Evaluation of focal breast lesions using ultrasound elastography with FNAC and/or histopathology correlation among patients visiting breast ultrasound and mammography units at Tikur Anbessa Specialized Teaching Hospital, Ethiopia, August, 2025

Bereket Engedasew[1]*, Ferdosa Ahmed[1], Daniel Admassie[1], Daniel Zewdneh Solomon[1], Getaneh Atile[1]

[1]Department of Radiology, School of Medicine, College of Health Sciences, Addis Ababa University, Ethiopia

*Corresponding author: Bereket Engedasew

Received: 31 January 2026 · Peer reviewed, accepted and published: 12 May 2026

Swiss Journal of Radiology and Nuclear Medicine · www.sjoranm.com · SJORANM GmbH · Rosenweg 3 · CH-6340 Baar · Switzerland

Abstract

Background: Ultrasound elastography provides tissue stiffness information that may complement conventional B-mode ultrasound in the assessment of breast lesions.

Methods: This prospective analytical cross-sectional study at Tikur Anbessa Specialized Hospital evaluated 100 patients with breast or post-mastectomy chest wall lesions using BI-RADS, elasticity scoring, and strain ratio, with FNAC and/or histopathology correlation. Diagnostic performance was evaluated in the 98 cases classified as malignant or benign; the two atypical cases were described separately.

Results: There were 72 malignant, 26 benign, and two atypical lesions. At the reported thresholds, BI-RADS had sensitivity of 98.6%, specificity of 7.7%, and accuracy of 74.5%; elasticity scoring had sensitivity of 95.8%, specificity of 69.2%, and accuracy of 88.8%; and strain ratio had sensitivity of 98.6%, specificity of 53.8%, and accuracy of 86.7%.

Conclusion: In this biopsy-enriched single-center cohort, elasticity scoring and strain ratio each showed higher specificity than BI-RADS at the reported thresholds. These descriptive findings support further evaluation of elastography as an adjunct to conventional ultrasound. They do not establish the performance of a combined testing rule or a reduction in unnecessary biopsies, and may not be generalizable to screening populations.

Keywords: BIRADS 3; BIRADS 4; breast lesion; cytology; elasticity scoring; elastography; histopathology; sensitivity and specificity; strain ratio; ultrasound

Introduction

Breast cancer is the most common malignancy among women worldwide, with approximately 2.3 million new cases and 670,000 deaths reported in 2022 [1]. In Ethiopia, breast cancer is the leading cancer among women, accounting for about one-third of female cancers and one-fifth of all cancers overall. Despite this high burden, early and accurate diagnosis remains a major challenge [2].

Traditionally, breast cancer diagnosis in Ethiopia has relied on clinical examination, mammography, and conventional B-mode ultrasonography, with histopathology as the diagnostic gold standard [3]. Although ultrasound is widely used because of its availability, non-invasiveness, and real-time imaging capability, its relatively low specificity limits its ability to reliably distinguish benign from malignant lesions. This limitation is particularly evident in BI-RADS category 3 and 4A lesions, where malignancy risk is low but not negligible. As a result, many patients undergo frequent follow-up or unnecessary biopsies, which increase cost, patient anxiety, and healthcare burden. Poor patient adherence to imaging follow-up, largely due to financial limitations and inadequate awareness, often compels clinicians to opt for biopsy even in cases with a low likelihood of malignancy [4, 5].

Ultrasound elastography, introduced as a technique to assess tissue stiffness, provides additional functional information that complements conventional ultrasound [6, 7]. Both strain elastography and shear wave elastography have demonstrated improved specificity in differentiating benign from malignant breast lesions, particularly in equivocal cases [8, 9]. Several international studies have shown that elastography, especially quantitative parameters such as strain ratio, can safely downgrade a significant proportion of BI-RADS 4A lesions, thereby reducing unnecessary biopsies without compromising cancer detection. Consequently, elastography has been incorporated into the ACR BI-RADS lexicon as an adjunct imaging tool [11, 12, 13].

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

While extensive evidence from Asia, the Middle East, South America, and other regions supports the diagnostic value of elastography, data from sub-Saharan Africa, including Ethiopia, are scarce. Differences in patient demographics, breast cancer biology, healthcare access, and imaging practice patterns limit the direct applicability of foreign data to the Ethiopian population [8, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26].

Therefore, there is a critical need to evaluate the role of ultrasound elastography in the characterization of breast lesions in Ethiopia. Generating local evidence on its diagnostic performance, particularly for BI-RADS 3 and 4A lesions, may help optimize patient management, reduce unnecessary biopsies, and improve cost-effective breast cancer care in resource-limited setting.

Objective

General Objective: To evaluate focal breast and post-mastectomy chest wall lesions using ultrasound elastography and correlate findings with FNAC/CNB results at TASH.

Specific Objective: To determine the diagnostic performance (sensitivity, specificity, PPV, NPV, and accuracy) of ultrasound elastography in differentiating benign from malignant lesions.

Materials and Methods

The study was conducted at Tikur Anbessa Specialized Hospital (TASH) in Addis Ababa, the main teaching hospital of the School of Medicine at Addis Ababa University, which provides a wide range of clinical services. This single-center prospective analytical cross-sectional study was carried out from December 1, 2024 to April 30, 2025, to evaluate focal breast and post-mastectomy chest wall lesions using ultrasound elastography with correlation to FNAC/CNB findings. The source population included all patients attending the Breast and Mammography Unit of the Radiology Department, while the study population consisted of eligible patients who met the predefined inclusion and exclusion criteria.

The study included females aged 16 to 80 years who had sonographically visible solid breast lesions smaller than 3 cm and categorized as BI-RADS 3, 4, or 5 on conventional ultrasound. For BIRADS 3 lesions, only those that had undergone fine needle aspiration cytology (FNAC) or biopsy were considered. Exclusion criteria were cystic lesions, solid lesions classified as BIRADS 2, lesions larger than 3 cm, lesions situated close to the skin surface or chest wall, and lesions without cytological or histopathological confirmation.

