# Analysis of Sonographic Features in the Differentiation of Fibroadenoma and Invasive Ductal Carcinoma

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**OBJECTIVE.** The purpose of this study was to determine the predictive power of sonographic tumor descriptors in the differentiation of fibroadenoma from invasive ductal carcinoma of the breast.

**SUBJECTS AND METHODS.** Three hundred thirty-six tumors (142 fibroadenomas and 194 invasive ductal carcinomas) of the breast diagnosed using sonography were prospectively recorded with respect to the shape, contour, echo texture, echogenicity, sound transmission, and surrounding tissue of the tumors. Evaluation included odds and odds ratios of single sonographic features as well as sensitivity, specificity, and positive and negative predictive values of combinations of features. Tumor descriptors were also evaluated using multiple logistic regression analysis after adjustment for age and clinical examination.

**RESULTS.** Irregular shape and contour, extensive hypoechogenicity, shadowing, echogenic halo, and distortion of surrounding tissue were the findings with the highest predictive value of malignancy. A thin echogenic pseudocapsule was the most important sonographic finding predictive of the benign nature of a solid mass. Echo texture was of little value in the differentiation of breast tumors. Age and clinical examination remained important predictors in a clinically referred patient population because a palpable mass in an elderly patient is most likely a carcinoma. We saw considerable overlap of most sonographic features in both benign and malignant tumors. However, using strict sonographic criteria and a combination of descriptors, we found a negative predictive value of 100% in palpable and 96% in impalpable tumors.

**CONCLUSION.** A combination of tumor descriptors gave negative predictive values approaching 100%, allowing downgrading of solid breast masses with a high degree of confidence. Extensive sonographic features analysis in patients with indeterminate clinical and mammographic findings has the potential for downgrading a tumor and possibly obviating the need for excision in a subgroup of patients. Further investigations may provide standardization of sonographic descriptor analysis and establishment of the combination of the most predictive features that would be useful in daily practice.

Breast sonography is the most important adjunct to mammography for patients with palpable breast masses and normal or equivocal mammographic findings. Most carcinomas smaller than 1 cm in diameter can be identified and analyzed with respect to sonographic features using modern high-resolution, linear array, real-time transducers [1]. A further indication for breast sonography is the diagnostic workup of impalpable masses manifesting as indeterminate densities on mammography. The main contribution of sonography is the differentiation of simple cysts from solid masses. The reported accuracy of sonography in the diagnosis of simple breast cysts is 96–100% [2].

The differentiation of benign from malignant solid breast masses has been considered an inappropriate use of breast sonography because of the considerable overlap of the sonographic findings, and it has been recommended that biopsies be performed on all solid masses seen on sonography to exclude malignancy [2–4]. In a recently published prospective study of solid breast nodules, however, a negative predictive value of 99.5% using strict sonographic criteria was reported [5]. The aim of this prospective study was to analyze the recorded sonographic tumor descriptors to evaluate their predictive power in the differentiation of fibroadenoma (the most common benign breast tumor) from invasive

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ductal carcinoma (the most common malignant breast tumor).

## Subjects and Methods

Breast sonography with prospective recording of the sonographic tumor features was performed for 142 patients with fibroadenoma and 194 patients with invasive ductal carcinoma at the breast imaging center at our institution from February 1989 through September 1992. The inclusion criterion of these 336 consecutive patients was the identification of a solid mass on sonographic examination. Patients having a mass on clinical or mammographic examination but with no tumor identification on sonography were excluded from the study. The result of the clinical examination was categorized as palpable, equivocal (indeterminate), or normal based on information from the referring physician, the surgeon in the outpatient department, and the radiologist before the sonographic examination. The clinical examination (palpation) was categorized as equivocal if a mass suspected by the patient or her referring physician could not be confirmed by the surgeon or the radiologist. Mammography was carried out with state-of-the-art equipment (Senographe 600 T; General Electric Medical Systems, Milwaukee, WI). Three projections (craniocaudal, lateral, and oblique) were obtained in most patients, and spot compression or magnification views were obtained if indicated.

