

Benefits of
Breast Tomosynthesis
Bibliography with
key findings

Summary

Following its introduction in 2009, a host of clinical studies on Digital Breast Tomosynthesis* have proceeded to demonstrate the value of this technique for breast imaging. The following is a summary of key findings from studies conducted with Mammomat Inspiration.

Glossary

AUC	Area Under the (ROC) Curve
BIRADS	Breast Imaging Reporting and Data System
(D)BT	(Digital) Breast Tomosynthesis
FBP	Filtered backprojection
(FF)DM, MMG	(Full Field) Digital Mammography
FP	False Positives
JAFROC	Jackknife Alternative Free-response Receiver Operating Characteristics
LL	Latero-lateral
MGD	Mean Glandular Dose
MRMC	Multi Reader Multi Center (study)
NPV	Negative Predictive Value
PMA	Premarket Approval
PMMA	Polymethylmethacrylate (phantom)
PPV	Positive Predictive Value
RM	Rotating Mammogram
ROC	Receiver Operating Characteristics
SM(MG)	Synthetic Mammogram
SRSAR	Super Resolution and Statistical Artifact Reduction
US	Ultrasound
VBDA	Volumetric Breast Density Assessment

*Some studies were conducted with a technology that is not yet commercially available. Due to regulatory reasons its future availability cannot be guaranteed.

Author and study title	Year	Key findings
Siemens Medical Solutions USA Inc. "MRMC study to demonstrate the superior accuracy of Siemens DBT to FFDM as a replacement for FFDM screening mammography" ¹	2016	The average AUC ROC was significantly higher with DBT as a stand-alone modality while the readers' average non-cancer recall rate was significantly lower for most of the readers. A lower inter-observer variability was noted here.
Clauser et al. "Diagnostic performance of digital breast tomosynthesis with a wide scan angle compared to full-field digital mammography for the detection and characterization of microcalcifications" ²	2016	Wide scan-angle DBT enables the detection and characterization of microcalcifications with no significant differences from FFDM.
Whelehan et al. "Clinical performance of Siemens digital breast tomosynthesis versus standard supplementary mammography for the assessment of screen-detected soft-tissue abnormalities: a multi-reader study" ³	2016	Siemens DBT demonstrates equivalent diagnostic accuracy according to ROC curve analysis when used in place of supplementary mammographic views in screen-detected soft-tissue mammographic abnormalities.
Lång et al. "False positives in breast cancer screening with one-view breast tomosynthesis: An analysis of findings leading to recall, work-up and biopsy rates in the Malmö Breast Tomosynthesis Screening Trial" ⁴	2016	FPs increased with BT screening mainly due to the recall of stellate distortions. The FP recall rate was still well within the European guidelines and showed evidence of a learning curve. The characterization of rounded lesions was improved with BT.
Uchiyama et al. "Diagnostic Usefulness of Synthetic MG (SMMG) with DBT (Digital Breast Tomosynthesis) for Clinical Setting in Breast Cancer Screening" ⁵	2016	SMMG plus DBT demonstrated higher AUC and superior diagnostic accuracy with regards to sensitivity, specificity, and NPV compared to SMMG and MG alone ($p < 0.05$). Also the 40% decrease of radiation dose allows for two-view SMMG plus DBT in breast cancer screening instead of MG.
Elizalde et al. "Additional US or DBT after digital mammography: which one is the best combination?" ⁶	2016	The combination of DM and additional US, DBT, or both, significantly increased the diagnostic performance (AUC) of DM.
Pozzi et al. "Digital Breast Tomosynthesis in Addition to Conventional 2D-Mammography Reduces Recall Rates and is Cost-Effective" ⁷	2016	Adding DBT to FFDM results in a significant reduction in recall rates preventing unnecessary burden on women and the healthcare system. Earlier, less costly treatment strategies can be applied.
Van Ongeval "The role of the Synthetic Mammogram" ⁸	2016	Diagnostic performances of SM and FFDM are comparable for detecting T1 stage breast cancers. There is an improvement of specificity of SM+DBT compared to 2D alone.
Timberg et al. "Breast Density Assessment Using Breast Tomosynthesis Images" ⁹	2016	The automated analysis (VBDA) is a promising approach using low dose central projection DBT images in order to obtain radiologist-like density ratings similar to results obtained from FFDM.