The sample size was calculated to be 138 based on a proportion estimate of p=0.9. After accounting for a 5% non-response rate, the final adjusted sample size was 145. A biopsy enriched convenience sampling technique was employed. A pre-prepared data collection checklist adapted from ACR BIRADS guideline was used as the primary tool for data collection.

The imaging equipment we used was the Mindray DC-60 Exp system, using the L14-6NE high-frequency linear array transducer.

Data collection tool and procedure

Lesions were initially evaluated using conventional B-mode ultrasonography, following a radial scanning pattern with patients in the supine position. Each lesion was classified into an appropriate BIRADS category based on conventional ultrasound features.

Elastography Technique and Parameters

Strain elastography data were obtained by positioning the field-of-view box to encompass the area from the subcutaneous fat layer down to the pectoralis muscle, while carefully avoiding the rib cage. Proper compression was verified by the appearance of two to three green blocks on the vertical column display on the left side of the ultrasound monitor; one or no block indicated insufficient compression, while four to five blocks signaled excessive pressure.

Elasticity scores (ES) were assigned according to the 5-point Tsukuba classification system introduced by Itoh et al [27].

Lesions scoring 1 to 3 were classified as benign, while scores of 4 or 5 were considered suspicious for malignancy.

The strain ratio (SR) was calculated by positioning the first region of interest (ROI) within the lesion and the second ROI in adjacent subcutaneous fat at a similar size and depth. This measurement was repeated three times, and the average value was used to provide a quantitative evaluation of tissue stiffness.

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

Histopathology

The lesions underwent fine-needle aspiration cytology (FNAC), ultrasound-guided core biopsy, or surgical excision, with histopathological findings serving as the reference standard for evaluating the results of conventional ultrasound and elastography.

Data Quality Control and Statistical Analysis

Radiological image acquisition and evaluation were performed by a single radiologist trained in breast strain elastography. To ensure quality control, the operator received prior training in strain elastography techniques and adhered strictly to the standardized data collection procedures described above. The primary investigator checked the data for accuracy and consistency to ensure its completeness and quality, and then entered it into IBM SPSS version 25.0 for analysis.

Nominal variables were summarized using frequencies and percentages. The associations between BI-RADS score, elasticity score, and strain ratio with biopsy results were analyzed, and a p-value of <0.05 was considered statistically significant. Receiver operating characteristic (ROC) curves were generated to evaluate the diagnostic performance of the methods by calculating the area under the curve (AUC). Comparisons between AUC values were performed descriptively, and no formal statistical test for differences between AUCs was applied. The results were presented using tables and charts.

Operational Definitions

BIRADS score (BS)- Negative or Benign lesions:1 to 3, positive or Suspicious lesions: 4 and 5 (ACR BI-RADS Atlas, 5th Edition, Breast Imaging Reporting and Data System)

Elasticity Score (ES)- Negative or Benign lesions: ES 1 to 3, Positive or Suspicious lesions: ES 4 and 5 (Itoh A et al. Breast disease: clinical application of US elastography)

Strain Ratio (SR) - Negative or Benign lesions: SR < 3.1, Positive or Suspicious lesions: SR ≥ 3.1 (Zhi et al ultrasonic in breast cancer diagnosis)

Ethical clearance was obtained from the Research and Ethics Committee of the Radiology Department at Addis Ababa University. Informed consent was obtained from all patients. All patient information was kept confidential and anonymous; direct identifiers such as names or specific addresses were not used. Participation in the study was strictly voluntary.

Results

Between December 1, 2024 and April 30, 2025 a total of 112 eligible patients with breast and post-mastectomy chest wall lesions were recruited. However, 12 cases were excluded due to loss to follow-up. In these patients, BI-RADS classification and strain elastography assessment were performed, but histopathological confirmation was unavailable either because the biopsy results were non-diagnostic or the patients did not undergo biopsy.

Consequently, 100 participants were included in the final analysis and subsequent follow-up phase. The final sample size was smaller than the initially calculated sample size due to time constraints and loss to follow-up. This reduction in sample size may have decreased the statistical power of the study and could limit the generalizability of the findings.

The largest proportion of participants 36% were aged 31–40 years, followed by 33% in the 41–50 age group. Fourteen participants 14% were aged 21–30 years, and 6% were 60–70 years old. The mean age of the participants was 42.6 years, with a standard deviation of 11 years (Table 1).

Most participants underwent examination for breast lump followed by routine screening (figure 1).

Histopathological evaluation of FNAC and core needle biopsy (CNB) specimens revealed that, among the 100 patients included in the study, 72 had malignant lesions, 26 had benign lesions, and 2 had atypical lesions. The most common malignant diagnosis was invasive carcinoma while fibroadenoma was the most frequently identified benign lesion (Figure 2). Binary diagnostic performance was evaluated in the 98 malignant or benign cases; the two atypical cases were described separately.

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

The high proportion of malignant cases is consistent with the nature of our institution as a tertiary referral center, where most referred patients present with clinically and radiologically suspicious lesions. Additionally, the study population consisted primarily of lesions selected for biopsy, which inherently included cases with higher suspicion for malignancy, while clearly benign-appearing lesions were less likely to undergo tissue sampling due to feasibility and clinical practice considerations.

The majority of the examined breast tissues exhibited a homogeneous distribution of fibro glandular element and located in the right breast. The upper outer quadrant was the most common site of breast lesions.

When evaluating all lesions, nearly half (48%) were classified as BI-RADS category 5, followed by 38% in category 4A. Categories 4B and 3 accounted for 10% and 4% of cases, respectively. Only a small number of lesions (4%) were categorized as benign (BI-RADS 3), while the majorities (96%) were considered suspicious (BI-RADS 4 or 5). Benign lesions typically featured oval shapes, parallel orientation, circumscribed margins, and hypoechoic echogenicity without posterior features, calcifications, or associated findings. In contrast, suspicious lesions were usually irregular, non-parallel, and non-circumscribed, with hypoechoic echotexture and internal vascularity.

