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PUB-2022-04

Wei-Mei Ma, Jiao Li, Shuang-Gang Chen, Pei-Qiang Cai, Shen Chen, Jie-Ting Chen, Chun-Yan Zhou, Ni He, Yaopan Wu, Correlation between contrast-enhanced cone-beam breast computed tomography features and prognostic staging in breast cancer, Br J Radiol. 2022 Apr 1;95(1132):20210466.

Abstract:

Objective: To evaluate whether contrast-enhanced cone-beam breast CT (CE-CBBCT) features can risk-stratify prognostic stage in breast cancer.

Methods: Overall, 168 biopsy-proven breast cancer patients were analysed: 115 patients in the training set underwent scanning using v. 1.5 CE-CBBCT between August 2019 and December 2019, whereas 53 patients in the test set underwent scanning using v. 1.0 CE-CBBCT between May 2012 and August 2014. All patients were restaged according to the American Joint Committee on Cancer eighth edition prognostic staging system. Following the combination of CE-CBBCT imaging parameters and clinicopathological factors, predictors that were correlated with stratification of prognostic stage via logistic regression were analysed. Predictive performance was assessed according to the area under the receiver operating characteristic curve (AUC). Goodness-of-fit of the models was assessed using the Hosmer-Lemeshow test.

Results: As regards differentiation between prognostic stage (PS) I and II/III, increased tumour-to-breast volume ratio (TBR), rim enhancement pattern, and the presence of penetrating vessels were significant predictors for PS II/III disease ($p < 0.05$). The AUCs in the training and test sets were 0.967 [95% confidence interval (CI) 0.938-0.996; $p < 0.001$] and 0.896 (95% CI, 0.809-0.983; $p = 0.001$), respectively. Two features were selected in the training set of PS II vs III, including tumour volume [odds ratio (OR)=1.817, $p = 0.019$] and calcification (OR = 4.600, $p = 0.040$), achieving an AUC of 0.790 (95% CI, 0.636-0.944, $p = 0.001$). However, there was no significant difference in the test set of PS II vs III ($P > 0.05$).

Conclusion: CE-CBBCT imaging biomarkers may provide a large amount of anatomical and radiobiological information for the pre-operative distinction of prognostic stage.

Advances in knowledge: CE-CBBCT features have distinctive promise for stratification of prognostic stage in breast cancer.

Link:

https://pubmed.ncbi.nlm.nih.gov/34930038/

PUB-2022-03

Yue Ma, Aidi Liu, Yuwei Zhang, Yueqiang Zhu, Yafei Wang, Mengran Zhao, Zhiran Liang, Zhiye Qu, Lu Yin, Hong Lu, Zhaoxiang Ye, Comparison of background parenchymal enhancement (BPE) on contrast-enhanced cone-beam breast CT (CE-CBBCT) and breast MRI, Eur Radiol. 2022 Mar 23. doi: 10.1007/s00330-022-08699-2.

Abstract:

Objectives: To compare the background parenchymal enhancement (BPE) levels on contrast-enhanced cone-beam breast CT (CE-CBBCT) and MRI, evaluate inter-reader reliability, and analyze the relationship between clinical factors and BPE level on CE-CBBCT.

Methods: In this retrospective study, patients who underwent both CE-CBBCT and MRI were analyzed. BPE levels on CE-CBBCT and MRI were assessed by five specialists independently in random fashion, with a wash-out period of 4 weeks. Weighted kappa was used to analyze the agreement between CE-CBBCT and MRI, and intraclass correlation coefficient (ICC) was used to evaluate the inter-reader reliability for each modality. The association between BPE level on CE-CBBCT and clinical factors was evaluated by univariate and multivariate logistic regression.

Results: A total of 221 patients from January 2017 to April 2021 were enrolled. CE-CBBCT showed substantial agreement (weighted kappa = 0.690) with MRI for BPE evaluation, with good degree of inter-reader reliability on both CE-CBBCT (ICC = 0.712) and MRI (ICC = 0.757). Based on majority reports, BPE levels on CE-CBBCT were lower than MRI ($p < 0.001$). BPE level on CE-CBBCT was significantly associated with menstrual status (odds ratio, OR = 0.125), breast density (OR = 2.308), and previously treated breast cancer (OR = 0.052) (all $p < 0.05$). BPE level for premenopausal patients was associated with menstrual cycle, with lower BPE level for the 2nd week of menstrual cycle (OR = 0.246).

