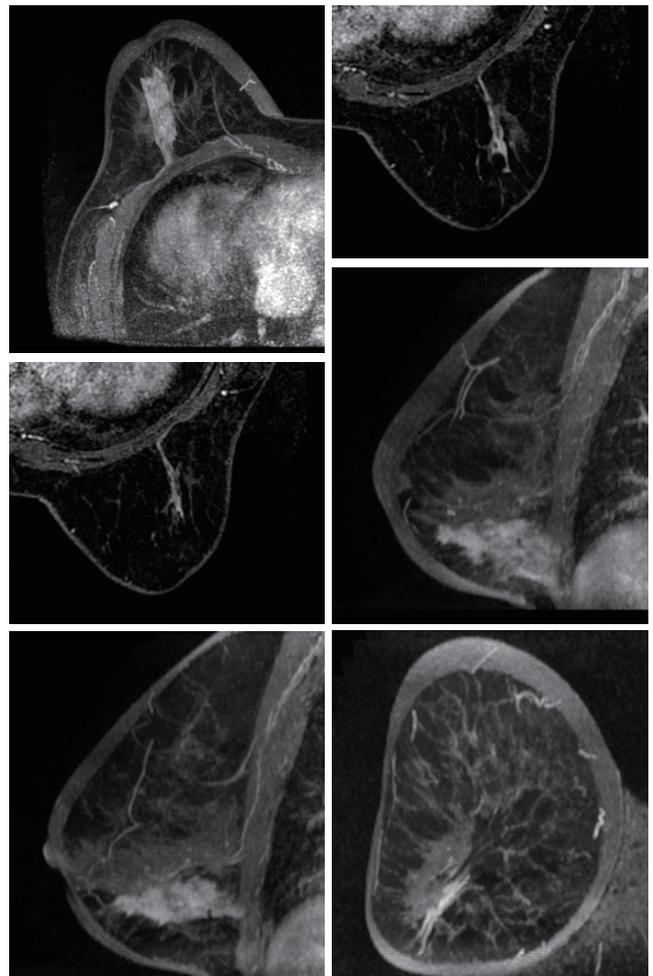
**Figure 20** Multiple stippled lesions are clear during the arterial phase, show centrifugal enhancement during the delayed phase, and then merge. C322572.



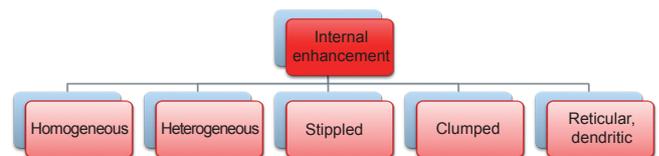
**Figure 21** Multiple regional enhancement not conform to segmental distribution, showing no pathological results. C862730.