Analysis of BI-RADS categorization showed that most benign lesions were classified as categories 3 and 4A, whereas the majority of malignant lesions were assigned to categories 4 and 5. The two atypical lesions were categorized as BI-RADS 3 and 4A.

Although lesions categorized as BI-RADS 4–5 showed higher odds of malignancy on FNAC/CNB, the association between BI-RADS category and FNAC/CNB result was not statistically significant ($p = 0.35$). This is likely due to the small number of cases in the BI-RADS 1–3 categories, resulting in class imbalance and reduced statistical power to detect a true association. The limited sample size in the lower BI-RADS groups may also have produced wide confidence intervals and unstable estimates, reducing the precision of the findings. Therefore, the lack of statistical significance should not be interpreted as contradicting the established diagnostic value of BI-RADS, but rather as a reflection of study-specific limitations, including the skewed case distribution and the relatively small number of benign lesions. (Table 2).

Using a BI-RADS cutoff of ≥4 to indicate malignancy, the diagnostic performance metrics demonstrated a sensitivity of 98.6% (95% CI: 96–100%) and a specificity of 7.7% (95% CI: 0–18%). The positive predictive value (PPV) was 74.7% (95% CI: 66–83%), while the negative predictive value (NPV) was 66.7% (95% CI: 13–100%), with an overall diagnostic accuracy of 74.5% (95% CI: 66–83%). Receiver operating characteristic (ROC) curve analysis showed an area under the curve (AUC) of 0.89 (95% CI: 0.83–0.95), indicating good overall discriminative ability of the BI-RADS scoring system. However, despite its high sensitivity, the low specificity resulted in the misclassification of 24 benign lesions as false positives (Figure 3).

Elastography assessment demonstrated that most benign lesions had elasticity scores of 2 or 3, whereas the majority of malignant lesions were assigned scores of 4 and 5. The two atypical lesions received elasticity scores of 3 and 4.

Statistical analysis revealed a highly significant association between elasticity score and FNAC/CNB results ($p < 0.001$). Lesions with elasticity scores of 4–5 had approximately 52 times higher odds of malignancy compared to those with scores of 1–3, indicating strong predictive value of higher elasticity scores for malignancy (Table 3).

Using an elasticity score cutoff of ≥4 to indicate malignancy, the diagnostic performance analysis demonstrated a sensitivity of 95.8% (95% CI: 91–100%) and a specificity of 69.2% (95% CI: 56–87%). The positive predictive value (PPV) was 89.6% (95% CI: 83–96%), while the negative predictive value (NPV) was 85.7% (95% CI: 71–100%), with an overall diagnostic accuracy of 88.8% (95% CI: 83–95%). Receiver operating characteristic (ROC) curve analysis showed an area under the curve (AUC) of 0.92 (95% CI: 0.88–0.98), indicating excellent discriminative ability of the elasticity scoring system. Despite this strong performance, 8 benign lesions were misclassified as false positives (figure 4).

Strain ratio analysis showed that 14 benign lesions had values below the cutoff of 3.1, whereas the majority of malignant lesions (71 cases) demonstrated strain ratios ≥3.1. Both atypical lesions had strain ratios below 3.1. Statistical analysis demonstrated a highly significant association between strain ratio and FNAC/CNB results ($P < 0.001$). Lesions with a strain ratio ≥3.1 had approximately 83-fold higher odds of malignancy compared to those with strain ratios <3.1. (Table 4)

Using a strain ratio cutoff value of 3.1 to indicate malignancy, the diagnostic performance analysis demonstrated a sensitivity of 98.6% (95% CI: 96–100%) and a specificity of 53.8% (95% CI: 35–73%). The positive predictive value (PPV) was 85.5% (95% CI: 78–93.1%), while the negative predictive value (NPV) was 93.3% (95% CI: 81–100%), with an overall diagnostic accuracy of 86.7% (95% CI: 80–93%). Receiver operating characteristic (ROC) curve analysis showed an area under the curve (AUC) of 0.85 (95% CI: 0.74–0.95), indicating good discriminative ability of the strain ratio method. Despite its effectiveness, the system misclassified 12 benign lesions as false positives (Figure 5).

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

A total of 13 patients were evaluated for suspected post-mastectomy chest wall recurrence. Histopathology confirmed 11 (84.6%) malignant lesions (all invasive carcinoma) and 2 (15.4%) benign lesions (one fat necrosis and one with no evidence of malignancy).

On BI-RADS assessment, lesions were distributed across probably benign to highly suspicious categories. Elastography demonstrated predominantly high elasticity scores, and most lesions had a strain ratio >3.1.

Diagnostic performance analysis for post mastectomy chest wall lesion showed:

BI-RADS: Sensitivity 91%, Specificity 50%, PPV 91%, NPV 50%, Accuracy 84.6%.

Elasticity Score: Sensitivity 91%, Specificity 100%, PPV 100%, NPV 66.7%, Accuracy 92.3%.

Strain Ratio: Sensitivity 100%, Specificity 50%, PPV 92%, NPV 100%, Accuracy 92.3%.

In the post-mastectomy chest wall lesion subgroup, elastography parameters demonstrated higher diagnostic accuracy compared to BI-RADS alone. However, this subgroup analysis is descriptive in nature and explicitly limited by the small sample size, which reduces statistical power and restricts the generalizability of the findings.

The diagnostic performance of the three individual methods is summarized in Table 5. Figure 6 displays their individual ROC curves for descriptive comparison.

Discussion

In this study, the majority of participants presented with a palpable breast lump (63%), followed by individuals undergoing routine screening (19%). These findings are comparable to reports from Bangladesh, where breast lumps and breast pain were identified as the most common reasons for seeking breast evaluation [23, 24].

The analysis of 100 patients evaluated using FNAC and CNB revealed that 72% of lesions were malignant, while 26% were benign. Invasive carcinoma constituted the majority of malignant cases (93.1%), whereas fibroadenoma was the most frequently identified benign lesion. These findings differ from reports from studies conducted in India, where a higher proportion of benign breast lesions have been described. Despite this variation in the overall distribution of benign and malignant lesions, the histopathological pattern remains consistent across studies, with fibroadenoma representing the most common benign lesion and invasive ductal carcinoma being the most prevalent malignant tumor [16, 17, 18].

