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Anatomical-radiological correlations: Architectural distortions

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KEYWORDS
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Abstract Architectural distortions consist of convergence areas and local retractions at the border of the gland. The authors examine the semiologic features of the distortions and their different causes, together with their pathological anatomy correlations. The predominant benign causes are the proliferative Aschoff body and the main malignant cause is infiltrating lobular carcinoma.

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Definition Architectural distortions are due to defective connective tissue harmony and include convergence areas and local retractions.

In the majority of cases they reflect a benign lesion, although after masses and microcalcifications, they are the third leading appearance of cancers and are difficult to detect and manage. This article reviews the different causes of distortions, together with their anatomical-radiological correlations.

Mammography appearances

Convergence areas

Convergence areas consist of convergent spicules but with no central mass. They produce a star shaped appearance, occasionally called a "black star" as they have no dense centre unlike the classical stellar appearance with a dense centre or mass with spiculated borders, known as a "white star" (Fig. 1).

A white star reflects centrifugal development of lesions, which begin at the centre and almost invariably represent an infiltrating carcinoma. The spicules are the centrifugal extension of the lesions (Fig. 2).

The white star is therefore classified as BIRADS category 5.

Conversely, in the majority of cases, a black star represents centripetal development of lesions from retraction generated by the centre of the lesion (Fig. 3). The black star

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Anatomical-radiological comparison, centre not of Retractions

Figure 1. Mass with spiculated outlines (a) formed from a dense centre and spiculated outlines with very high likelihood of malignancy, to be classified as ACR category 5 and to be compared to the convergence area (b) where spicules are present with no central mass and which is classified as category 4.

Figure 2. White star (infiltrating ductal carcinoma): this is a centrifugal lesion invading the benign breast structures (b) peripherally.

is classified as category 4 as it is only malignant in 10 to 40% of cases [1].

The distinction between a black star and a white star is not always straightforward on mammography if the dense centre is small (Fig. 4).

Retractions at the edge of the gland

These are difficult to diagnose and are identified by comparison, examining for loss of continuity at the boundary of the gland. They may involve the superficial (Fig. 5) or deep (Fig. 6) boundary of the gland.

Benign causes

The proliferative Aschoff body or radial scar

Mammographic appearances

These are generally found on routine mammography as a convergence area without a dense centre, confirmed on a local compression view (Fig. 7).

Some mammography appearances are suggestive of the Aschoff body: thin long spicules which are occasionally curved or paired with radiotransparent bands, no palpable mass even in superficial lesions and no dense centre (Fig. 8), although these signs are not sufficiently specific as 30% to 60% of cases are malignant [2]. Only 66.2% of a series of 142 distortions suggestive of radial scarring [3] were in fact radial scars, whereas 28.6% were malignant and 7% were fibrocystic disease.

Diagnosis and management

Faced with these mammographic appearances, an ultrasound is required. If this is positive, the Aschoff body can be diagnosed from a needle biopsy.

Management is controversial if pure radial scarring is present: the conventional approach is to excise the lesion as in 1/3 of cases, examination of the surgical specimen reveals either atypical lesions (15 to 20%) or an infiltrating or in situ carcinoma (15%) [3–5], which may not be seen on biopsy as it is occasionally located at the periphery of the lesion.

Others suggest no treatment for an Aschoff body diagnosed on needle biopsy, if a sufficient number of samples are taken and if no atypia is present [6,7].

Surgery, however, continues to be recommended for a proliferative Aschoff body because of the difficulty in monitoring distortions and the risk of under-estimation on needle biopsy [5].

If the ultrasound is normal, the question of diagnosis arises. Two approaches may be used:
**Figure 5.** Local retraction of the superficial edge of the gland clearly seen on the postero-anterior view following the edge of the gland (arrow) (a) more difficult to see on the oblique view (arrow) (b): infiltrating lobular carcinoma.

**Figure 6.** Retraction of the deep edge of the gland with a convergence area visible on the postero-anterior (arrow) (a) and oblique (arrow) (b) views confirmed by local compression (arrow) (c): infiltrating ductal carcinoma.

**Figure 7.** Convergence area on the postero-anterior (arrow) (a) and oblique (arrow) (b) views confirmed by a local compression view (c). Ultrasound guided biopsy shows a proliferative Aschoff body or radial scar (d), groping together tubules lined by a double basal cell layer. The myoepithelial cells are revealed by immunohistochemistry using anti-p63 antibodies (e).
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Figure 8. Convergence area with no dense centre and with long curved spicules.

- surgical biopsy: stereotactic biopsy raises the technical problem of targeting the abnormality because of its variability between different views;
- MR to examine a target that can be biopsied prior to surgery under MR guidance. If the MR is negative, as it is in 1/3 of cases of Aschoff bodies [8], monitoring may be offered instead of surgery because of the high negative predictive value of MR (97.4%) [9].

Sclerosing adenosis

Mammographic appearances
This is characterized either by a mass or by foci of microcalcifications [10,11] and more rarely by a convergence area (Fig. 9).