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Lång et al. "Performance of one-view breast tomosynthesis as a stand-alone breast cancer screening modality: results from the Malmö Breast Tomosynthesis Screening Trial, a population-based study" ¹⁰	2015	Breast cancer detection rate improved by 43%. Breast cancer screening with one-view DBT as a stand-alone modality seems feasible. Breast compression can be reduced by 50%.
Siemens Medical Solutions USA, Inc. "PMA (P140011) study with MAMMOMAT Inspiration with Tomosynthesis Option" ¹¹	2015	FFDM + 2-view DBT is superior in terms of diagnostic accuracy (AUC) to FFDM alone. Readers' sensitivity increased with the addition of 2-view DBT to FFDM. Noncancer recall rate was reduced by 19% for FFDM plus 2-view DBT as compared to FFDM alone.
Mercier et al. "The role of tomosynthesis in breast cancer staging in 75 patients" ¹²	2015	Tomosynthesis found more lesions than mammography in 10% of patients, resulting in an adaptation of the surgical planning.
Urano et al. "Digital mammography versus digital breast tomosynthesis for detection of breast cancer in the intraoperative specimen during breast-conserving surgery" ¹³	2015	DBT can detect breast cancer more accurately than DM in LL views, indicating its potential to more precisely diagnose vertical invasion.
Baptista et al. "Dosimetric characterization and organ dose assessment in digital breast tomosynthesis: Measurements and Monte Carlo simulations using voxel phantoms" ¹⁴	2015	Taking into account an average breast with a thickness of 4.5 cm, the MGDs for DM and DBT acquisitions were below the achievable value (2.0 mGy) defined by the European protocol.
Timberg et al. "Detection of calcification clusters in digital breast tomosynthesis slices at different dose levels utilizing a SRSAR reconstruction and JAFROC" ¹⁵	2015	With SRSAR reconstruction it is possible to maintain high detection performance for calcification clusters and reduce dose levels by 50%.
Galati et al. "Added value of one-view DBT combined with DM according to readers' concordance – changing in BIRADS rate and follow-up management: A preliminary study" ¹⁶	2014	The combination of two-view DM and one-view DBT increased the concordance between the readers for the BIRADS classification, and reduced recalls.
Uchiyama et al. "Clinical Efficacy of Novel Image Processing Techniques in the Framework of Filtered Back Projection (FBP) with Digital Breast Tomosynthesis (DBT)" ¹⁷	2014	The novel FBP reconstruction was significantly superior to the standard FBP. In particular, the diagnostic certainty in the assessment of microcalcifications with the novel FBP was improved.
Tani et al. "Assessing Radiologist Performance and Microcalcifications Visualization Using Combined 3D Rotating Mammogram (RM) and Digital Breast Tomosynthesis" ¹⁸	2014	The visualization of microcalcifications was significantly better for all microcalcification-dominant cancer lesions with the adjunction of RM to DBT.