**Figure 22** Ductal enhancement; Multiple intraductal papilloma. C813581.



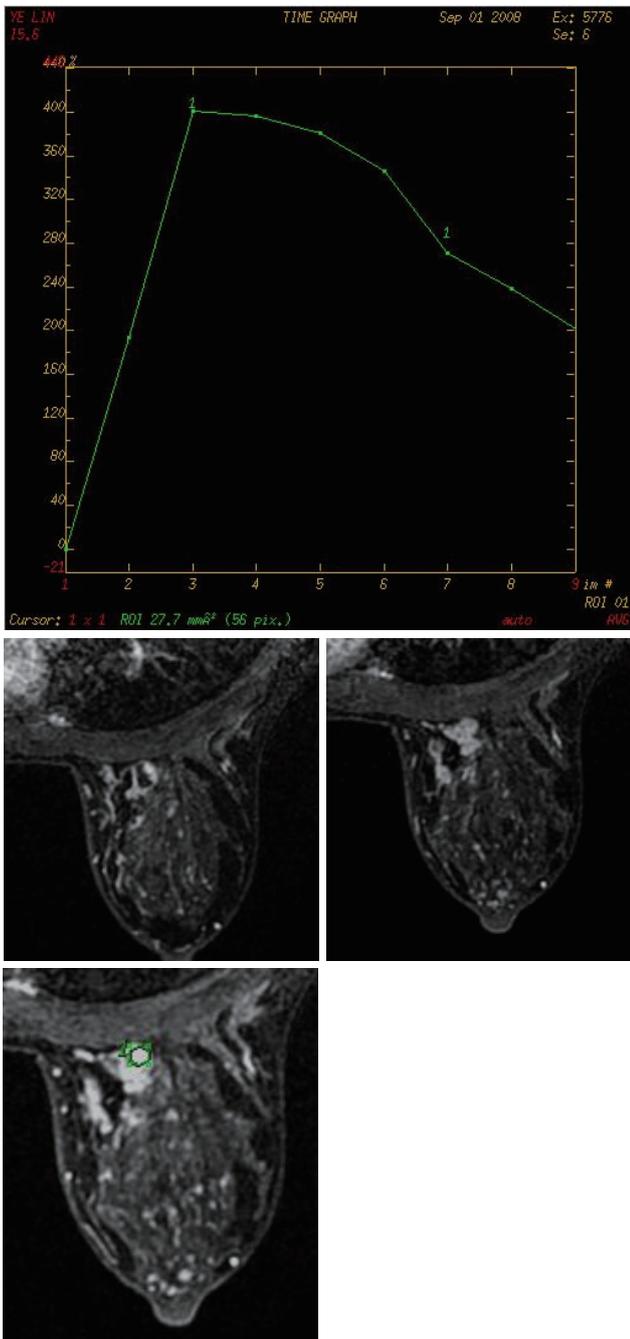
**Figure 23** Stripe-like enhancement of breast. Assisted observation on different views is required. B563800.



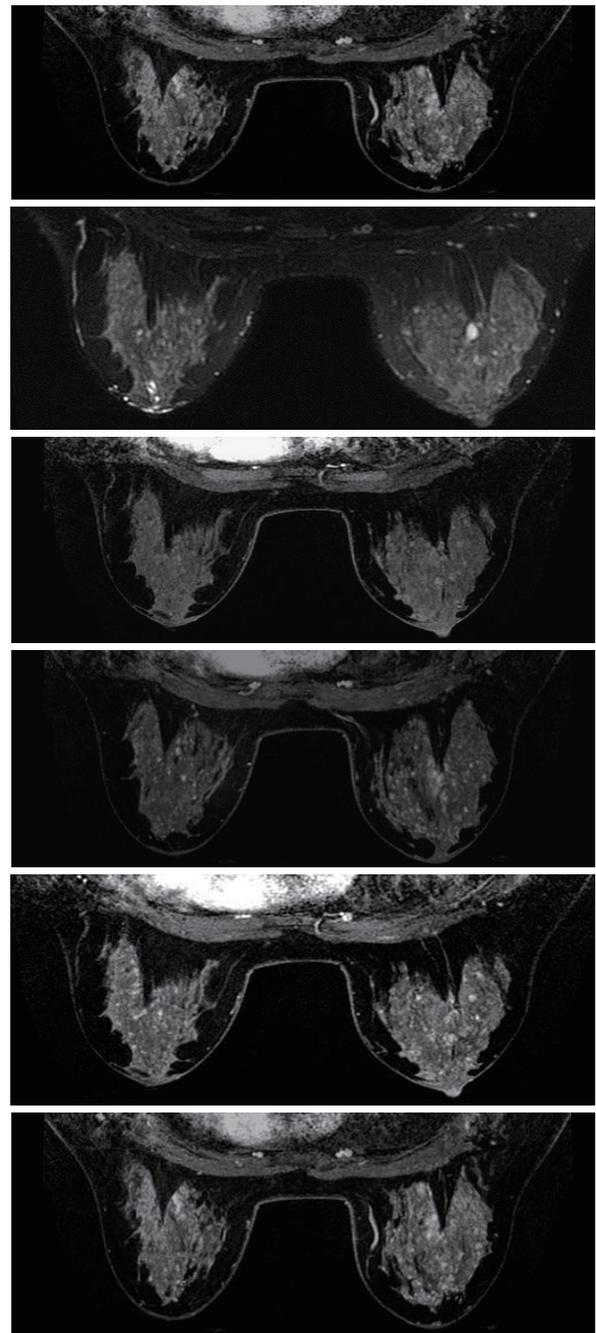
**Figure 24** Internal enhancement.