Sonography was performed with a 7.5-MHz hand-held linear-array real-time transducer (RT 2800; General Electric Medical Systems, Milwaukee, WI). The sonographic examination was carried out by a radiologist who was familiar with the mammographic findings. No acoustic standoff pad was used. In general, only the quadrant of the breast with an abnormality found on clinical or mammographic examination was evaluated. Hard copies from a multiformat camera were available from all examinations. The following sonographic tumor descriptors were recorded prospectively: shape (round/oval, lobulated, and irregular); contour (pseudocapsule, smooth, and irregular); echo texture (homogeneous and heterogeneous); echogenicity (hyperechoic, isoechoic, mildly hypoechoic, and markedly hypoechoic); sound through-transmission (posterior attenuation, neutral, edge shadowing only, mildly central posterior shadowing, and markedly central posterior shadowing); and surrounding (adjacent) tissue (normal, hyperechoic rim or halo, and distortion). All sonographic examinations with prospectively recorded tumor features included in this study were carried out by one of the authors. The final diagnosis of all tumors included in this study was confirmed on histologic examination.

Statistics include odds and odds ratio of single sonographic tumor features. On the basis of the odds of malignancy, a dichotomization of the tumor descriptors into "benign" and "malignant" features was performed. Sensitivity, specificity, positive predictive value, and negative predictive value for combinations of these dichotomized sonographic descriptors were calculated. The Student's $t$ test was used for the comparison of age groups. Logistic regression analysis using statistical software (BMDP Statistical Software, Los Angeles, CA) was carried out for modeling the combination of descriptors that could best predict malignancy.

## Results

The mean age of the patients with fibroadenoma was 39 years (range, 18–81 years) and of patients with invasive ductal carcinoma, 64 years (range, 28–88 years). The difference between the two groups of 25 years (95% confidence interval, 22–28 years) was statistically significant (two-tailed $t$ test, $p < .001$). The tumor was palpable in 76 patients (54%), equivocal on palpation in 21 patients (15%), and impalpable in 45 patients (32%) with fibroadenoma. The tumor was palpable in 130 patients (67%), equivocal on clinical examination in 27 patients (14%), and impalpable in 37 patients (19%) with invasive ductal carcinoma. The tumors classified as equivocal on clinical examination were categorized as impalpable for overall statistics. Mean and median size of palpable carcinomas as measured sonographically was 22.0 mm and 21.0 mm, respectively (size range, 7–58 mm); and mean and median size of impalpable carcinomas was 12.8 mm and 11.5 mm, respectively (size range, 5–24 mm). Mean and median size of palpable fibroadenomas was 18.6 mm and 16.5 mm, respectively (size range, 6–57 mm); and mean and median size of impalpable fibroadenomas was 14.3 mm and 13.0 mm, respectively (size range, 5–35 mm).

Table 1 shows the odds and the odds ratio of carcinoma for the recorded sonographic features. We found a broad range of the confidence interval of the odds ratio for some of the sonographic features because of the small number of lesions in some of the categories (as shown in Table 1). For daily clinical practice, it is desirable to dichotomize all descriptors. All tumor descriptors were dichotomized on the basis of a cut-off level according to the most significant increase in the odds for cancer (Table 1). The cut-off level for dichotomization to achieve binary variables based on odds ratio was obvious for the four tumor descriptors echo texture, echogenicity, sound transmission, and surrounding tissue (Table 1). The descriptors shape and contour should be considered as ordinal variables according to our results. Taking into account that strict sonographic criteria are necessary to achieve high negative predictive values of benign tumors, the cut-off level for dichotomization was set between round/oval and lobulated for shape and between pseudocapsule and smooth for contour.

