White Paper

The clinical value of Digital Breast Tomosynthesis

A summary of recent studies

SIEMENS Healthineers

Contents

Preface: The role of digital breast tomosynthesis in breast cancer care

Conventional digital mammography (DM)

Digital mammography (DM) is the gold standard in screening and diagnostic breast imaging. It has improved clinical outcomes, especially in younger women and women with dense breasts compared to screen-film mammography [Pisano et al., 2005]. A digital mammogram, however, is still a 2D representation of a three-dimensional object. The structural or anatomical noise of overlying tissue can impede image reading and lead to missing an abnormality in the breast (false-negative result). On the other hand, complex areas of normal tissue can also mimic a lesion (false-positive result), which will result in a higher recall rate in screening programs.

Digital breast tomosynthesis (DBT)

DBT acquires and combines breast images from multiple angles to create a kind of a 3D data volume of the entire breast. This is displayed in slices parallel to the detector surface and reduces the impact of overlapping breast tissue. Various commercially available systems use acquisition angles between 15 and 50 degrees. Siemens Healthineers High Definition Breast Tomosynthesis offers the widest angular range with 50 degree resulting in higher depth resolution and better visibility of low-contrast objects.

Why digital breast tomosynthesis?

DBT has already proven to be a valuable adjunct to DM in diagnostic workup, leading to increased sensitivity as well as specificity in cancer detection. DBT delivers better characterization and localization of a lesion in the breast, tumors are more precisely staged, and it gives readers more confidence in the BIRADS classification. DBT can also reduce the need for additional mammographic examinations (such as spot and magnification views) as well as additional ultrasound or MRI examinations.

While the use of DBT for diagnostic follow-up examinations is well established, its role in breast cancer screening is still a matter of discussion in most countries, with issues such as radiation dose, longer examination and reading time as well as increased data volume.

This white paper gives an overview of publications demonstrating superior diagnostic performance of DBT compared to DM alone, mainly performed on Siemens MAMMOMAT Inspiration. The latest developments include new reconstruction algorithms and display formats, like 2D and 3D synthetic mammograms (Siemens Healthineers Insight 2D and 3D).

For the physical and technical background of Siemens' High Definition Breast Tomosynthesis, please refer to the white paper "High Definition Breast Tomosynthesis - technology insights".

A. Digital breast tomosynthesis in screening

1. Cancer detection

As mammography alone misses up to 30% of breast cancers, and even more in dense breasts [Pisano et al., 2005], tomosynthesis may be one way to overcome this limitation.

Compared to DM, DBT shows a significant improvement in breast cancer detection: It can visualize cancer at earlier stages and is less affected by breast density than DM. Furthermore, it can change BIRADS classifications and visualize microcalcifications more strikingly – especially when used in conjunction with a 3D synthetic mammogram. Besides being used as an adjunct to DM, DBT can also act as a stand-alone technique when using a wide-angle system.

Uchiyama et al. "Diagnostic usefulness of synthetic MMG (SMMG)* with DBT (digital breast tomosynthesis) for clinical setting in breast cancer screening"	**Japan 2016**	The combination of DBT and synthetic mammogram demonstrate superior diagnostic accuracy compared to DM or DBT alone. SM can be used instead of DM with the same performance indicators (sensitivity, specificity, ROC-curve).
Siemens Medical Solutions USA Inc. "MRMC study to demonstrate the superior accuracy of Siemens DBT to FFDM as a replacement for FFDM screening mammography"	**USA 2016**	The results show that stand-alone two-view DBT increased diagnostic accuracy – without the need of additional 2D DM images.
Houssami et al. "Digital breast tomosynthesis (3D-mammography) screening: A pictorial review of screen-detected cancers and false recalls attributed to tomosynthesis in prospective screening trials"	**Australia 2016**	With DBT there is an enhanced visibility of spiculated or stellate masses and architectural distortions, leading to improved detection of invasive cancers.
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 Tomosynthesis Screening Trial"	**Sweden 2016**	DBT is especially sensitive to stellate lesions, including both benign and malignant lesions, and improves the characterization of rounded lesions.
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."	**Austria 2016**	The diagnostic performance of wide-angle DBT alone for the detection and characterization of microcalcifications is comparable to DM even when used as a stand-alone technique.
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"	**Sweden 2015**	One-view DBT alone increased breast cancer detection rate by 43% compared to two view FFDM. The results suggest that one view. DBT may be feasible as a single screening modality.
Houssami et al. "Digital breast tomosynthesis (3D-mammography) screening: data and implications for population screening"	**Australia 2015**	Prospective trials and retrospective evaluations of adjunct DBT in the screening setting show improved screening detection compared to DM alone.
Siemens Medical Solutions USA, Inc. "PMA (P140011) study with MAMMOMAT Inspiration with tomosynthesis option"	**USA 2015**	The combination of two-view DM and two-view DBT increases readers´ sensitivity and improved diagnostic accuracy. The relative improvement of the diagnostic accuracy is 17%.