Conclusions: CE-CBBCT showed substantial agreement and comparable inter-reader reliability with MRI for BPE evaluation, indicating that the corresponding BI-RADS lexicons could be used to describe BPE level on CE-CBBCT. The 2nd week of menstrual cycle timing is suggested as the optimal examination period for CE-CBBCT.

Key points: • CE-CBBCT showed substantial agreement and comparable inter-reader reliability with MRI for BPE evaluation. • Menstrual status, breast density, and previously treated breast cancer were associated with the BPE level on CE-CBBCT images. • The 2ndweek of the menstrual cycle is suggested as the optimal examination period for CE-CBBCT.

Link:

https://pubmed.ncbi.nlm.nih.gov/35320411/

PUB-2022-02

Yueqiang Zhu, Avice M O'Connell, Yue Ma, Aidi Liu, Haijie Li, Yuwei Zhang, Xiaohua Zhang, Zhaoxiang Ye, Dedicated breast CT: state of the art-Part II. Clinical application and future outlook, Eur Radiol. 2022 Apr;32(4):2286-2300.

Abstract:

Dedicated breast CT is being increasingly used for breast imaging. This technique provides images with no compression, removal of tissue overlap, rapid acquisition, and available simultaneous assessment of microcalcifications and contrast enhancement. In this second installment in a 2-part review, the current status of clinical applications and ongoing efforts to develop new imaging systems are discussed, with particular emphasis on how to achieve optimized practice including lesion detection and characterization, response to therapy monitoring, density assessment, intervention, and implant evaluation. The potential for future screening with breast CT is also addressed. KEY POINTS: • Dedicated breast CT is an emerging modality with enormous potential in the future of breast imaging by addressing numerous clinical needs from diagnosis to treatment. • Breast CT shows either noninferiority or superiority with mammography and numerical comparability to MRI after contrast administration in diagnostic statistics, demonstrates

excellent performance in lesion characterization, density assessment, and intervention, and exhibits promise in implant evaluation, while potential application to breast cancer screening is still controversial. • New imaging modalities such as phase-contrast breast CT, spectral breast CT, and hybrid imaging are in the progress of R & D.

Link:

https://pubmed.ncbi.nlm.nih.gov/34476564/

PUB-2022-01

Yueqiang Zhu, Avice M O'Connell, Yue Ma, Aidi Liu, Haijie Li, Yuwei Zhang, Xiaohua Zhang, Zhaoxiang Ye, Dedicated breast CT: state of the art-Part I. Historical evolution and technical aspects, Eur Radiol. 2022 Mar;32(3):1579-1589

Abstract:

Dedicated breast CT is an emerging 3D isotropic imaging technology for breast, which overcomes the limitations of 2D compression mammography and limited angle tomosynthesis while providing some of the advantages of magnetic resonance imaging. This first installment in a 2-part review describes the evolution of dedicated breast CT beginning with a historical perspective and progressing to the present day. Moreover, it provides an overview of state-of-the-art technology. Particular emphasis is placed on technical limitations in scan protocol, radiation dose, breast coverage, patient comfort, and image artifact. Proposed methods of how to address these technical challenges are also discussed. KEY POINTS: • Advantages of breast CT include no tissue overlap, improved patient comfort, rapid acquisition, and concurrent assessment of microcalcifications and contrast enhancement. • Current clinical and prototype dedicated breast CT systems differ in acquisition modes, imaging techniques, and detector types. • There are still details to be decided regarding breast CT techniques, such as scan protocol, radiation dose, breast coverage, patient comfort, and image artifact.