The odds and odds ratio of carcinoma for each dichotomized tumor descriptor in impalpable and palpable tumors are shown in Table 2. The six tumor descriptors were subjected to a multiple logistic regression analysis with invasive ductal carcinoma as the dependent variable and were adjusted for age (continuous variable) and clinical examination (binary variable). The results of the logistic regression analysis are shown in Table 3. All tumor descriptors except echo texture entered the model significantly, and the goodness-of-fit chi-square test $p$ value of 1.0 indicates an appropriate logistic model for the data set.

Using strict criteria for a negative sonographic test result to achieve high negative predictive values, the sonography was defined as "negative" if all the dichotomized descriptors predicted a benign lesion and as "positive" if one or more of the dichotomized descriptors predicted a malignant lesion (Table 2). Including all six descriptors in a two-by-two table analysis, the overall sensitivity, specificity, positive predictive value, and negative predictive value were 99.5%, 29%, 66%, and 98%, respectively. The only false-negative finding was among the impalpable tumors, so that the negative predictive value was 100% in palpable and 96% in impalpable tumors. When echo texture as the only descriptor in the logistic model without a statistically significant contribution was excluded from the test analysis, the overall sensitivity, specificity, positive predictive value, and negative predictive value were 99%, 37%, 68%, and 96%, respectively. The exclusion of echo texture led to one false-negative diagnosis among the palpable masses, so the negative predictive value dropped from 100% to 96% in the palpable tumor group. When only the three most predictive descriptors in the logistic model (surrounding tissue, sound transmission, and contour) were included, the negative predictive value was 93% for palpable and 97% for impalpable tumors.

## Discussion

The characteristic sonographic findings of benign tumors include a round or oval, slightly hypoechoic lesion with smooth borders or a pseudocapsule, homogeneous internal echoes, no central posterior acoustic shadowing, and normal surrounding tissue [4–11] (Fig. 1). The typical features of malignancy include irregular shape, irregular margins, hypoechogenicity, a surrounding echogenic rim or halo, and posterior acoustic shadowing [3, 5–11] (Fig. 2). All dichotomized descriptors were "benign"

**TABLE 1 Frequency of Carcinoma, Odds of Cancer, and Odds Ratio for Each Sonographic Feature in 142 Fibroadenomas (FA) and 194 Invasive Ductal Carcinomas (IDC)**

| Tumor Descriptor | FA (*n* = 142) | IDC (*n* = 194) | Frequency of IDC (%) | Odds of Cancer | Odds Ratio |
|---|---|---|---|---|---|
| Shape | | | | | |
| Round/oval | 122 | 56 | 32 | 0.46 | 1.0 |
| Lobulated | 15 | 53 | 78 | 3.53 | 7.7 |
| Irregular | 5 | 85 | 94 | 17.00 | 37.0 |
| Contour | | | | | |
| Pseudocapsule | 59 | 3 | 5 | 0.05 | 1.0 |
| Smooth | 72 | 40 | 36 | 0.56 | 10.9 |
| Irregular | 11 | 151 | 93 | 13.73 | 270.0 |
| Echo texture | | | | | |
| Homogeneous | 92 | 56 | 38 | 0.61 | 1.0 |
| Heterogeneous | 50 | 138 | 73 | 2.76 | 4.5 |
| Echogenicity | | | | | |
| Hyperechoic | 4 | 4 | 50 | 1.00 | 1.0 |
| Isoechoic | 32 | 12 | 27 | 0.38 | 0.4 |
| Slightly hypoechoic | 101 | 118 | 54 | 1.17 | 1.2 |
| Extensively hypoechoic | 5 | 60 | 92 | 12.00 | 12.0 |
| Sound transmission | | | | | |
| Enhancement | 19 | 4 | 17 | 0.21 | 1.0 |
| Neutral | 87 | 47 | 35 | 0.54 | 2.6 |
| Edge shadowing | 27 | 19 | 41 | 0.70 | 3.3 |
| Slight shadowing | 9 | 106 | 92 | 11.78 | 55.9 |
| Extensive shadowing | 0 | 18 | 100 | — | — |
| Surrounding tissue | | | | | |
| Normal | 133 | 108 | 45 | 0.81 | 1.0 |
| Hyperechoic rim | 9 | 74 | 89 | 8.22 | 10.1 |
| Distortion | 0 | 12 | 100 | — | — |