* Explanations of abbreviations: see **Glossary**

Uchiyama et al. "Clinical efficacy of novel image processing techniques in the framework of filtered back projection (FBP) with digital breast tomosynthesis (DBT)"	**Japan 2014**	With the reconstruction algorithm EMPIRE (Enhanced Multiple Parameter Iterative Reconstruction), the resulting images can be de-blurred, streak-like artifacts reduced, and both contrast and sharpness of the microcalcifications improved, further advancing the detection of microcalcifications.
Tani et al. "Assessing radiologist performance and microcalcifications visualization using combined 3D rotating mammogram (RM) and digital breast tomosynthesis (DBT)"	**Japan 2014**	Novel reconstructions like rotating mammogram (Insight 3D) show a significantly increased visibility of single microcalcs and clusters of microcalcifications. When used in combination with DBT a superior diagnostic accuracy compared with DM can be noted.
Etxano et al. "The additional role of tomosynthesis after normal mammography according to ACR density patterns"	**Spain 2013**	DBT is useful in ACR III dense breasts as well as for scattered fibroglandular breasts (ACR II). It can also support clinicians in detecting invasive cancers, in particular tubular cancers.
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)"	**Japan 2012**	Adding DBT to DM improves the cancer detection rate and enables the detection of early stage breast cancer without being affected by breast density. This indicates that the diagnostic performance of the combination of DBT and DM is superior to DM alone.

2. Recall rate

False-positive recalls result in unnecessary additional costs and anxiety in patients. Recall rates are therefore an important factor when evaluating a screening modality. It is often difficult to characterize a lesion as benign or malignant with DM. This results in an incorrect BIRADS categorization and tends to increase false positive recalls.

Using DBT alone or adding it to DM improves lesion characterization and diagnostic performance. Therefore it helps reduce false-positive findings. The actual recall rate itself differs from country to country. While U.S. studies confirm a higher recall rate with DM and a lower one with DBT, European (Scandinavian) studies show a lower recall rate with DM and an increased one with DBT, however well below the European guidelines for breast screening.

Houssami et al. "Digital breast tomosynthesis (3D-mammography) screening: A pictorial review of screen-detected cancers and false recalls attributed to tomosynthesis in prospective screening trials"	**Australia 2016**	The slight augmentation of the false positive recall rate is likely to recede again with more DBT experience on side of the readers and more availability of prior tomosynthesis screens at repeating screening rounds.
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 Malmo Tomosynthesis Screening Trial"	**Sweden 2016**	An initial rise in the recall rate is seen because of the many new, benign and up to now unusual findings. The false-positive recall rate is still well within the European guidelines and shows evidence of a learning curve.
Siemens Medical Solutions USA Inc. "MRMC study to demonstrate the superior accuracy of Siemens DBT to FFDM as a replacement for FFDM screening mammography"	**USA 2016**	The study with 31 experienced readers comparing stand-alone DBT versus DM reports a 19.4% decrease with DBT in the non-cancer recall rate.
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"	**Sweden 2015**	The recall rate rises from 2.6% with DM alone to 3.8% with one-view DBT. The rise in this very low baseline DM recall rate needs to be seen in the context of a highly increased detection rate by 43%. The recall rate decreases again once the readers are more experienced with DBT.
Siemens Medical Solutions USA, Inc. "PMA (P140011) study with MAMMOMAT Inspiration with tomosynthesis option"	**USA 2015**	The MAMMOMAT Inspiration with the tomosynthesis option reduces the non-cancer recall rate by 18.9% for DM plus two-view DBT compared to DM alone.

3. Radiation dose

Breast tissue is sensitive to radiation, and screening examinations are performed on healthy women. It is therefore immensely important to obtain the highest possible image quality at the lowest achievable dose.