Regarding ultrasound characteristics, benign lesions in the present study predominantly demonstrated an oval shape (75%), parallel orientation (75%), circumscribed margins (100%), and a hypoechoic echotexture (100%). In contrast, malignant lesions were more frequently associated with irregular shape (63.5%), non-parallel orientation (72.5%), non-circumscribed margins (64.5%), hypoechoic echotexture (80.2%), and increased vascularity (74%). These findings are consistent with previously published studies, including those conducted at Enam Medical College and Hospital in India, which reported similar ultrasound characteristics distinguishing benign from malignant breast lesions [23].

Receiver operating characteristic (ROC) analysis of the BI-RADS scoring system in the current study demonstrated a high sensitivity of 98.6% but relatively low specificity of 7.7% using BI-RADS ≥4 as the threshold for malignancy. The area under the curve (AUC) was 0.89, indicating strong overall diagnostic performance. These findings are comparable to results reported in a study conducted at Aster CMI Hospital in India [18]. This comparison highlights the value of BI-RADS as a highly sensitive screening tool; however, its relatively low specificity emphasizes the need for complementary diagnostic modalities to improve overall diagnostic accuracy and specificity.

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

Tables

Table 1. Age distribution of patients with breast and post-mastectomy chest wall lesions at TASH (1 December 2024–30 April 2025).

Age category (years)	Frequency	Percent
21–30	14	14
31–40	36	36
41–50	33	33
51–60	10	10
61–70	6	6
71–80	1	1
Total	100	100

Table 2

Association between BI-RADS scores and FNAC/CNB results (98 malignant or benign cases).

BI-RADS score	Benign	Malignant
1–3	2	1
4–5	24	71

Reported $\chi^2 = 0.875$; $p = 0.35$; odds ratio = 6.

Table 3

Association between elasticity scores and FNAC/CNB results (98 malignant or benign cases).

Elasticity score	Benign	Malignant
1–3	18	3
4–5	8	69

Reported $\chi^2 = 44.24$; $p < 0.001$; odds ratio = 52.

Table 4

Association between strain ratio and FNAC/CNB results (98 malignant or benign cases).

Strain ratio	Benign	Malignant
<3.1	14	1
≥3.1	12	71

Reported $\chi^2 = 40.3$; $p < 0.001$; odds ratio = 83.

Table 5

Diagnostic performance of the individual methods (98 malignant or benign cases).

Method	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Accuracy (%)	AUC
BI-RADS score	98.6	7.7	74.7	66.7	74.5	0.89
Elasticity score	95.8	69.2	89.6	85.7	88.8	0.92
Strain ratio	98.6	53.8	85.5	93.3	86.7	0.85

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

Figures

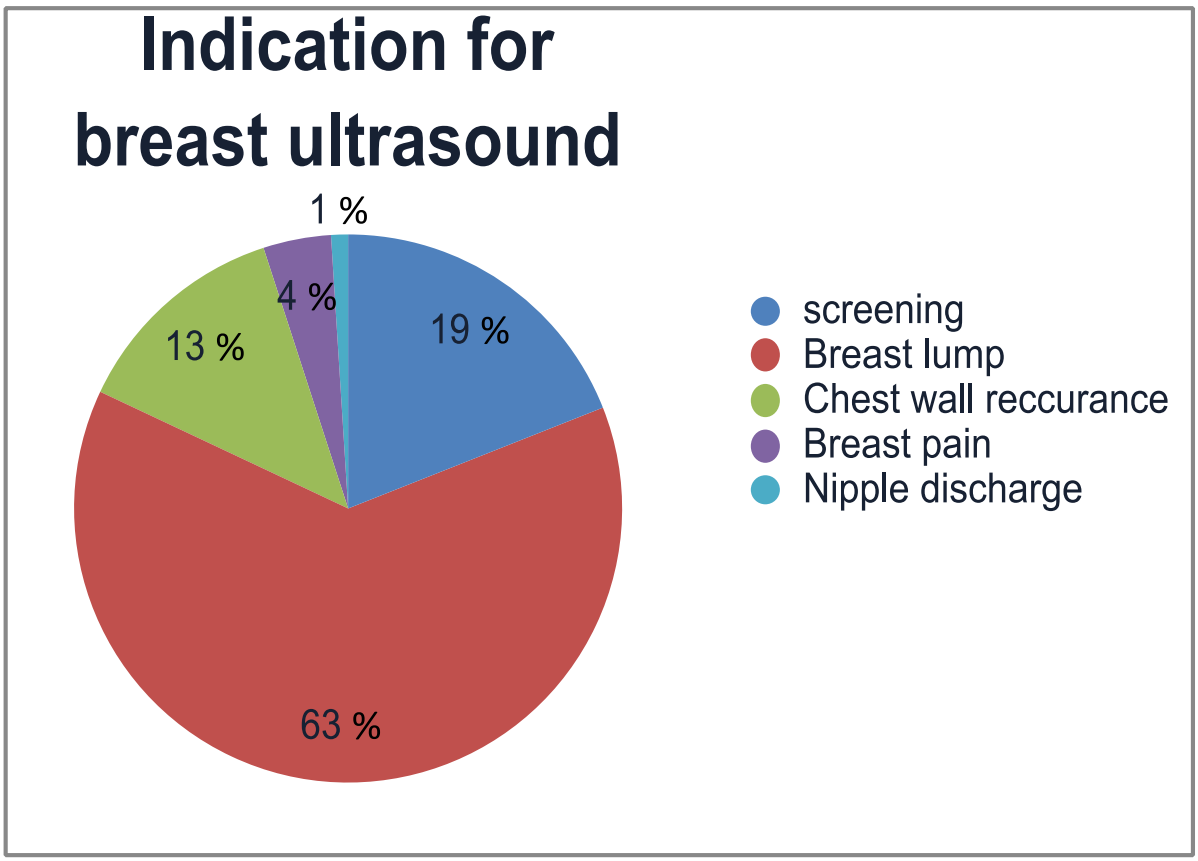


Figure 1. Indications for breast ultrasound among patients attending the breast and mammography unit, Radiology Department, TASH (1 December 2024–30 April 2025).