Note.—Dash (—) indicates noncalculable because no fibroadenomas had these features. Findings with an odds ratio of 1.0 are the reference point for the calculation of all ratios.

in 41 (29%) of 142 of fibroadenomas, but all dichotomized descriptors were "malignant" in only 15 (8%) of 194 invasive ductal carcinomas in this study (Tables 1 and 2). The reported considerable overlap of sonographic features in benign and malignant tumors [6–13] reflects the common overlap in border characteristics and internal structure for benign and malignant tumors on gross pathology. Therefore, this overlap is not entirely attributable to the imaging system but to a large degree to the tumors themselves [4].

Shape can be an important predictor of malignancy if irregularity is present, but a round/oval tumor is an inconclusive finding. A round/oval shape is found in 85–86% of fibroadenomas and in 29–42% of carcinomas [11, 14] (Table 1). We grouped round and oval tumors as one category as some previous authors had done [4, 11]. Recent studies have shown that the ratio of the length (L) of the tumor to its anteroposterior (AP) diameter (L:AP ratio) might be an important criterion in the characterization of breast masses [10]. One study reported a low sensitivity for this parameter [15], but our own experience over the last years confirms the diagnostic power of the L:AP ratio [1]. Consequently, it would have been more appropriate to separate round and oval tumors. A lobulated shape had an odds ratio of 7.7:1 in the present material and was therefore a feature suspicious for malignancy in our analysis (Tables 1 and 2). A few gently curving, circumscribed lobulations (macrolobulations) are considered a benign

**TABLE 2 Odds and Odds Ratios of Sonographic Features in Impalpable and Palpable Fibroadenomas (FA) and Invasive Ductal Carcinomas (IDC)**

| Tumor Descriptors, Dichotomized | Impalpable Tumors (*n* = 130) | | | | Palpable Tumors (*n* = 206) | | | |
|---|---|---|---|---|---|---|---|---|
| | FA | IDC | Odds | Odds Ratio | FA | IDC | Odds | Odds Ratio |
| Shape | | | | | | | | |
| Round/oval | 55 | 19 | 0.35 | 1.0 | 67 | 37 | 0.55 | 1.0 |
| Lobulated/irregular | 11 | 45 | 4.10 | 11.8 | 9 | 93 | 10.33 | 18.7 |
| Contour | | | | | | | | |
| Pseudocapsule | 33 | 1 | 0.03 | 1.0 | 26 | 2 | 0.08 | 1.0 |
| Smooth/irregular | 33 | 63 | 1.91 | 63.0 | 50 | 128 | 2.56 | 33.3 |
| Echo texture | | | | | | | | |
| Homogeneous | 46 | 25 | 0.54 | 1.0 | 46 | 31 | 0.67 | 1.0 |
| Heterogeneous | 20 | 39 | 1.95 | 3.6 | 30 | 99 | 3.30 | 4.9 |
| Echogenicity | | | | | | | | |
| Hyper-iso-/slightly hypoechoic | 63 | 45 | 0.71 | 1.0 | 74 | 89 | 1.20 | 1.0 |
| Extensively hypoechoic | 3 | 19 | 6.33 | 8.9 | 2 | 41 | 20.50 | 17.0 |
| Sound transmission | | | | | | | | |
| No central shadowing | 58 | 15 | 0.26 | 1.0 | 75 | 55 | 0.73 | 1.0 |
| Central shadowing | 8 | 49 | 6.13 | 23.7 | 1 | 75 | 75.00 | 102.3 |
| Surrounding tissue | | | | | | | | |
| Normal | 60 | 31 | 0.52 | 1.0 | 73 | 77 | 1.05 | 1.0 |
| Rim/distortion | 6 | 33 | 5.50 | 10.7 | 3 | 53 | 17.70 | 16.8 |

Note.—Findings with an odds ratio of 1.0 are the reference point for the calculation of all ratios.

