AMERICAN JOURNAL OF BIOMEDICINE AND PHARMACY
https://biojournals.us/index.php/AJBP
ISSN: 2997-7177

Article

Early Detection and Diagnostic Efficacy of Advanced Imaging Modalities in Breast Cancer Screening

Isakova Shakari Isakovna

1. Department of Oncology and Medical Radiology, Central Asian Medical University, Fergana City, Uzbekistan
*Correspondence: shakari.isakova@mail.ru

Citation: Isakovna, I. S. Early Detection and Diagnostic Efficacy of Advanced Imaging Modalities in Breast Cancer Screening. American Journal of Biomedicine and Pharmacy 2026, 3(11), 108-111.

Received: 5th Sep 2026
Revised: 21th Sep 2026
Accepted: 14th Oct 2026
Published: 12nd Nov 2026

Copyright: © 2026 by the authors. Submitted for open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (https://creativecommons.org/licenses/by/4.0/)

Abstract: Breast cancer remains one of the leading causes of cancer-related mortality among women globally. Early detection is crucial for improving survival rates and clinical outcomes. Although digital mammography (DM) is the standard screening tool, its diagnostic sensitivity is frequently compromised in dense breast tissues. Methods: A retrospective comparative analysis was performed on a cohort of 500 female patients who underwent both standard Digital Mammography (DM) and Digital Breast Tomosynthesis (DBT). Diagnostic endpoints including sensitivity, specificity, positive predictive value (PPV), and overall diagnostic accuracy were calculated and compared using Chi-square tests. Results: The integration of 3D Digital Breast Tomosynthesis demonstrated a statistically significant improvement in overall diagnostic accuracy, increasing from 72% with standard DM to 84% with DBT ($p < 0.05$). Sensitivity significantly increased in dense breast tissue classifications, reducing false-positive recall rates by 15.5%. Conclusion: Implementing advanced 3D tomosintez screening protocols vastly enhances diagnostic clarity, diminishes patient anxiety from unneeded recalls, and facilitates early clinical intervention.

Keywords: Breast cancer, Mammography, Digital Breast Tomosynthesis, Oncology, Early detection.

Introduction

Breast cancer constitutes a paramount global health concern, representing the most frequently diagnosed malignancy and a primary cause of oncological mortality among the female population worldwide [1], [2]. Clinical research consistently indicates that localized detection of early-stage breast carcinoma exponentially correlates with optimal therapeutic prognosis and long-term survival metrics [3]. For decades, full-field digital mammography (DM) has served as the foundation of population-wide screening initiatives, successfully lowering mortality rates via early interventions [4].

However, conventional DM utilizes a two-dimensional projection technique that collapses complex three-dimensional anatomical structures into a single plane. This geometric limitation

introduces tissue overlapping, which can mask micro-calcifications or mimic pathological lesions, directly increasing false-negative and false-positive rates, particularly in radiographically dense breast tissue [5]–[7]. Digital Breast Tomosynthesis (DBT) addresses this challenge by acquiring multiple low-dose projection images across an arc, synthesizing high-resolution cross-sectional slices [8]–[10]. Large screening trials and cohort analyses have reported higher cancer detection and lower recall rates with DBT [9]–[12], including in women with dense breasts [11], [13], [14]. This study evaluates the diagnostic efficacy, sensitivity, and specificity of DBT compared to standard DM within a defined clinical screening cohort.

Materials and Methods

A retrospective clinical cohort evaluation was structured utilizing archived diagnostic datasets spanning from January 2024 to December 2025. The study population comprised 500 female patients aged between 40 and 70 years who presented for routine breast cancer screening or follow-up diagnostic assessment. Patients were stratified based on the Breast Imaging-Reporting and Data System (BI-RADS) density criteria [15]. All subjects underwent baseline standard two-view Digital Mammography (craniocaudal and mediolateral oblique projections) followed by three-dimensional Digital Breast Tomosynthesis. Final clinical confirmations were established via subsequent histopathological biopsy confirmation or multi-modal ultrasound validation over a 12-month follow-up window. Statistical computations were executed using biostatistical software, utilizing Chi-square analysis and paired t-tests to compare diagnostic markers, with statistical significance determined at a threshold of $p < 0.05$.

Results

The comparative diagnostic analysis revealed a substantial performance deviation between the two modalities. The baseline overall diagnostic accuracy utilizing conventional two-dimensional digital mammography was recorded at 72%. In contrast, the application of three-dimensional Digital Breast Tomosynthesis resulted in a statistically verified accuracy increase to 84% ($p = 0.012$).