Link:

https://pubmed.ncbi.nlm.nih.gov/34342694/

PUB-2021-06

Jingchen Ma, Ni He, Jin H Yoon, Richard Ha, Jiao Li, Weimei Ma, Tiebao Meng, Lin Lu, Lawrence H Schwartz, Yaopan Wu, Zhaoxiang Ye, Peihong Wu, Binsheng Zhao, Chuanmiao Xie, Distinguishing benign and malignant lesions on contrast-enhanced breast cone-beam CT with deep learning neural architecture search, Eur J Radiol. 2021 Sep;142:109878.

Abstract:

Purpose: To utilize a neural architecture search (NAS) approach to develop a convolutional neural network (CNN) method for distinguishing benign and malignant lesions on breast cone-beam CT (BCBCT).

Method: 165 patients with 114 malignant and 86 benign lesions were collected by two institutions from May 2012 to August 2014. The NAS method autonomously generated a CNN model using one institution's dataset for training (patients/lesions: 71/91) and validation (patients/lesions: 20/23). The model was externally tested on another institution's dataset (patients/lesions: 74/87), and its performance was compared with fine-tuned ResNet-50 models and two breast radiologists who independently read the lesions in the testing dataset without knowing lesion diagnosis.

Results: The lesion diameters (mean ± SD) were 18.8 ± 12.9 mm, 22.7 ± 10.5 mm, and 20.0 ± 11.8 mm in the training, validation, and external testing set, respectively. Compared to the best ResNet-50 model, the NAS-generated CNN model performed three times faster and, in the external testing set, achieved a higher (though not statistically different) AUC, with sensitivity (95% CI) and specificity (95% CI) of 0.727, 80% (66-90%), and 60% (42-75%), respectively. Meanwhile, the performances of the NAS-generated CNN and the two radiologists' visual ratings were not statistically different.

Conclusions: Our preliminary results demonstrated that a CNN autonomously generated by NAS performed comparably to pre-trained ResNet models and radiologists in predicting malignant breast lesions on contrast-enhanced BCBCT. In comparison to ResNet, which must be designed by an expert, the NAS approach may be used to automatically generate a deep learning architecture for medical image analysis.

Link:

https://pubmed.ncbi.nlm.nih.gov/34388626/

PUB-2021-05

Wei Kang, Wuning Zhong, Danke Su, The cone-beam breast computed tomography characteristics of breast non-mass enhancement lesions, Acta Radiol. 2021 Oct;62(10):1298-1308. doi: 10.1177/0284185120963923.

Abstract:

Background: Cone-beam computed tomography (CBBCT) of the breast is emerging as a way of improving breast cancer diagnostic yield.

Purpose: To find characteristics of non-mass enhancement (NME) lesions on breast CBBCT and to identify the characteristics that distinguish malignant and benign lesions.

Material and methods: Breast CBBCT images of 84 NME lesions were analyzed. Internal enhancement distribution and patterns, calcification distribution and suspicious morphology, and ΔHU enhancement values were compared between post-contrast and pre-contrast malignant and benign lesions. Univariate analyses were applied to find the strongest indicators of malignancy, and logistic regression analysis was used to develop a fitting equation for the combined diagnostic model.

Results: In the 84 NME lesions, the indicators of malignancy were as follows: segmental enhancement distribution (P = 0.011, 53.62% sensitivity, 86.67% specificity, 94.87% positive predictive value [PPV], and 28.89% negative predictive value [NPV]), clumped internal enhancement patterns (P = 0.017, 50.72% sensitivity, 86.67% specificity, 94.59% PPV, and 27.66% NPV), $\Delta HU \geqslant 93.57$ Hounsfield units (HU) (P = 0.004, 66.67% sensitivity, 73.33% specificity, 92.00% PPV, and 32.35% NPV), and NME lesions with calcification (P = 0.002, 36.23% sensitivity, 20.00% specificity, 82.14% PPV, and 67.57% NPV). The fitting equation for the combined diagnostic model was as follows: Logit (P) = -0.579 +1.318 × enhancement distribution + 1.000 × internal enhancement patterns + 1.539 × ΔHU value + 1.641 ×NME type.

Conclusion: Individual diagnostic criteria based on breast CBBCT characteristics (segmental enhancement distribution, clumped internal enhancement patterns, ΔHU values > 93.57 HU, and NME lesions with calcification) had high specificity and PPV; when combined, they had high sensitivity in predicting malignant NME lesions.