Fig. 1.—28-year-old woman with fibroadenoma. Sonogram shows typical benign tumor with homogeneous echo texture and no posterior shadowing. Note thin echogenic pseudocapsule at posterior border, which is less obvious anteriorly. Longest diameter of oval tumor was parallel to skin surface, with a length:anteroposterior ratio of 1.7.

Fig. 2.—67-year-old woman with invasive ductal carcinoma. Sonogram reveals typical malignant tumor with irregular contour, hypoechoic with heterogeneous echo texture, and central posterior shadowing. Longest diameter of tumor is perpendicular to skin surface.

feature, whereas many small lobulations of 1–2 mm (microlobulations) are considered a malignant characteristic in a recent study [5]. It would perhaps have been more appropriate to separate the lobulated group into macro- and microlobulations.

Contour is one of the most important sonographic tumor features [6, 8, 9, 11] (Tables 1–3). A pseudocapsule (Fig. 1A) is a strong predictor of a benign lesion, the odds of cancer being 0.03 in impalpable and 0.08 in palpable tumors in our material (Table 2). The identification of the hyperechoic pseudocapsule can be impossible if the fibroadenoma is surrounded by echogenic fibroglandular tissue. Irregular contour, a "malignant" finding, has been reported in 25–27% of fibroadenomas [10, 14] as compared with 8% in this study (Table 1). A smooth wall contour, reported in 75–94% of fibroadenomas when a "pseudocapsule" has not been included in the classification scheme [8, 14], was a sonographic feature with odds of 0.56 for cancer and thus with a poor predicting power in this material (Table 1).

Echo texture, commonly divided into homogeneous and heterogeneous echo pattern, is often considered a less specific sonographic feature. Homogeneous echo texture has been found in 71–89% of fibroadenomas and in 12–59% of malignant breast tumors [1, 8, 10]. Echo texture had the lowest odds and odds ratio of malignancy in the present study, and echo texture was the only descriptor without a statistically significant contribution to the differentiation between benign and malignant tumors in the logistic model (Tables 1–3). Elimination of echo texture from the two-by-two table analysis had only minor influence on the overall statistics, the number of false-positive diagnoses being reduced from 101 to 89 cases, with an overall improvement of the specificity from 29% to 37%. In the impalpable tumor group, the false-positive diagnoses were reduced from 45 to 39 (the six cases being correctly grouped as true-negative without echo texture included in the analysis) with still only one false-negative diagnosis, and consequently we noted a minimal but not significant improvement of the negative predictive value from 95.5% to 96.4%. In the palpable tumor group, the elimination of echo texture led to an insignificant decrease of the negative predictive value from 100% to 96%.

Echogenicity has often been of less importance for the differentiation of solid masses, partly because no standardized definition of this parameter exists. By far most tumors are hypoechoic when compared with the adjacent echogenic fibroglandular tissue [1, 6, 10, 16]. In this study, 94% of fibroadenomas and 92% of the invasive carcinomas were hypoechoic (Table 1). More useful information can be gained by comparing tumor echogenicity with that of the fatty tissue of the breast rather than with that of adjacent echogenic fibroglandular tissue surrounding the tumor nidus [5]. Extensive hypoechogenicity is a prominent feature of carcinomas (Table 1). Density perception by the human eye has been considered unreliable in evaluating echogenicity of breast masses, and the difference between density values of carcinoma and fibroadenoma was also found to be insignificant using gain-assisted densitometric evaluation [17].