NMLE”.

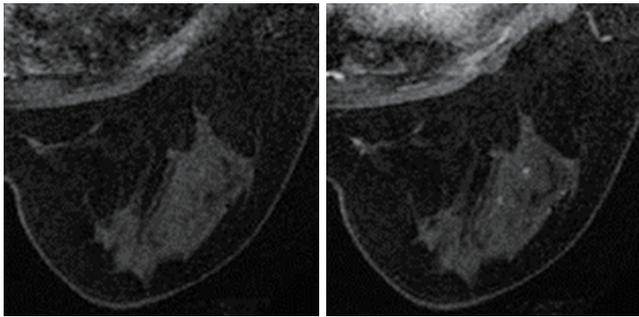
Lesions with NMLE should be reconstructed and visualized on multiple views during MRI. Some lesions may present as regional distribution on one view and as segmental distribution on another view; in fact, a segmental distribution is more suggestive of malignancy (Figures 33,34).



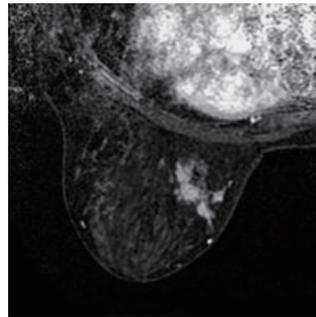
**Figure 25** Segmental distribution. clumped enhancement, segmental enhancement, and ductal enhancement Triangular region of enhancement with apex pointing to nipple. Space is not continuous, and some of them show ductal enhancement along the ducts. The enhancement shows a clumped pattern. Pathology: intraductal carcinoma (intermediate grade) clumped enhancement Multiple small nodular lesions confined within certain scope, with varied size. Pathology: invasive ductal carcinoma with low-grade intraductal cancer. The lesions can be merged or not. A243775.



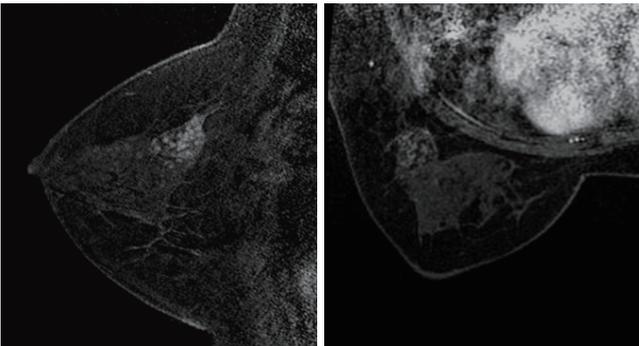
**Figure 26** Diffusely distributed stippled enhancement Scattered mild stippled enhancements are symmetrically distributed in both breasts during the early arterial phase (A). During the delayed phase (B and C), the lesions have increasingly marked enhancement and show a trend of expansion/merging. This condition is often seen during the secretory phase of the menstrual cycle, mammary gland hyperplasia, or adenosis BI-RADS-MRI category 3 is considered. Re-examination or follow-up is required. Pathology: adenoid hyperplasia. B434270.