Link:

https://pubmed.ncbi.nlm.nih.gov/33070636/

PUB-2021-04

Avice M. O'Connell, Thomas J. Marini, and Daniel T. Kawakyu-O'Connor. Cone-Beam Breast Computed Tomography: Time for a New Paradigm in Breast Imaging, J Clin Med. 2021 Nov; 10(21): 5135.

Abstract:

It is time to reconsider how we image the breast. Although the breast is a 3D structure, we have traditionally used 2D mammography to perform screening and diagnostic imaging. Mammography has been continuously modified and improved, most recently with tomosynthesis and contrast mammography, but it is still using modifications of compression 2D mammography. It is time to consider 3D imaging for this 3D structure. Cone-beam breast computed tomography (CBBCT) is a revolutionary modality that will assist in overcoming the limitations of current imaging for dense breast tissue and overlapping structures. It also allows easy administration of contrast material for functional imaging. With a radiation dose on par with diagnostic mammography, rapid 10 s acquisition, no breast compression, and true high-resolution isotropic imaging, CBBCT has the potential to usher in a new era in breast imaging. These advantages could translate into lower morbidity and mortality from breast cancer.

Link:

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8584471/

PUB-2021-03

Aidi Liu, Lu Yin, Yue Ma, Peng Han, Yalin Wu, Yaopan Wu, Zhaoxiang Ye, Quantitative breast density measurement based on three-dimensional images: a study on cone-beam breast computed tomography, Acta Radiol. 2021 Jul 14;2841851211027386. doi: 10.1177/02841851211027386.

Abstract:

Background: Breast density is an independent predictor of breast cancer risk. Quantitative volumetric breast density (QVBD) is expected to provide more information on the prediction of breast cancer risk.

Purpose: To evaluate the reliability of QVBD measurements based on cone-beam breast computed tomography (CBBCT) images.

Material and methods: A total of 216 breasts were used to evaluate the stability of QVBD measurements based on CBBCT images and the correlations between this volumetric measurement and visual and area-based measurement methods. The intra- and inter-observer consistency of QVBD measurements were compared. Visual breast density (VBD) was evaluated with Breast Imaging Reporting and Data System (BI-RADS) standard on CBBCT images. The correlation between QVBD and VBD was evaluated by Spearman correlation coefficient. Receiver operating characteristic (ROC) curve was used to assess the sensitivity and specificity of the volumetric method in distinguishing dense and non-dense breasts. The correlation between QVBD and quantitative area-based breast density (QABD) was determined with Pearson correlation coefficient. Then, the breast volume measured with CBBCT images was compared with the breast specimen obtained during nipple-sparing mastectomy (NSM) by Pearson correlation coefficient and linear regression.

Results: Excellent intra- and inter-observer consistency was found from QVBD measurements. The volumetric method distinguished dense and non-dense breasts at a cutoff value of 9.5%, with 94.5% sensitivity and 77.1% specificity. Positive correlations were found between QVBD and QABD (r=0.890; P<0.001) and between the volume measured with CBBCT images and Archimedes method (r=0.969; P<0.001).

Conclusion: CBBCT images can evaluate breast density reliably on a continuous scale.

Link:

https://pubmed.ncbi.nlm.nih.gov/34259021/

PUB-2021-02

Hsin Wu Tseng, Andrew Karellas, Srinivasan Vedantham, Radiation dosimetry of a clinical prototype dedicated cone-beam breast CT system with offset detector, Med Phys. 2021 Mar;48(3):1079-1088. doi: 10.1002/mp.14688. Epub 2021 Jan 26.

Abstract:

Purpose: A clinical-prototype, dedicated, cone-beam breast computed tomography (CBBCT) system with offset detector is undergoing clinical evaluation at our institution. This study is to estimate the normalized glandular dose coefficients (DgNCT) that provide air kerma-to-mean glandular dose conversion factors using Monte Carlo simulations.