Sound through-transmission and the acoustic characteristics of the posterior wall are sonographic features frequently discussed in the literature. Central posterior shadowing is a feature suggesting malignancy, reported in 72–97% of breast carcinomas [7, 8]. Slightly central shadowing was found in 55% and extensive shadowing in 9% of invasive ductal carcinomas in our material (Table 1). Moderate posterior shadowing has been reported in 7–10% of fibroadenomas and was seen in 6% of cases in this study [7, 10] (Table 1). Only one palpable fibroadenoma presented with posterior shadowing in our material (Table 2). A brightly reflective zone corresponding to the posterior margin of the tumor may suggest the presence of a fibroadenoma rather than a carcinoma when posterior shadowing is present [13]. Edge or lateral shadowing,

**TABLE 3 Multiple Logistic Regression Analysis of Dichotomized Tumor Descriptors in 142 Fibroadenomas and 194 Invasive Ductal Carcinomas[a]**

| Sonographic Feature | Coefficient | SE | Odds Ratio | 95% Confidence Interval of Odds Ratio | $p$ |
|---|---|---|---|---|---|
| Surrounding tissue | 2.03 | 0.65 | 7.6 | 2.1–27.3 | .002 |
| Sound transmission | 1.95 | 0.63 | 7.0 | 2.0–24.3 | .002 |
| Echogenicity | 1.84 | 0.93 | 6.3 | 1.0–38.7 | .048 |
| Contour | 1.80 | 0.77 | 6.1 | 1.3–27.4 | .019 |
| Shape | 1.45 | 0.51 | 4.3 | 1.6–11.6 | .004 |
| Echo texture | 0.48 | 0.49 | 1.6 | 0.6– 4.2 | .325 |

Note.—Goodness-of-fit chi-square test. $p = 1.0$ indicates an appropriate logistic model for the data set. SE = standard error.

[a]Adjusted for age and clinical examination (palpation).

considered to be characteristic of benign masses, has also been reported in 15–33% of malignant tumors and was recorded in 10% of carcinomas in this series [8] (Table 1).

The surrounding tissue of the tumor nidus was classified in this study as normal, having an echogenic rim or halo, or showing distortion (Table 1). It is a matter of definition whether the echogenic halo (Fig. 3), which strongly predicted malignancy in this series (Tables 1–3), should be classified as a feature of the contour, and whether distortion, which was always associated with invasive ductal carcinoma in our material (Table 1), should be classified as a secondary rather than a primary sonographic feature, as has been done by some other authors. The identification of the echogenic halo can be difficult if the tumor nidus is surrounded by hyperechoic fibroglandular tissue. A halo was recorded in only 38% of carcinomas in this series but has been reported in 53–64% of carcinomas [7, 10]. A hyperechoic rim or halo was recorded in 14 (16%) of 90 carcinomas in the first half as compared with 60 (58%) of 104 carcinomas in the second half of the study, this difference obviously reflecting a learning curve in a prospective study of nearly 4 years' duration. In retrospect, the nine recorded "halos" in fibroadenomas (Table 2) were all interpretation errors (Fig. 4).

Breast sonography as an adjunct to mammography in patients with indeterminate findings on clinical and mammographic examination serves two main purposes: to increase the sensitivity in patients with breast cancer, and to increase the specificity by downgrading the imaging findings in patients with benign tumors. Any tumor suggestive of malignancy on clinical examination or mammography should undergo biopsy regardless of the sonographic findings. In general, biopsy is recommended in patients with probably benign tumors on palpation and mammography if the sonographic finding is suspicious for malignancy. Upgrading if one or more of the dichotomized descriptors indicate malignancy (Table 2) will give a high sensitivity, but this high sensitivity is achieved at the cost of a low specificity. False-positive sonographic diagnoses caused by overlap of the sonographic features is a well-known problem. Downgrading of a tumor requires a more extensive sonographic features analysis because a negative predictive value on sonography of nearly 100% is mandatory if downgrading will have an impact on clinical decision making by obviating the need for biopsy. Attention must be paid to combinations of sonographic features rather than any single characteristic. For daily clinical practice, this features analysis must not be too complicated, and we suggest that a dichotomization of descriptors as proposed in this study (Tables 1–3) would be a practicable solution. The L:AP ratio and dynamic parameters including mobility and compressibility [6] were not included in our analysis, and it is possible that other and more simple combinations of sonographic features might give higher predictive values than in this analysis. In this study, a total of 41 (29%) of 142 fibroadenomas had all features suggesting benign tumor, and the negative predictive value was 98% if all dichotomized descriptors were included. The only false-negative sonographic diagnosis was in retrospect an interpretation error (Fig. 5). If only the three most predictive descriptors in the logistic model (surrounding tissue, sound transmission, and contour) were used for test statistics, this case was still the only false-negative diagnosis in the impalpable group, and the negative predictive value was then 97%. The high negative predictive value of impalpable tumors is of interest with respect to the diagnostic work-up of small tumors found on screening mammography. In general, we no longer perform needle biopsy in impalpable tumors definitely classified as benign on extensive sonographic features analysis.