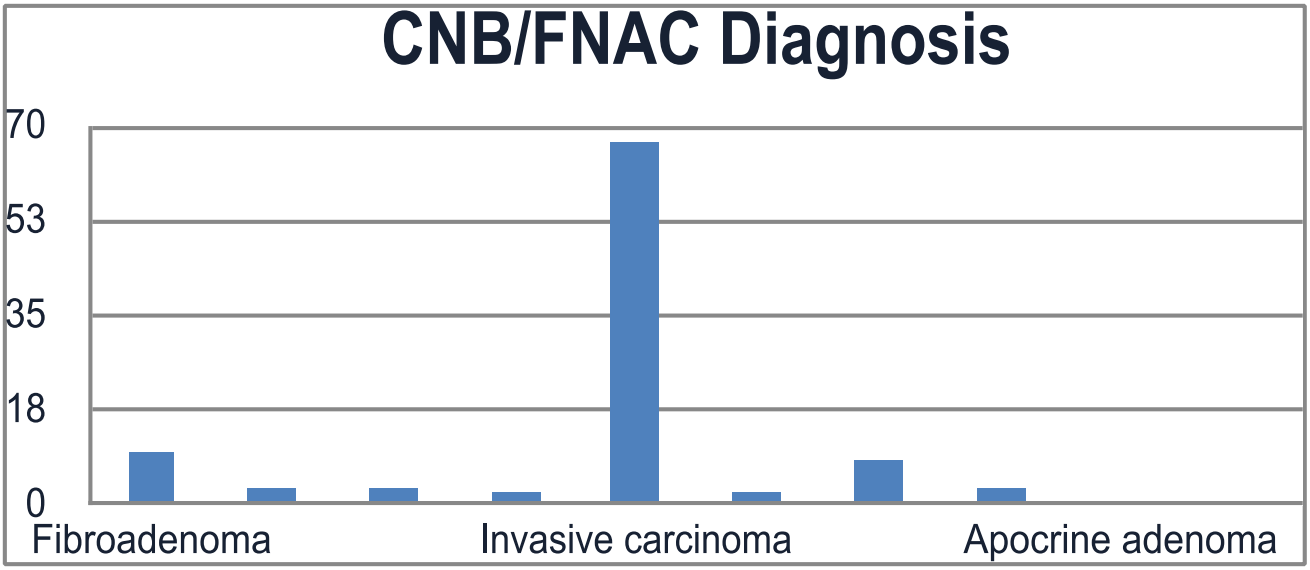


Figure 2. CNB/FNAC diagnoses of breast and post-mastectomy chest wall lesions at TASH (1 December 2024–30 April 2025).

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

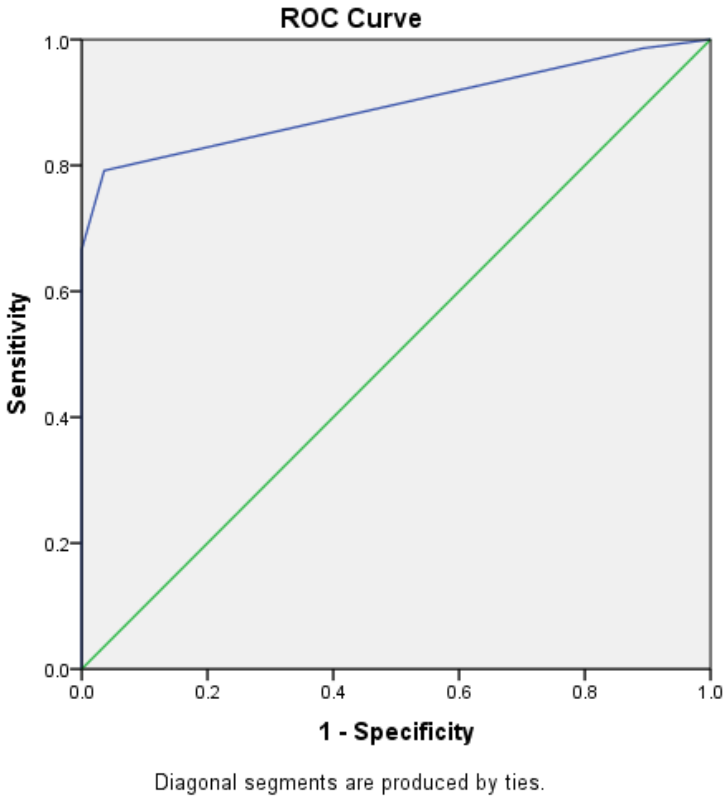


Figure 3. ROC curve of BI-RADS scoring for breast and post-mastectomy lesions at TASH (1 December 2024–30 April 2025). Reported AUC: 0.89 (95% CI: 0.83–0.95).