Materials and methods: The clinical prototype CBBCT system uses 49 kV x-ray spectrum with 1.39 mm 1st half-value layer thickness. Monte Carlo simulations (GATE, version 8) were performed with semi-ellipsoidal, homogeneous breasts of various fibroglandular weight fractions (fg=0.01,0.15,0.5,1), chest wall diameters (d=8,10,14,18,20 cm), and chest wall to nipple length (l=0.75d), aligned with the axis of rotation (AOR) located at 65 cm from the focal spot to determine the DgNCT. Three geometries were considered 40×30cm detector with no offset that served as reference and corresponds to a clinical CBBCT system, 30×30cm detector with 5 cm offset, and a 30×30cm detector with 10 cm offset.

Results: For 5 cm lateral offset, the DgNCT ranged 0.177−0.574 mGy/mGy and reduction in DgNCT with respect to reference geometry was observed only for 18 cm (6.4%±0.23%) and 20 cm (9.6%±0.22%) diameter breasts. For the 10 cm lateral offset, the DgNCT ranged 0.221−0.581mGy/mGy and reduction in DgNCT was observed for all breast diameters. The reduction in DgNCT was 1.4%±0.48%, 7.1%±0.13%, 17.5%±0.19%, 25.1%±0.15%, and 27.7%±0.08% for 8, 10, 14, 18, and 20 cm diameter breasts, respectively. For a given breast diameter, the reduction in DgNCT with offset-detector geometries was not dependent on fg . Numerical fits of DgNCT(d,l,fg) were generated for each geometry.

Conclusion: The DgNCT and the numerical fit, DgNCT(d,l,fg) would be of benefit for current CBBCT systems using the reference geometry and for future generations using offset-detector geometry. There exists a potential for radiation dose reduction with offset-detector geometry, provided the same technique factors as the reference geometry are used, and the image quality is clinically acceptable.

Link:

https://pubmed.ncbi.nlm.nih.gov/33501686/

PUB-2021-01

Jiawei Li, Guobin Zhong, Keqiong Wang, Wei Kang, Wei Wei, Tumor-to-Gland Volume Ratio versus Tumor-to-Breast Ratio as Measured on CBBCT: Possible Predictors of Breast-Conserving Surgery, Cancer Manag Res. 2021 Jun 3;13:4463-4471.

Abstract:

Background: Breast-conserving surgery plus postoperative radiotherapy is the standard surgical treatment mode for early breast cancer. Currently, there are no clear predictive indicators to determine whether a patient can choose breast-conserving surgery, which mainly depends on the surgeon's clinical experience and subjective judgment. Cone-beam breast computed tomography (CBBCT) reconstructs the breast 3D image from three mutually perpendicular angles, helping surgeons to locate and accurately measure the volume of the tumor, mammary gland, and breast. We used CBBCT to retrospectively measure the tumor-to-gland volume ratio and tumor-to-breast volume ratio in breast cancer cases. Then, we analyzed the correlation between the surgical methods and ratios in breast cancer patients.

Methods: We collected 100 patients undergoing breast-conserving surgery as the study group, and 100 patients undergoing mastectomy as the control group. All patients chose the surgical approach after comprehensive consideration of examination results and assessment of patient condition. Patients underwent CBBCT examination before surgery. We retrospectively measured the volume of tumor, mammary glands and breast, then calculated tumor-to-gland and tumor-to-breast volume ratios.

Results: Tumor volume and the ratios of the two groups statistically differed ($P < 0.001$), while the mammary gland and breast volume did not ($P > 0.05$). The average tumor-to-gland volume ratio was 4.32% in the study group and 10.74% in the control group, and the average tumor-to-breast volume ratio was 0.74% in the study group and 1.36% in the control group. In breast-conserving surgery, the 95% reference range of tumor-to-gland ratio is (0, 12.90%), and the 95% reference range of tumor-to-breast ratio is (0, 2.17%).

Conclusion: The tumor-to-gland volume ratio and tumor-to-breast volume ratio measured using CBBCT are correlated with the choice of surgical methods (breast-conserving surgery or mastectomy) for breast cancer patients. This can be used as possible predictor of breast-conserving surgery to help surgeons.