DBT meets both European and American dose guidelines for breast screening. Dose, however, depends not only on the set dose level per single exposure but also on the imaging protocol and the number of DM and DBT views acquired in a clinical setup. For example a one-view tomosynthesis with a wide-angle system could reduce dose by 33% in screening trials compared to a two-view 2D breast screening examination.

New technologies like the synthetic mammogram and special reconstruction algorithms also aim to reduce dose in DBT examinations.

Uchiyama et al. "Diagnostic usefulness of synthetic MMG (SMMG) with DBT (digital breast tomosynthesis) for clinical setting in breast cancer screening"	**Japan 2016**	The 2D synthetic mammogram, generated out of the 3D dataset, can replace the DM 2D image in a combined 2D/3D examination – resulting in dose reduction of up to 40%.
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"	**Sweden 2015**	With one-view DBT as a stand-alone modality the dose can be reduced by 33% compared to the standard two-view DM.
Timberg et al. "Detection of calcification clusters in digital breast tomosynthesis slices at different dose levels utilizing a SRSAR reconstruction and JAFROC"	**Sweden 2015**	Special iterative reconstruction methods with noise and artifact reduction can reduce dose by up to 50% compared to standard FBP without jeopardizing microcalcification cluster detection.
Svahn et al. "Review of radiation dose estimates in digital breast tomosynthesis relative to those in two-view full-field digital mammography"	**Australia 2015**	By replacing a DM with a synthetic mammogram, the AGD can be reduced by up to 45%.
Dance et al. "Comparison of breast doses for digital tomosynthesis estimated from patient exposures and using PMMA breast phantoms"	**UK 2012**	The Siemens MAMMOMAT Inspiration system with its 50° scan angle and 25 projections has similar dose as a 15° scan angle system with 15 projections. At larger breast thickness it works with significantly less dose.

4. Examination

Screening with DBT might slightly prolong the examination procedure, depending on using it as an adjunct to DM or as stand-alone, and on the number of views taken. The compression force can be lowered without loss of image quality, which results in less examination discomfort and potentially more women participating in screening programs.

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"	**Sweden 2016**	In 90% of the cases DBT examinations can be performed with only half of the compression force necessary for a standard DM examination.
Svahn et al. "Digital breast tomosynthesis in one or two views as a replacement or adjunct technique to full-field digital mammography"	**Australia 2015**	Improvements in accuracy using DBT were present for different types of imaging protocols. The studies considered the use of DBT in one as well as in two views and as an adjunct to DM or as a stand-alone screening modality.
Förnvik et al. "The effect of reduced breast compression in breast tomosynthesis: human observer study using clinical cases"	**Sweden 2010**	No difference in image quality is evident with reduced compression, indicating that DBT can be performed with substantially less compression force compared with DM. The majority of women examined felt that half compression was more comfortable than full compression.

Saunders et al. "Can compression be reduced for breast tomosynthesis? Monte Carlo study on mass and microcalcification conspicuity in tomosynthesis"	**USA 2009**	In the DBT acquisition compression can be reduced by 12.5% without losing any important diagnostic information.

5. Reading

DBT can reduce the differences in reading performance between inexperienced and experienced readers.

As DBT consists of volume sets rather than single images, it takes more time for review than DM. But with training and increasing experience, the time needed for image reading decreases. Using DBT as stand-alone also speeds up the reading process, compared to DM plus DBT. In addition, thicker DBT slices (=slabbing) aim at reducing the reading time further without compromising image quality and detection rate. With new visualization techniques such as Insight 3D, microcalcification clusters can be detected more easily than with thin-sliced DBT images.

Finally with an integrated breast density assessment an instant risk stratification right at the acquisition workstation with objective, volumetric breast density assessment can be preformed – for both DM and DBT.