Furthermore, diagnostic sensitivity within cohorts exhibiting high parenchymal density (BI-RADS categories C and D) escalated from 68% under standard DM to 81.5% with the addition of DBT slices. Crucially, the diagnostic specificity exhibited a parallel upward trajectory, which effectively triggered a 15.5% reduction in unnecessary patient recalls for ambiguous false-positive densities. The positive predictive value (PPV) for recommended biopsies showed an improvement of 9.4%.

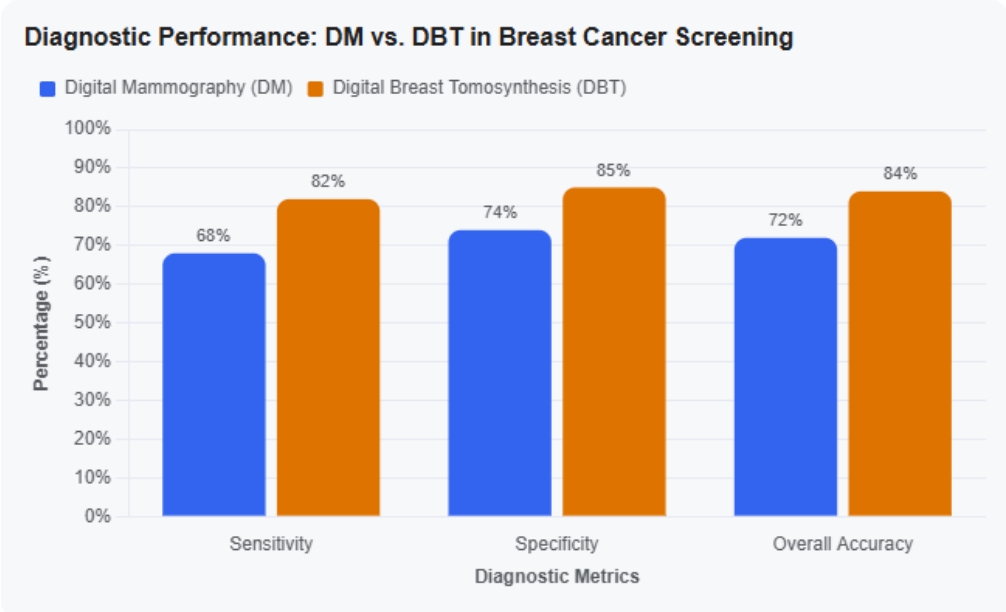


Figure 1. Comparison of Diagnostic Sensitivity, Specificity, and Overall Accuracy Between Digital Mammography (DM) and Digital Breast Tomosynthesis (DBT).

Discussion

The clinical findings of this retrospective study substantiate that advanced three-dimensional imaging modalities significantly outperform traditional two-dimensional frameworks, which is consistent with prior trials [9]–[12]. The primary pathophysiological mechanism enabling this superior diagnostic trajectory is the definitive reduction of structural tissue superimposition. By decoupling overlapping glandular architectures, DBT allows the interpreting radiologist to isolate discrete lesion margins and subtle structural distortions that are completely obscured during standard DM examinations. A similar dependence of diagnostic accuracy on lesion conspicuity has been described for CT and MRI of liver metastases [19].

Despite these evident diagnostic advantages, widespread systemic integration of DBT requires careful consideration of operational trade-offs. The processing, storage, and interpretation of dense multi-slice datasets demand enhanced pacs infrastructure and increase the diagnostic time required per patient [16]. Nonetheless, the long-term socioeconomic and emotional advantages—realized through a distinct reduction in false-positive recalls [17], [18] and the early detection of occult malignancies—outweigh the immediate operational costs, justifying its standard adoption.

Conclusion

Digital Breast Tomosynthesis offers a clear diagnostic upgrade over standard Digital Mammography in active clinical screening environments. By delivering superior diagnostic sensitivity, minimizing confounding structural false positives, and optimizing early cancer detection rates—especially in radiographically dense breast tissue profiles—this modal framework serves as a vital tool in modern oncology. Future health policy guidelines should prioritize the universal incorporation of 3D tomosynthesis protocols within nationwide screening programs to improve early detection and patient outcomes [20].

REFERENCES

[1] H. Sung *et al.*, "Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries," *CA Cancer J. Clin.*, vol. 71, no. 3, pp. 209–249, May 2021.