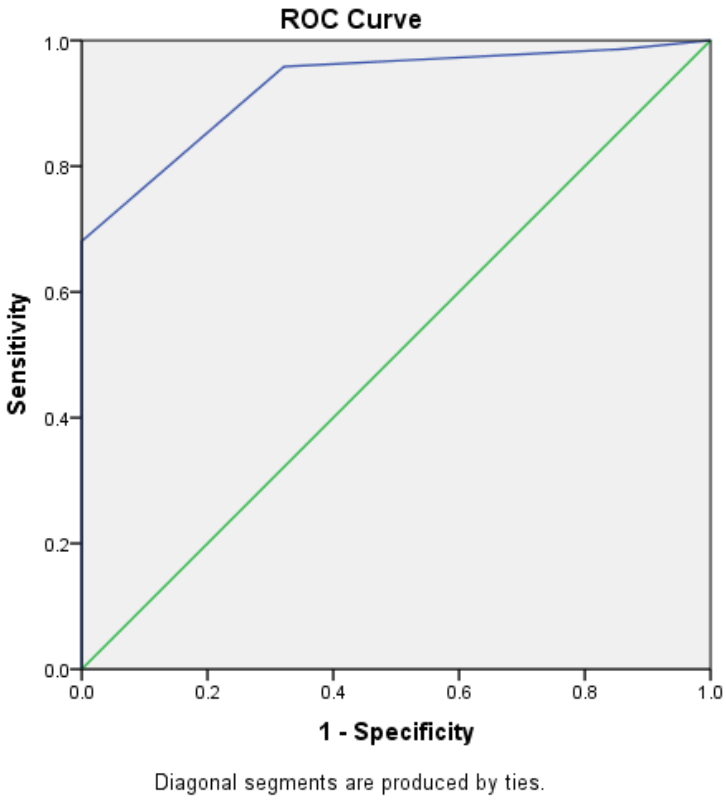


Figure 4. ROC curve of elasticity scoring for breast and post-mastectomy lesions at TASH (1 December 2024–30 April 2025). Reported AUC: 0.92 (95% CI: 0.88–0.98).

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

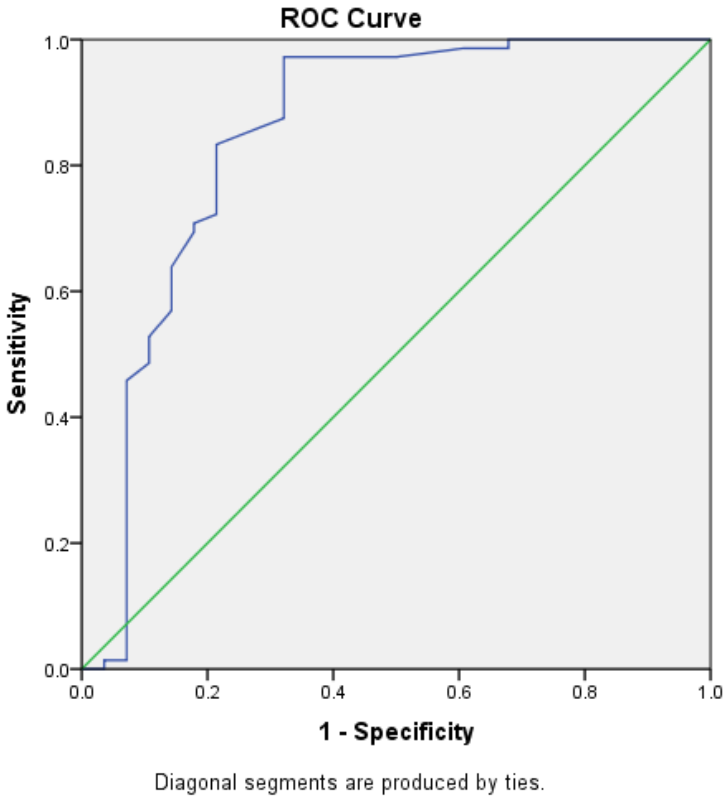


Figure 5. ROC curve of strain ratio for breast and post-mastectomy lesions at TASH (1 December 2024–30 April 2025). Reported AUC: 0.85 (95% CI: 0.74–0.95).

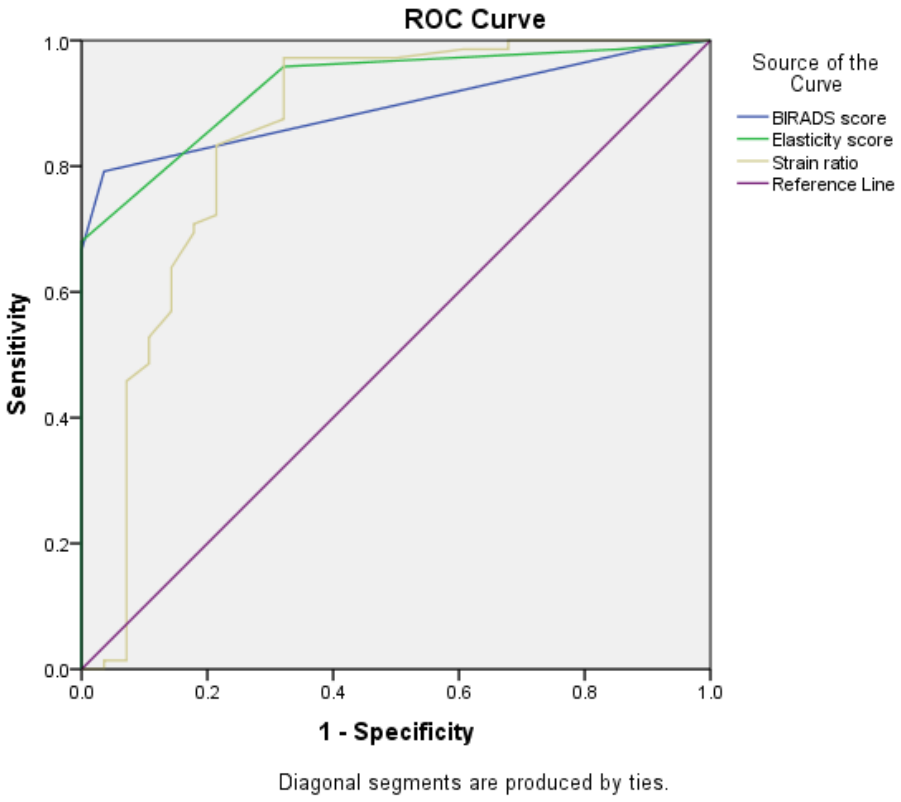


Figure 6. Comparison of the three individual ROC curves: BI-RADS score (AUC 0.89), elasticity score (AUC 0.92), and strain ratio (AUC 0.85), at TASH (1 December 2024–30 April 2025). The curves represent the individual methods; the comparison is descriptive.