Management of sclerosing adenosis
Sclerosing adenosis is a benign, proliferative lesion, which is often seen in the peri-menopausal period. It is not a high-risk lesion [10] although its histological diagnosis is difficult with a risk of under-diagnosis. In addition, when histology is carried out on a micro-biopsy (Fig. 10), this must be confirmed on a macro-biopsy (Fig. 11) [12]. If the diagnosis is confirmed on a macro-biopsy and if no atypia is present, the patient may be monitored. If not, the general rule is to excise the lesion.

Figure 9. Left supero-internal convergence area visible on the postero-anterior (arrow) (a) and oblique (arrow) (b) views and found on ultrasound (c).

Figure 10. Micro-biopsy (sclerosing adenosis): hyperplasia of the duct-lobule units, the organization of which is changed by fibrosis of the intra-lobular tissue. No atypia present.

Figure 11. Macro-biopsy (sclerosing adenosis): confirmation of the lesions described in Fig. 10. No atypia or neoplasia in the lobular root.
Other benign causes

These are far more rare and include the Abrikosoff tumor, a ubiquitously located granular tumor and the hyalinized fibroma.

Malignant causes

Infiltrating lobular carcinoma

Mammographic appearances

Architectural distortion is a classical presenting appearance for infiltrating lobular carcinoma, which is the most common malignant cause of convergence areas and presents with this appearance in 16% to 20% of cases depending on the author [13,14] (Fig. 12).

Diagnosis

If distortion is visible on both views, the diagnosis is made either by ultrasound guided needle micro-biopsy or by MR vacuum-assisted macro-biopsy if the ultrasound is negative. Surgical biopsy is occasionally required (Fig. 12).

Occasionally, distortion is only visible on one view, when the diagnosis is more difficult. If the distortion is confirmed on a local compression view and ultrasound is negative, MR is required to confirm actual distortion and provide a diagnosis (Fig. 13).

Figure 12. Sixty-nine year old patient. Screening mammography shows a convergence area with no dense centre visible on the postero-anterior view (arrow) (a) which is seen on the oblique view (arrow) (b) and on the local view (c). Surgical biopsy: infiltrating lobular carcinoma (d): fine rows of small non-cohesive tumor cells in a very poorly vascularized fibrous stroma.

Figure 13. Right superior convergence area visible on an oblique view (arrow) but not on the postero-anterior view. The local view confirms distortion (b). Ultrasound is normal. MR (c) shows a mass with spiculated outlines (infiltrating lobular carcinoma).
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Intra-ductal carcinoma

Whilst intra-ductal carcinomas usually present with foci of microcalcifications, they can also appear as a distortion (Fig. 14). They also represented 4% of asymptomatic distortions and almost 17% of palpable architectural distortions in Patterson’s series [15] (Table 1).

The calcifications seen in intra-ductal carcinomas may be secretory (in which case the morphology is often round or punctiform) or necrotic, which are then typically worm-like in appearance because of tumor proliferation within the ducts onto which the calcifications form. Occasionally, the central necrosis does not calcify (Fig. 15), explaining the unusual mammographic appearance.

Infiltrating ductal carcinoma

This can also be seen as architectural distortion and raises the same diagnostic difficulties if no ultrasound appearances are present (Fig. 6).

Table 1 Causes of architectural distortions depending on whether or not they are palpable [15].

<table>
<thead>
<tr>
<th></th>
<th>Benign lesion (%)</th>
<th>Atypical hyperplasia (%)</th>
<th>Intra-ductal carcinoma (%)</th>
<th>Infiltrating carcinoma (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymptomatic patients</td>
<td>74.4</td>
<td>18.6</td>
<td>4.7</td>
<td>2.3</td>
</tr>
<tr>
<td>Symptomatic patients</td>
<td>48.3</td>
<td>19.1</td>
<td>16.9</td>
<td>15.7</td>
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</tbody>
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Figure 14. Fifty-eight year old patient, screening mammography. The mammogram shows local retraction of the superior edge of the gland (arrow) (a) confirmed by the local compression view (b) but not seen on the postero-anterior view (c). Ultrasound is normal. Because of this diagnostic difficulty, MR was performed and showed segmental contrast uptake in the suspected area (d), classified as ACR category 5. Targeted ultrasound did not show any abnormality which could be biopsied. The biopsy was then performed under MR and showed a high-grade intra-ductal carcinoma.

Conclusion

Architectural distortions raise diagnostic and management difficulties as they do not always have ultrasound appearances and can generally not be biopsied under mammography. In view of their high predictive value for malignancy (30%), practitioners should be prepared to proceed as far as MR or even surgical biopsy to obtain a diagnosis. The predominant benign lesions are the proliferative Aschoff body and the main malignant causes are infiltrating lobular carcinomas.

TAKE-HOME MESSAGES
- Architectural distortions involve convergence areas and retractions of the border of the gland.
• They are classified as BIRADS, category 4.
• The most common cause is the proliferative Aschoff body.
• If an Aschoff body is diagnosed, surgical excision is still the general rule because of the possibility of a co-existent carcinoma.
• Sclerosing adenosis can just be monitored if it has been diagnosed by a macro-biopsy and does not contain atypia.
• The most common malignant cause of architectural distortions is infiltrating lobular carcinoma.
• Intra-ductal carcinomas may produce appearances of pure distortions with no calcification in the absence of any calcified necrosis.

Disclosure of interest

The authors declare that they have no conflicts of interest concerning this article.

References