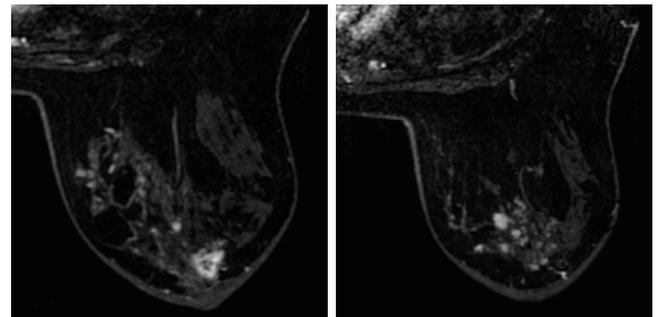
**Figure 27** Stippled enhancement No abnormal enhancement is observed during the first-phase contrast-enhanced scan; however, multiple dot-like enhancement with poorly-defined margin is observed during the delayed phase. Pathology: mammary gland hyperplasia.



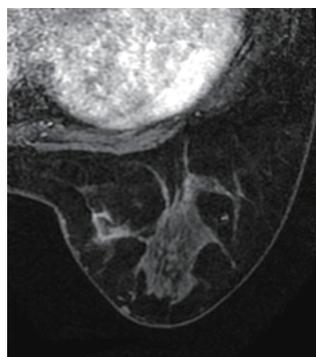
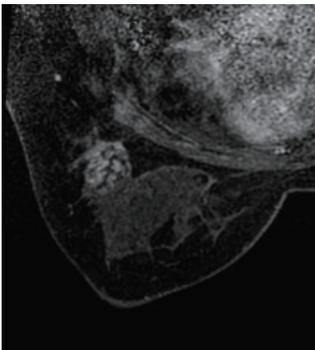
**Figure 29** Clumped enhancement. The lesion shows stippled enhancement with a regional distribution. The margin is poorly defined, and the enhancement is heterogeneous, with enhanced fatty components within the lesion. Pathology: Intraductal carcinoma. 101835.



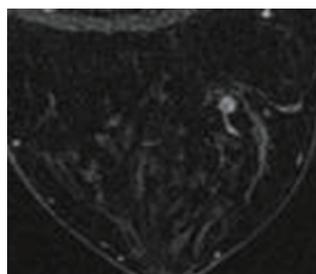
**Figure 28** Delayed phase. Stippled enhancement with a segmental distribution is found in the upper outer quadrant of the right breast. It is a NMLE less than 1/4 quadrant, inside which there is stippled enhancement with a clumped distribution. Pathology: breast adenosis. 557573.



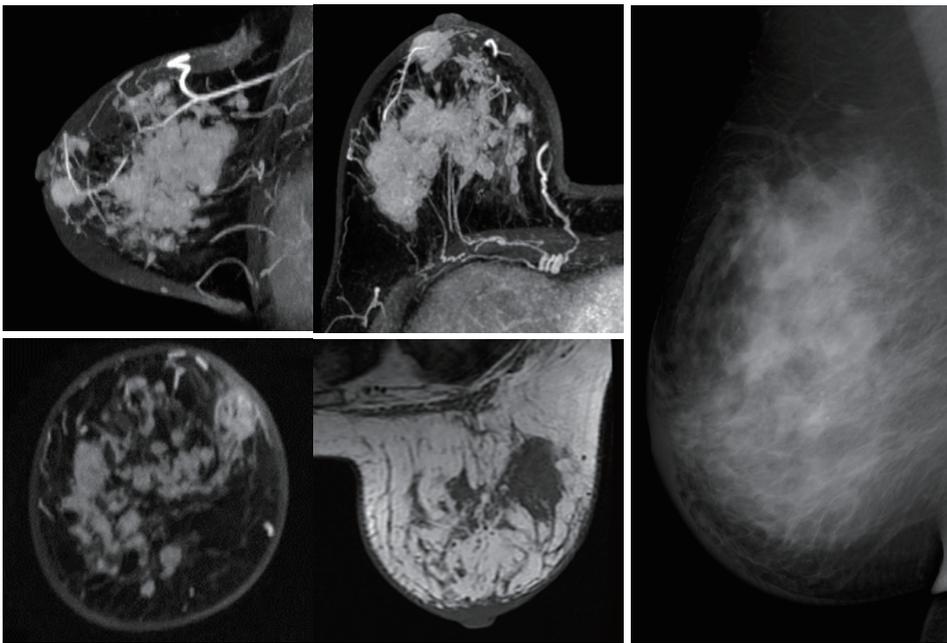
**Figure 30** Clumped enhancement. C187948.