Link:

https://pubmed.ncbi.nlm.nih.gov/34113172/

PUB-2020-07

Wuning Zhong, Wei Kang, Danke Su, Xin Zhao, Yu Liu, Yunying Qin, Yinghua Yu, Comparative Analysis of Contrast-Enhanced Cone Beam Breast CT, MRI and Digital Mammography Measure size of Breast Non-Mass Lesions, Advances in Clinical Medicine, 10(10), 2387-2392 (in Chinese)

Abstract:

Objective:

To compare the accuracy of contrast enhanced cone beam breast CT (CE-CBBCT), MRI and digital mammography (DM) in the measurement of preoperative tumor sizes of breastnon-mass lesion (NML).

Methods:

In this retrospective study, the study cohort included 37 patients acquired between July 2019 and December 2019 with histopathologic confirmed NML findings. The patients in the cohort underwent all three modalities (CE-CBBCT, DM, and MRI). The sizes of NML measured from the three imaging modalities were compared using surgical pathology measurements as gold standard. Pearson coefficient was used to analyze the correlation between the sizes measured from images and pathological specimens.

Results:

The maximum diameters of CBBCT, MRI, DM and pathology specimen were (4.60 ± 1.70) cm, (4.70 ± 2.12) cm, (5.75 ± 2.33) cm and (4.50 ± 2.12) cm, respectively. The sizes of three imaging methods were larger than pathological specimens. The correlation coefficients (r) between the three imaging methods and pathology were 0.941, 0.846 and 0.609, respectively (P < 0.001), CBBCT had the highest correlation with pathology. Conclusion: CE-CBBCT is more accurate than MRI and DM in evaluating the sizes of NML.

Link:

https://doi.org/10.12677/acm.2020.1010360

PUB-2020-06

MEGN Liyu, SU Danke, ZHAO Xin, Consistency Analysis of Cone Beam Breast CT and MRI for Morphological Description of Breast Cancer, JOURNAL OF CLINICAL RADIOLOGY, 39(10), 1952-1956 (in Chinese)

Abstract:

Objective

To investigate the conformity of cone beam computed tomography (CBBCT) and MRI in the observation of morphological features of breast cancer.

Methods

This study retrospectively analyzed 24 patients (41 lesions) with plain and enhanced CBBCT and plain and enhanced MRI examination who met the inclusion criteria, including 19 invasive ductal carcinomas (34 lesions). There were 2 cases of invasive carcinoma (4 lesions) and 3 cases of ductal carcinoma in situ (3 lesions).

Results

The flattened CBBCT detection rate of the 41 lesions was 68.42%, the detection rate of flattened MRI was 94.74%, and the detection rates of enhanced CBBCT and enhanced MRI were 100%. The maximum diameter of the lesions in the flattened CBBCT group was larger than that in the undetected group and the difference was statistically significant. The maximum diameter of the lesions in the flattened MRI group was larger than that in the undetected group, but the difference was not statistically significant. Among the 41 lesions, there was no significant difference in the mean diameter of the same lesion measured by enhanced CBBCT and enhanced MRI. In 38 mass lesions, for the same lesion in the enhanced CBBCT and MRI images, the coincidence rate of shape was 84.21%, the coincidence rate of margin was 86.84%, the coincidence rate of border was 89.47%, and coincidence rate of enhancement mode was 86.84%. In the three non-mass lesions, for the same lesion in the enhanced CBBCT and MRI images, the coincidence rate of the distribution was 66.67%, and the coincidence rate of enhancement mode was 100%.

Conclusion

The detection rate of flattened CBBCT is lower than that of flattened MRI. The detection rate of enhanced CBBCT is comparable to that of enhanced MRI. There was no significant difference in the size of the same lesion measured in enhanced CBBCT and MRI images, and coincidence rate of the mass lesions morphological features (shape, margin, border, and enhancement mode) and the morphological signs

(distribution and enhancement mode) of non-mass lesions were high in the enhanced CBBCT and enhanced MRI images.