Author and study title	Year	Key findings
Dustler et al. "Image Quality of Thick Average Intensity Pixel Slabs Using Statistical Artifact Reduction in Breast Tomosynthesis" ¹⁹	2014	It is possible to review DBT volumes with 2 mm slabs without compromising image quality, and the visibility of microcalcifications is improved.
Lång et al. "Breast cancer detection in digital breast tomosynthesis and digital mammography: a side-by-side review of discrepant cases" ²⁰	2014	Lesion visualization with DBT is superior to FFDM, particularly for spiculated tumors suggesting that DBT is better than FFDM in visualizing breast cancer.
Bernathova M "Digital breast tomosynthesis – another milestone in breast imaging" ²¹	2014	DBT has comparable or superior image quality and a higher conspicuity of lesions. It improves the specificity and accuracy, increases the detection rate and has the potential to decrease the recall rate.
Van Ongeval et al. "Is DBT the new standard in diagnostic imaging? How to implement in specialist training?" ²²	2014	Compared to FFDM and ultrasound, DBT has better diagnostic accuracy in early detection for breast lesions and is more accurate in determining lesion size.
Bick et al. "Tomosynthesis and the impact on patient management" ²³	2014	In screening, DBT improved cancer detection rates and reduced recalls for false-positives.
Pina et al. "Interpretation of masses, distortions and densities with Tomosynthesis" ²⁴	2014	DBT increases the detection rate of breast cancer up to 27% and is very sensitive to spiculations and architectural distortions, resulting in a high PPV.
Zackrisson S, Houssami N "Digital breast tomosynthesis: the future of mammography screening or much ado about nothing?" ²⁵	2013	Overview of tomosynthesis and its improvements compared to standard mammography.
Schulz-Wendtland et al. "Full Field Digital Mammography (FFDM) versus CMOS Technology, Specimen Radiography System (SRS) and Tomosynthesis (DBT) – Which System Can Optimise Surgical Therapy?" ²⁶	2013	Mammomat Inspiration tomosynthesis system had the highest sensitivity of the three systems tested. The rate of re-excisions was reduced compared to the results of FFDM.
Dustler et al. "A Study of the Feasibility of using slabbing to reduce Tomosynthesis Review Time" ^{27*}	2013	Slabbing in screening reduces the reading time significantly.
Timberg et al. "Visibility of single spiculations in digital breast tomosynthesis" ^{28*}	2013	SRSAR improves visibility of spiculations and promises to be an alternative to FBP.
Slon et al. "The Role of Additional Ultrasound and Tomosynthesis After Normal Digital Mammography: Comparison Between Both Techniques" ²⁹	2013	The study results show that DBT detected additional cancers not visible on DM and increased the detection rate.
Extano et al. "The additional role of tomosynthesis after normal mammography according to ACR density patterns" ³⁰	2013	DBT is useful in ACR III-IV dense breasts as well as for scattered fibroglandular breasts (ACR II), increasing the sensitivity compared to FFDM, and detects more invasive cancers, in particular tubular cancers.

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Author and study title	Year	Key findings
Heywang-Köbrunner et al. "Use of Tomosynthesis for the assessment of screen-detected lesions" ³¹	2013	Due to higher specificity, the diagnostic performance is improved if DBT replaces additional views.
Uchiyama et al. "Diagnostic Impact of Adjunction of Digital Breast Tomosynthesis (DBT) to Full Field Digital Mammography (FFDM) and in Comparison with Full Field Digital Mammography (FFDM)" ³²	2012	DBT+FFDM detect more cancers than FFDM alone. DBT as an adjunct to FFDM was able to detect early-stage breast cancer and it is not affected by breast density.
Dance et al. "Comparison of breast doses for digital tomosynthesis estimated from patient exposures and using PMMA breast phantoms" ³³	2012	The results conclude that the dose for tomosynthesis with the Siemens Mammomat Inspiration system is lower than with systems of other vendors.
Uchiyama et al. "Usefulness of Adjunction of Digital Breast Tomosynthesis (DBT) to Full-Field Digital Mammography (FFDM) in Evaluation of Pathological Response after Neoadjuvant Chemotherapy (NAC) for Breast Cancer" ³⁴	2012	The adjunction of DBT to FFDM combined with other diagnostic modalities contributes to more accurate assessment of response to NAC. The adjunction of DBT to FFDM improves the assessment of the lesion and its margins without utilizing a contrast medium.
Svahn et al. "Breast tomosynthesis and digital mammography: a comparison of diagnostic accuracy" ³⁵	2012	The diagnostic accuracy of BT was significantly better than that of DM.
Uchiyama et al. "Evaluation of correlation between pathological size and diagnostic size" ³⁶	2012	The diagnostic performance of DBT+FFDM was comparable to MRI. Further, DBT+FFDM had the higher correlation for diagnostic and pathological size.
Förnvik et al. "Breast tomosynthesis: Accuracy of tumor measurement compared with digital mammography and ultrasonography" ³⁷	2010	The study indicates that BT is superior to DM in the assessment of breast tumor size and stage.
Förnvik et al. "The effect of reduced breast compression in breast tomosynthesis: human observer study using clinical cases" ³⁸	2010	No difference in the image quality was evident with reduced compression, indicating that DBT may be performed with substantially less compression force compared with 2D mammography. A majority of the examined women felt that half compression was more comfortable than full compression.

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