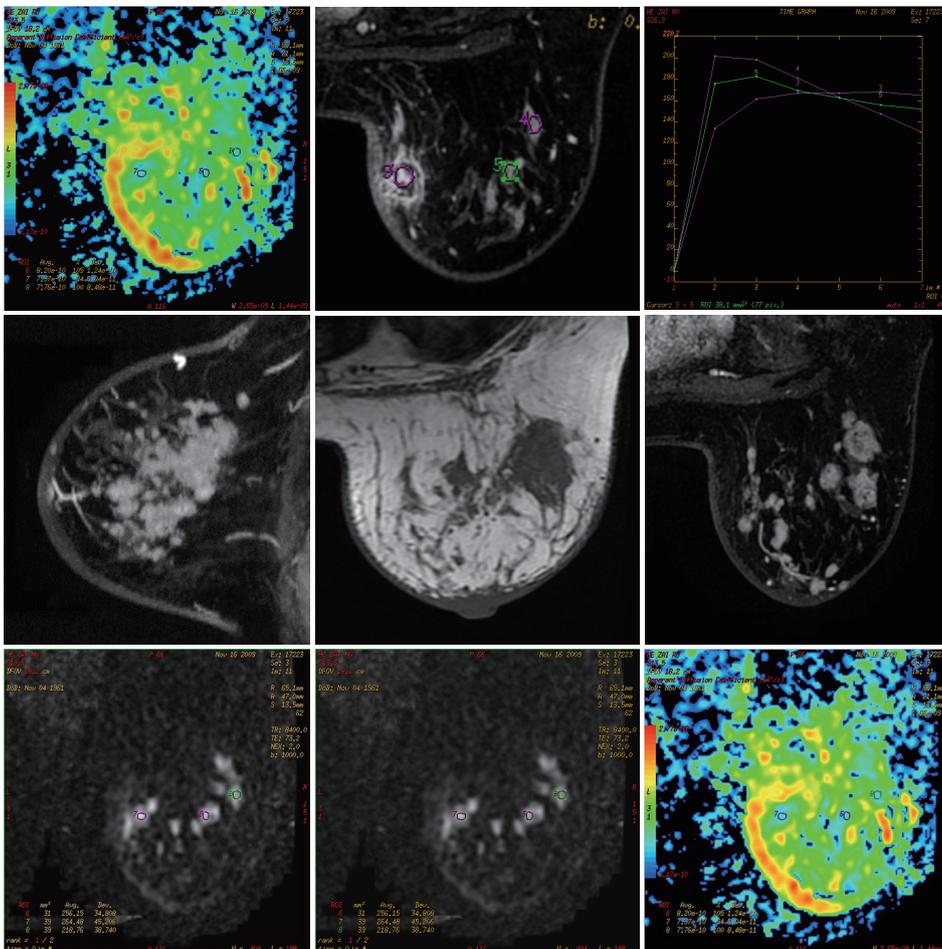
**Figure 31** Stripe-like enhancement MRI shows distorted trabecular-like thickening, with glands and adipose tissues within the lesion. B927110.



**Figure 32** Stripe-like structures after 8 years of chemotherapy for breast cancer (without mastectomy).



**Figure 33** Regional enhancement; multifocal invasive breast cancer; Or, multiple masses? B402978.



**Figure 34** Differentiation between multiple masses and clumped enhancement. Although fat compartments exist among multiple masses, no fat compartment is present within each mass; meanwhile, each lesion has a clearly-defined border with fat, showing specific space-occupying effect. Pathology: invasive ductal carcinoma. B402978.

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