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

Similarly, ROC analysis of the elasticity scoring (ES) system demonstrated a sensitivity of 95.8% and specificity of 69.2% when elasticity scores ≥4 were considered indicative of malignancy with an AUC of 0.92. These findings are in agreement with results reported from Aster CMI Hospital, where elasticity scoring achieved a sensitivity of 92.3%, specificity of 94.6%, and an AUC of 0.98 [18]. The high sensitivity observed in both studies supports the clinical utility of elasticity scoring as a non-invasive technique for differentiating benign from malignant breast lesions.

Furthermore, ROC analysis of the strain ratio in the present study demonstrated a sensitivity of 98.6% and specificity of 53.8% at a cutoff value of 3.1, with an AUC of 0.85. The strain ratio yielded a positive predictive value (PPV) of 85.5%, a negative predictive value (NPV) of 93.3%, and an overall diagnostic accuracy of 86.7%. These findings are comparable to those reported in a study conducted at Aster CMI Hospital [18]. Although the specificity observed in our study was relatively lower, the high sensitivity and comparable diagnostic accuracy suggest that strain ratio measurement can serve as a useful adjunct in the evaluation of suspicious breast lesions, particularly in high-sensitivity screening settings.

Finally, the relatively high prevalence of malignancy in the study population (72%) likely influenced the predictive values observed. Higher disease prevalence tends to increase the positive predictive value while reducing the negative predictive value. Although sensitivity and specificity are theoretically independent of disease prevalence, the relatively small proportion of benign cases may affect the precision of specificity estimates. Additionally, diagnostic accuracy may appear higher in populations with a high proportion of malignant lesions.

Strengths and Limitations of the Study

This study provides a comprehensive evaluation of multiple diagnostic modalities with robust statistical analyses, including contingency table and ROC curve assessments, offering clinically relevant insights into diagnostic performance. However, several limitations should be acknowledged. The relatively high prevalence of malignant cases and the single-center referral setting may introduce referral and selection bias, thereby limiting the generalizability of the findings. The results may also have been influenced by operator dependence, particularly in image acquisition and interpretation. In addition, interobserver variability was not assessed, making it difficult to determine how consistently the imaging features and diagnostic thresholds could be reproduced across different radiologists or institutions. This lack of reproducibility assessment may limit the applicability of the findings in routine clinical practice, where variability in reader experience and technique can influence diagnostic performance. Furthermore, the actual sample size was smaller than initially planned, and no external validation of the diagnostic cutoffs was performed. These factors should be considered when interpreting the findings and extrapolating them to broader patient populations.

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14

Conclusions

In this biopsy-enriched single-center cohort, elasticity scoring and strain ratio each showed higher specificity than BI-RADS at the reported thresholds. These descriptive findings support further evaluation of elastography as an adjunct to conventional ultrasound. They do not establish the performance of a combined testing rule or a reduction in unnecessary biopsies, and may not be generalizable to screening populations.

Conflict of Interest

The authors declare no conflicts of interest.

Financial Declaration / Funding

This study received no external funding.

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Addis Ababa University, College of Health Sciences, Department of Radiology Ethical Review Committee (ERC) issued approval Ref. DRPC/009/2017.

Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following: Payment/services info: All authors have declared that no financial support was received from any organization for the submitted work. Financial relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Bereket Engedasew, Daniel Zewdneh, Ferdosa Ahmed, Daniel Admasie, Getaneh Atile

Acquisition, analysis, or interpretation of data: Bereket Engedasew, Daniel Zewdneh, Daniel Admasie, Getaneh Atile

Drafting of the manuscript: Bereket Engedasew, Daniel Zewdneh, Ferdosa Ahmed, Daniel Admasie, Getaneh Atile

Critical review of the manuscript for important intellectual content: Bereket Engedasew, Daniel Zewdneh, Ferdosa Ahmed, Daniel Admasie, Getaneh Atile

Supervision: Bereket Engedasew, Daniel Zewdneh, Ferdosa Ahmed, Daniel Admasie

Acknowledgements

We would like to extend our sincere appreciation to the Department of Radiology and the IRB of the College of Health Sciences at Addis Ababa University for its support and encouragement throughout the research process. The data are available reasonable request at bereket306@gmail.com

Disclaimer/Publisher's Note

The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of Swiss J. Radiol. Nucl. Med. and/or the editor(s). Swiss J. Radiol. Nucl. Med. and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.

This work is licensed under a Creative Commons Attribution 4.0 International License.