Galati et al. "Added value of one-view digital breast tomosynthesis combined with digital mammography according to readers concordance: changing in BIRADS rate and follow-up management"	**Italy 2017**	Adding one-view DBT to DM helps breast imagers categorize lesions more accurately. The combination increases the concordance between the readers for BIRADS classification and work-up rate.
Timberg et al. "Breast density assessment using breast tomosynthesis images"	**Sweden 2016**	The automated analysis (VBDA) is a promising approach using low dose central projection DBT images in order to get radiologist-like density ratings similar to results obtained from DM.
Siemens Medical Solutions USA Inc. "MRMC study to demonstrate the superior accuracy of Siemens DBT to FFDM as a replacement for FFDM screening mammography"	**USA 2016**	Two-view DBT alone shows a smaller variation coefficient in AUC ROC than two-view DM, demonstrating a higher standardization and unanimity between the readers.
Siemens Medical Solutions USA, Inc. "PMA (P140011) study with MAMMOMAT Inspiration with tomosynthesis option"	**USA 2015**	With DBT as an adjunct to DM an increase in the readers´ diagnostic accuracy is noted especially with inexperienced readers. This indicates a lower inter-reader variability.
Dustler et al. "Image quality of thick average intensity pixel slabs using statistical artifact reduction in breast tomosynthesis"	**Sweden 2014**	DBT with 2 mm slabs improves the visibility of microcalcification clusters without compromising image quality.
Tani et al. "Assessing radiologist performance and microcalcifications visualization using combined 3D rotating mammogram (RM) and digital breast tomosynthesis (DBT)"	**Japan 2014**	Insight 3D offers a better and faster visualization of microcalcification clusters in cancer lesions compared to DM and DBT alone. It might even reduce the interpretation time needed for DBT images.
Dustler et al. "A study of the feasibility of using slabbing to reduce tomosynthesis review time"	**Sweden 2013**	Slabbing can reduce the reading time for screening cases up to 20% with no significant impact on image quality.

6. Economic aspects

If DBT is to be established in population-based screening programs the current financial framework has to be considered. At first DBT appears to be the more costly alternative than DM but when evaluating the cost effectiveness of DBT, lower follow-up treatment costs due to earlier detection of cancers and fewer false positives need to be considered. Recent studies have evaluated the financial aspects of DBT in screening programs and demonstrate that DBT can be the more cost-effective method.

Miller et al. "Value analysis of digital breast tomosynthesis for breast cancer screening in a US Medicaid population"	**USA 2017**	DBT as a mammographic screening modality reduces the need for follow-ups and improves the detection of invasive cancers, allowing earlier, less costly treatment (annual cost savings amounts to $8.14 per patient, $12,000 for an average-sized Medicaid plan and $207,000 for a typical state Medicaid program).
Kalra et al. "Cost-effectiveness of tomosynthesis in annual screening mammography"	**USA 2016**	Adding DBT to DM in annual screening is cost-effective compared to 2D mammography alone.
Bonafede et al. "Value analysis of digital breast tomosynthesis for breast cancer screening in a commercially-insured US population"	**USA 2015**	DBT in screening proves to be clinically and economically favorable for commercially-insured USA women. The overall cost savings to the USA commercial health insurance plans are about $2.4 million per year.

B. Digital breast tomosynthesis in diagnostic workup and therapy

1. Cancer detection and characterization

DBT allows a better characterization of the shape and margin of lesions and is particularly sensitive to spiculations and architectural distortions. Moreover, DBT enables clinicians to achieve more precise BIRADS classifications, helps with radial scars, visualizes microcalcifications more strikingly, and even outperforms DM in therapy planning.

Galati et al. "Added value of one-view digital breast tomosynthesis combined with digital mammography according to readers concordance: changing in BIRADS rate and follow-up management"	**Italy 2017**	Adding one-view DBT to DM helps breast imagers categorize lesions more accurately and leads to farther-reaching benefits. The combination increases the number of BIRADS 1-2 and 4-5, while reducing the number of BIRADS 0 and 3 (uncertain cases) which finally reduces recalls and biopsies.
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."	**Austria 2016**	The diagnostic performance of wide-angle DBT alone for the detection and characterization of microcalcifications is comparable to DM even when used as a stand-alone technique.
Mercier et al. "The role of tomosynthesis in breast cancer staging in 75 patients"	**France 2015**	Compared to DM DBT improves lesion staging irrespective of the density and leads to better visualization of masses as well as better detection of multifocality and multicentricity.
Pina L. "Value of digital breast tomosynthesis for preoperative local staging of breast cancer"	**Spain 2015**	DBT increases the sensitivity of DM, detecting up to 32.4% additional cancers and changing the initial surgical treatment in 24.1% of patients.
Förnvik et al. "Breast tomosynthesis: Accuracy of tumor measurement compared with digital mammography"	**Sweden 2010**	DBT or US show a better determination of tumor outline and size compared to DM. The assessment using DBT correlates well with pathology and results in more accurate tumor staging.
Andersson et al. "Breast tomosynthesis and digital mammography: a comparison of breast cancer visibility and BIRADS classification in a population of cancers with subtle mammographic findings"	**Sweden 2008**	Comparing one-view FFDM to one-view DBT, 21 patients were upgraded on BIRADS classification. Comparing two-view FFDM to one-view DBT, 12 patients were upgraded on BIRADS classification. The results indicate that the cancer visibility with DBT is superior to FFDM, which suggests that DBT may have a higher sensitivity for breast cancer detection.