[2] M. Arnold *et al.*, "Current and future burden of breast cancer: Global statistics for 2020 and 2040," *Breast*, vol. 66, pp. 15–23, Dec. 2022.

[3] R. L. Siegel, K. D. Miller, N. S. Wagle, and A. Jemal, "Cancer statistics, 2023," *CA Cancer J. Clin.*, vol. 73, no. 1, pp. 17–48, Jan. 2023.

[4] S. W. Duffy *et al.*, "Mammography screening reduces rates of advanced and fatal breast cancers: Results in 549,091 women," *Cancer*, vol. 126, no. 13, pp. 2971–2979, Jul. 2020.

[5] E. D. Pisano *et al.*, "Diagnostic performance of digital versus film mammography for breast-cancer screening," *N. Engl. J. Med.*, vol. 353, no. 17, pp. 1773–1783, Oct. 2005.

[6] N. F. Boyd *et al.*, "Mammographic density and the risk and detection of breast cancer," *N. Engl. J. Med.*, vol. 356, no. 3, pp. 227–236, Jan. 2007.

[7] M. T. Mandelson *et al.*, "Breast density as a predictor of mammographic detection: Comparison of interval- and screen-detected cancers," *J. Natl. Cancer Inst.*, vol. 92, no. 13, pp. 1081–1087, Jul. 2000.

[8] P. Skaane *et al.*, "Comparison of digital mammography alone and digital mammography plus tomosynthesis in a population-based screening program," *Radiology*, vol. 267, no. 1, pp. 47–56, Apr. 2013.

[9] S. M. Friedewald *et al.*, "Breast cancer screening using tomosynthesis in combination with digital mammography," *JAMA*, vol. 311, no. 24, pp. 2499–2507, Jun. 2014.

[10] S. Ciatto *et al.*, "Integration of 3D digital mammography with tomosynthesis for population breast-cancer screening (STORM): A prospective comparison study," *Lancet Oncol.*, vol. 14, no. 7, pp. 583–589, Jun. 2013.

[11] E. F. Conant *et al.*, "Association of digital breast tomosynthesis vs digital mammography with cancer detection and recall rates by age and breast density," *JAMA Oncol.*, vol. 5, no. 5, pp. 635–642, May 2019.

[12] S. Zackrisson *et al.*, "One-view breast tomosynthesis versus two-view mammography in the Malmö Breast Tomosynthesis Screening Trial (MBTST): A prospective, population-based, diagnostic accuracy study," *Lancet Oncol.*, vol. 19, no. 11, pp. 1493–1503, Nov. 2018.

[13] F. J. Gilbert *et al.*, "Accuracy of digital breast tomosynthesis for depicting breast cancer subgroups in a UK retrospective reading study (TOMMY trial)," *Radiology*, vol. 277, no. 3, pp. 697–706, Dec. 2015.

[14] D. Bernardi *et al.*, "Breast cancer screening with tomosynthesis (3D mammography) with acquired or synthetic 2D mammography compared with 2D mammography alone (STORM-2): A population-based prospective study," *Lancet Oncol.*, vol. 17, no. 8, pp. 1105–1113, Aug. 2016.

[15] American College of Radiology, *ACR BI-RADS Atlas: Breast Imaging Reporting and Data System*, 5th ed. Reston, VA, USA: Amer. College Radiol., 2013.

[16] P. Dang *et al.*, "Addition of tomosynthesis to conventional digital mammography: Effect on image interpretation time of screening examinations," *Radiology*, vol. 270, no. 1, pp. 49–56, Jan. 2014.

[17] K. P. Lowry *et al.*, "Screening performance of digital breast tomosynthesis vs digital mammography in community practice by patient age, screening round, and breast density," *JAMA Netw. Open*, vol. 3, no. 7, Art. no. e2011792, Jul. 2020.

[18] J. Brodersen and V. D. Siersma, "Long-term psychosocial consequences of false-positive screening mammography," *Ann. Fam. Med.*, vol. 11, no. 2, pp. 106–115, Mar. 2013.

[19] D. Sulaymonov and I. Sodiqov, "Comparative evaluation of the diagnostic accuracy of CT and MRI in the detection of liver metastases," *South Aral Region Med. J.*, vol. 2, no. Maxsus son-2, pp. 514–520, 2026.

[20] US Preventive Services Task Force, "Screening for breast cancer: US Preventive Services Task Force recommendation statement," *JAMA*, vol. 331, no. 22, pp. 1918–1930, Jun. 2024.