SJORANM-LinkedIn: Journal profile

References

1. WHO report march 3 2024 https://www.who.int/news-room/fact-sheets/detail/breast-cancer
2. National Guideline for Breast Health, Early Diagnosis and Timely Breast Cancer Management in Ethiopia, April, 2024 Addis Ababa, Ethiopia https://www.iccp-portal.org/file/final-breast-cancer-guideline-ethiopia-2024pdf
3. Saarenmaa I, Salminem T, Geiger U, et al. The effect of age and density of the breast on the sensitivity of breast cancer diagnosis by mammography and ultrasound 2001;67(2):117-123 https://doi.org/10.1023/a:1010627527026
4. American College of Radiology, BI-RADS Committee. ACR BI-RADS breast imaging and reporting data system: breast imaging atlas. Reston, VA: American College of Radiology, 2003. https://develop.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Reporting-and-Data-Systems/BI-RADS
5. D'Orsi C, Sickles E, Mendelson E, et al. ACR BI-RADS Atlas, Breast Imaging Reporting and Data System. Reston, VA: American College of Radiology, 2013 https://develop.acr.org/Clinical-Resources/Clinical-Tools-and-Reference/Reporting-and-Data-Systems/BI-RADS
6. Ophir J, Cespedes I, Ponnekanti H, et al. Elastography: a quantitative method for imaging the elasticity of biological tissues. Ultrasound Image 1991; 13: 111–134 https://doi.org/10.1177/016173469101300201
7. Moon WK, Chang SC, Huang CS, et al Breast tumor classification using fuzzy clustering for breast elastography. Ultrasound Med Biol 2011; 37: 700–708. https://doi.org/10.1016/j.ultrasmedbio.2011.02.003
8. Fleury Ede F. The importance of breast elastography added to the BI-RADSVR (5th edition) lexicon classification. Rev Assoc Med Bras 2015; 61: 313–316. https://doi.org/10.1590/1806-9282.61.04.313
9. Bojanic K, Katavic N, Smolic M, et al. Implementation of elastography score and strain ratio in combination with B-mode ultrasound avoids unnecessary biopsies of breast lesions. Ultrasound Med Biol 2017; 43: 804–816. https://doi.org/10.1016/j.ultrasmedbio.2016.11.019
10. Youk JH, Kim EK. Supplementary screening sonography in mammographically dense breast: pros and cons. Korean J Radiol 2010; 11:589–593. https://doi.org/10.3348/kjr.2010.11.6.589
11. Gheonea IA, Stoica Z, Bondari S, et al. differential diagnosis of breast lesions using ultrasound elastography. Indian J Radiology imaging 2011;21(4):301-305. https://doi.org/10.4103/0971-3026.90697
12. Tan SM, Teh HS, Mancer JF, and et al. Improving B mode ultrasound evaluation of breast lesions with real-time ultrasound elastography –a clinical approach. Breast 2008; 17:252–257. https://doi.org/10.1016/j.breast.2007.10.015
13. Cho N, Lim J, Moon WK. Usefulness of ultrasound elastography in reducing the number of Breast Imaging Reporting and Data System category 3 lesions on ultrasonography. Ultrasonography 2014; 33:98–104. https://doi.org/10.14366/usg.13024
14. Cho N, Moon WK, Park JS, et al. Nonpalpable breast masses: evaluation by US elastography. Korean J Radiol 2008:111–118. https://doi.org/10.3348/kjr.2008.9.2.111
15. Youk JH, Son EJ, Gweon HM, et al. Comparison of strain and shear wave elastography for the differentiation of benign from malignant breast lesions, combined with B-mode ultrasonography: qualitative and quantitative assessments. Ultrasound Med Biol 2014; 40:2336–2344. https://doi.org/10.1016/j.ultrasmedbio.2014.05.020
16. Raunak Sinha, Zafar Ali, Manish Jaiswal, AnuggyaMimansa, Evaluation of Focal Breast Lesions Using Ultrasound Elastography with FNAC and / or Histopathological Correlation - A Prospective Observational Study in the Region of Katihar, Bihar. J Evid Based Med Healthc 2021;8(25):2143-2148. https://doi.org/10.18410/jebmh/2021/402
17. ShyamChhadi, TulsiChhadi, KamleshBagde, Ultrasound elastography evaluation of breast masses with FNAC and/or histopathologicalcorrelation.Int J Res Med Sci. 2018 Dec;6(12):4034-4038(22). https://doi.org/10.18203/2320-6012.ijrms20184903
18. Sukrity Sharma, Nischal G KundaragiandSudhir Kumar Kale Added value of strain elastography in the characterisation of breast lesions: A prospective study. ultrasound 2020 Aug; 28(3): 164–173. https://doi.org/10.1177/1742271X20912762
19. Anil Kumar M. S., Nandini Singh Tanwar, Evaluation of breast lump using elastography, histopathology and its diagnostic accuracy. International Surgery Journal 2019 Feb;6(2):574-580. https://doi.org/10.18203/2349-2902.isj20190406
20. Dr. Jyoti Reddy, Dr. Sanjay M. Khaladkar, Evaluation of Focal Breast Lesions on Ultrasound, Color Doppler and Real Time Elastography: A Prospective Study. International Journal of Research & Review Vol.6; Issue: 1; January 2019;6(1):5-13. https://www.ijrrjournal.com/IJRR_Vol.6_Issue.1_Jan2019/IJRR002.pdf
21. Dr. AnuAtul Kaushik, Evaluation of Focal Breast Lesions Using Ultrasound Elastography. International Journal of Medical Science and Diagnosis Research Volume 2, Issue 6; November-December: 2018; Page No. 244-252. https://www.ijmsdr.com/index.php/ijmsdr/article/view/178
22. Priya Raman Bhole, Vijay IndalNaik, Radiological study of ultrasound elastography in the evaluation of breast lesions at a tertiary hospital. MedPulse International Journal of Radiology. December 2021; 20(3): 73-78. https://www.medpulse.in/Radio%20Diagnosis/Article/Volume20Issue3/Radiology_20_3_9.pdf
23. TaranaYasmin, MashahBinte Amin, Samar Chandra Sarkar, KanizaKabir, SamantaFaria. Diagnostic Accuracy of Strain Elastography Ultrasound in Differentiation of Benign and Malignant Breast Lesions with Histopathological Correlation Bangladesh J Enam Med Col 2021; 11(2): 99-107. https://doi.org/10.3329/jemc.v11i2.65192
24. Amjad A, Ahmed SN, Aburabee AI, Iqbal A, Zafar I, Qazi A, Ahmad I, PanhwarAAk, Evaluation of Focal Breast Lesions Using Ultrasound Elastography. Biol. Clin. Sci. Res. J., Volume, 2024: 1032. https://doi.org/10.54112/bcsrj.v2024i1.1032
25. Koh J, Kim E-K, Kim MJ, Yoon JH, Park VY, Moon HJ. Role of elastography for downgrading BI-RADS category 4a breast lesions according to risk factors. ActaRadiologica. 2019; 60(3):278-285. https://doi.org/10.1177/0284185118780901
26. HyeMiGweon, EunJu Son, Ji Hyun Youk, Jeong-Ah Kim and Jin Chung Value of the US BI-RADS final assessment following mastectomy: BI-RADS 4 and 5 lesions, Acta Radiologica 2012; 53: 255–260. https://doi.org/10.1258/ar.2011.110597
27. Itoh A, Ueno E, Tohno E, et al. Breast disease: clinical application of US elastography for diagnosis. Radiology 2006; 239: 341–350. https://doi.org/10.1148/radiol.2391041676

Open Access · CC BY 4.0 · © 2026 The Author(s) · Published by SJORANM GmbH, Switzerland
ISSN 2813-7221 · Swiss J. Radiol. Nucl. Med. 2026 30(1):1-12 · DOI 10.59667/sjoranm.v30i1.14