Our results indicate a potential of sonography for downgrading a subgroup of patients in which biopsy can be avoided and confirm the high negative predictive value recently reported [5, 18]. Interobserver variation may be a serious problem in breast imaging, and it has been reported that radiologists differ substantially in their interpretation of mammograms [19]. Test interpretation bias might have influenced our results, but sonography is an adjunct to mammography and should always be performed with full knowledge of the mammographic findings [1]. Agreement on breast sonographic diagnosis is reported to be lower than for mammographic diagnosis, but the highest agreement was found on combined mammographic–sonographic interpretation [20]. Sonography is an operator-dependent examination technique, and a weakness of this investigation is the single-reader study design. To our knowledge, no prospective multiple-reader study on breast sonography assessing the variability in interpretation attributable to reader differences has been reported. However, considerable interobserver variability for scoring of sonographic tumor features has been reported [21]. The confusion associated with the success of sonography for characterization of breast tumors is not only due to interobserver variability but is also caused by a

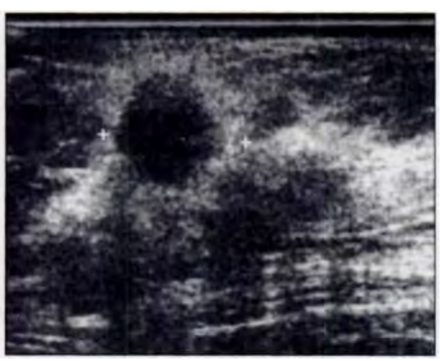

**Fig. 3.**—65-year-old woman with invasive ductal carcinoma. Sonogram shows slightly irregular hypoechoic tumor with longest diameter perpendicular to skin surface. Broad hyperechoic rim or halo surrounding tumor nidus is easily identified.

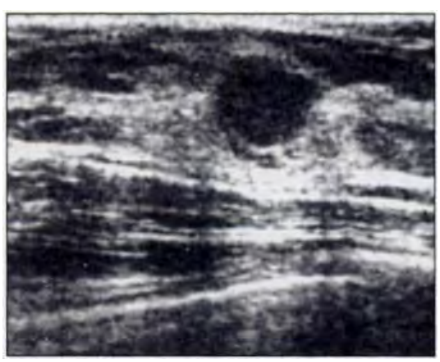

**Fig. 4.**—39-year-old woman with fibroadenoma that was falsely diagnosed as cancer. Normal echogenic tissue surrounding tumor anteriorly was misinterpreted as hyperechoic halo. However, smooth border indicating a pseudocapsule is seen posteriorly.

**Fig. 5.**—82-year-old woman with invasive ductal carcinoma falsely diagnosed as benign lesion. This 9-mm impalpable solid mass was recorded as round/oval tumor with a pseudocapsule. However, shape is slightly irregular and contour is smooth, and no pseudocapsule is present.

great variation in the diagnostic features that different workers describe as useful. Some authors are ignoring diagnostic features that others find useful [6]. Standardization of sonographic features analysis for daily clinical practice is necessary to reduce the interobserver variability and to improve the potential of breast sonographic features analysis. Further research on this subject should be encouraged to confirm the role of sonography for differentiation between benign and malignant breast tumors.

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