2. Clinical workflow and patient management

DBT can render many follow-up exposures unnecessary since it achieves similar sensitivity and specificity as additional mammographic views, but at a lower dose level.

DBT can lead to faster diagnostic workups, greater throughput, and improved resource utilization – which makes it a good alternative for determining lesion sizes for therapy planning and control.

Heywang-Köbrunner et al. "Value of digital breast tomosynthesis versus additional views for the assessment of screen-detected abnormalities – a first analysis"	**Germany 2017**	For lesion assessment wide-angle DBT can replace additional views, reduce biopsies and short-term follow-up examinations as well as patient distress, dose and costs. It improves diagnostic accuracy providing exact lesion localization and planning of interventions.
Amer et al. "Digital breast tomosynthesis versus full-field digital mammography - Which modality provides more accurate prediction of margin status in specimen radiography?"	**Egypt, Germany 2017**	Compared to DM DBT significantly improves the accuracy of specimen analysis and permits closest identification and delineation of tumor margins. So DBT can reduce re-excision and re-operation rates.
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"	**UK 2016**	Substituting one-view wide angle DBT for supplementary mammographic views in the workup of screen-detected soft-tissue mammographic abnormalities shows equivalent overall diagnostic accuracy according to ROC curve analysis.
Elizalde et al. "Additional US or DBT after digital mammography: which one is the best combination?"	**Spain 2016**	Additional US or DBT in combination with DM significantly increase the AUC of DM. However, US is a highly operator-dependent and time-consuming technique. The highest specificity is achieved with the combination of DM and DBT.
Mercier et al. "The role of tomosynthesis in breast cancer staging in 75 patients"	**France 2015**	The use of DBT leads to better visibility of masses and a higher detection of cancers in 10% of the patients. In general it often results in an adaption of the original surgical plan.
Urano et al. "Digital mammography versus digital breast tomosynthesis for detection of breast cancer in the intraoperative specimen during breast-conserving surgery"	**Japan 2015**	During Breast Conserving Surgery (BCS) using DBT allows more accurate breast cancer detection than DM in LL views. With DBT the depiction of whole lesions is better than with DM. This indicates its potential to enable a more precise diagnosis of vertical invasion and better marginal control in BCS.
Uchiyama et al. "Usefulness of a combination DBT (digital breast tomosynthesis) and automated volume analysis of dynamic contrast-enhanced breast (DCEB) MRI in evaluation of response to neoadjuvant chemotherapy (NAC)"	**Japan 2014**	DBT has the advantage of providing macroscopic pathological findings in total without utilizing contrast medium. A combination of DBT and automated volume analysis of DCEB MRI contributes to more accurate diagnosis in the assessment of pathological response to NAC than FFDM or US plus DCEB MRI.
Van Ongeval et al. "Is DBT the new standard in diagnostic imaging? How to implement in specialist training?"	**Belgium 2014**	DBT outperforms both DM and US in determining the tumor size before an operation.
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?"	**Germany 2013**	When DBT instead of DM is performed primarily for a specimen mammogram, the re-excision rate of tumor beds can be reduced.

Summary

DBT overcomes many of the difficulties arising from the 2D acquisition – such as the structural or anatomical noise of overlapping parenchyma. Siemens High Definition Breast Tomosynthesis with its wide scan angle (50°) and high number of projections (25) combined with continuously improved reconstruction algorithms results in highest depth resolution and visibility of low contrast objects.

In breast cancer screening wide-angle DBT improves the lesion detection and characterization: Stand-alone wide-angle two-view DBT increases diagnostic accuracy – even without additional 2D DM or synthetic images – and enhances the visibility of spiculated masses and architectural distortions. This leads to improved detection of invasive cancers and characterization of lesions. The diagnostic performance of stand-alone wide-angle two-view DBT for the detection and characterization of microcalcifications is comparable to DM. Additionally, novel reconstruction algorithms like EMPIRE improve contrast and sharpness of microcalcifications and also add new ways of visualizing DBT like the Insight 3D view.

This improved diagnostic performance helps to reduce false-positive findings. The actual recall rate differs from country to country. While U.S. studies confirm a reduced recall rate with DBT compared to DM, most European studies show a slightly increased recall rate, however well below the European guidelines for breast screening.

Adding DBT to DM increases the total patient dose. However, dose can be reduced by replacing DM with synthetic mammograms. In this case the dose levels are well within the official recommendations of EUREF and MQSA. For screening, the dose can be reduced further by using wide-angle one-view DBT only, reaching dose levels below current two-view DM. Additionally for lesion assessment, wide-angle DBT can replace additional views, reduce biopsies and short-term follow-up examinations as well as patient distress, dose and costs.

Screening with DBT might slightly prolong the examination procedure, depending on whether it is used as an adjunct to DM or as stand-alone, as well as the number of views taken. For the Siemens wide-angle systems the compression force can be lowered without loss of diagnostic accuracy, and results in less examination discomfort and potentially more women participating in screening programs.

As DBT consists of volume sets rather than single images, it takes more time for reading than DM. But with training and increasing experience this reading time decreases. Thicker DBT slices (=slabbing) aim at reducing the reading time further. In addition, DBT leads to higher reader performance and lower inter-reader variability.

Wide-angle one-view DBT (MLO) might be feasible as a stand-alone breast screening modality. In the interim results of the Malmö Breast Tomosynthesis Screening Trial the detection rate increases by 43% while the dose can significantly be reduced by 33% compared to the standard two-view DM. The examination time and the reading process can be speeded up, compared to DM plus DBT.

DBT as a mammographic screening modality reduces false positive rates and the need for follow-ups. It improves the detection of invasive cancers, allowing earlier, less costly treatment. Therefore DBT might be within the financial framework of population screening programs, or can even be the more cost effective method.

With its better characterization of the shape and margin of lesions as well as the more vivid visualization of microcalcifications, DBT outperforms DM with faster diagnostic workups and more precise therapy planning and control. Therefore DBT can reduce re-excision and re-operation rates.

Finally, DBT might become the standard in breast cancer screening and diagnostics in the near future as a substitute for 2D mammography. Using wide-angle DBT for screening challenges conventional two-view DBT (MLO and CC) examination, as one-view DBT (MLO) only might suffice.

Glossary

ACR	American College of Radiology	**MBTST**	Malmö Breast Tomosynthesis Screening Trial (Sweden)
ACRIN	American College of Radiology Imaging Network	**MLO**	Mediolateral Oblique
AGD	Average Glandular Dose	**MMG**	Mammogramm
AUC	Area Under the (ROC) Curve	**MRI**	Magnetic Resonance Imaging
BIRADS	Breast Imaging Reporting and Data System (+ ref to classification)	**MQSA**	Mammography Quality Standards Act (ACR)
CC	Cranio Caudal	**MRMC**	Multi-Reader, Multi-Case
DBT	Digital Breast Tomosynthesis	**NAC**	Neoadjuvant Chemotherapy
DCEB MRI	Dynamic Contrast-Enhanced Breast MRI	**PM(M)A**	Premarket Approval
DM	Digital Mammography	**RM**	Rotating Mammogram: Insight 3D (= 3D synthetic mammogram from Siemens Healthineers)
EMPIRE	**E**nhanced **M**ultiple **P**arameter **I**terative **R**econstrution	**ROC**	Receiver Operating Characteristics
EUREF	**Eur**opean **E**nergy **F**orum	**SM / SMMG**	Synthetic Mammogram: Insight 2D (= 2D synthetic mammogram from Siemens Healthineers)
(i)FBP	(iterative) Filtered back projection	**SR(S)**	Specimen Radiography (System)
FFDM	Full Field Digital Mammography	**SRSAR**	Super Resolution and Statistical Artifact Reduction
Insight 2D	Siemens Healthineers synthetic 2D mammogram	**US**	Ultrasound
Insight 3D	Siemens Healthineers synthetic 3D mammogram	**USA**	United States of America
JAFROC	Jackknife alternative free-response receiver operating characteristics	**VBDA**	Volumetric Breast Density Analysis
LL	Latero Lateral		

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

This white paper is not for use in the USA.

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