Link:

https://cdw.cnki.net/kcms/detail/detail.aspx?filename=LCFS202010012&dbcode=CRJT_CJFD&dbname=CJFDAUTODAY&v=

PUB-2020-05

Wei Kang, Wuning Zhong, Danke Su, The cone-beam breast computed tomography characteristics of breast non-mass enhancement lesions, Acta Radiol. 2020 Oct 18;284185120963923. doi: 10.1177/0284185120963923.

Abstract:

Background: Cone-beam computed tomography (CBBCT) of the breast is emerging as a way of improving breast cancer diagnostic yield.

Purpose: To find characteristics of non-mass enhancement (NME) lesions on breast CBBCT and to identify the characteristics that distinguish malignant and benign lesions.

Material and methods: Breast CBBCT images of 84 NME lesions were analyzed. Internal enhancement distribution and patterns, calcification distribution and suspicious morphology, and ΔHU enhancement values were compared between post-contrast and pre-contrast malignant and benign lesions. Univariate analyses were applied to find the strongest indicators of malignancy, and logistic regression analysis was used to develop a fitting equation for the combined diagnostic model.

Results: In the 84 NME lesions, the indicators of malignancy were as follows: segmental enhancement distribution (P = 0.011, 53.62% sensitivity, 86.67% specificity, 94.87% positive predictive value [PPV], and 28.89% negative predictive value [NPV]), clumped internal enhancement patterns (P = 0.017, 50.72% sensitivity, 86.67% specificity, 94.59% PPV, and 27.66% NPV), $\Delta HU \geqslant 93.57$ Hounsfield units (HU) (P = 0.004, 66.67% sensitivity, 73.33% specificity, 92.00% PPV, and 32.35% NPV), and NME lesions with calcification (P = 0.002, 36.23% sensitivity, 20.00% specificity, 82.14% PPV, and 67.57% NPV). The fitting equation for the combined diagnostic model was as follows: Logit (P) = -0.579 +1.318 × enhancement distribution + 1.000 × internal enhancement patterns + 1.539 × ΔHU value + 1.641 ×NME type.

Conclusion: Individual diagnostic criteria based on breast CBBCT characteristics (segmental enhancement distribution, clumped internal enhancement patterns, ΔHU values > 93.57 HU, and NME lesions with calcification) had high specificity and PPV; when combined, they had high sensitivity in predicting malignant NME lesions.

Keywords: Cone-beam computed tomography; breast carcinoma; non-mass-like enhancement lesions.

Link:

https://pubmed.ncbi.nlm.nih.gov/33070636/

PUB-2020-04

Chen JT, Zhou CY, He N, Wu YP. Optimal acquisition time to discriminate between breast cancer subtypes with contrast-enhanced cone-beam CT [published online ahead of print, 2020 Jan 30]. Diagn Interv Imaging. 2020;S2211-5684(20)30002-4. doi:10.1016/j.diii.2020.01.001

Abstract:

Abstract

Purpose: To identify the optimal acquisition time to best discriminate between benign and malignant breast lesions on contrast-enhanced cone beam CT (CE-CBCT) and evaluate the potential of CE-CBCT to differentiate between breast cancer subtypes.

Material and method: A total of 98 women with a mean age of 49±10 (SD) years (range: 29-77 years) with 100 BI-RADS 4 or 5 breast lesions were prospectively included. CE-CBCT images were obtained at 1- and 2-min after intravenous administration of iodinated contrast material. Contrast enhancement of breast lesions on CE-CBCT were evaluated and compared between different subtypes. Cut-off values for best discriminating between benign and malignant breast lesions with CE-CBCT were obtained from receiver operating characteristic curves.

Results: Malignant breast lesions showed greater enhancement than benign ones at 1-min (67.28±39.79 [SD] HU vs. 42.27±40.31 [SD] HU, respectively; P=0.007) and 2-min (70.93±38.05 [SD] HU vs. 48.94±41.83 [SD] HU, respectively; P=0.016) after intravenous administration of contrast material. At 1-min after intravenous administration of contrast material, an optimal cut-off value of 54.43 HU was found to best discriminate between malignant and benign breast lesions (AUC=0.681; 95%CI: 0.558-0.805; P=0.006) yielding 69.0% sensitivity (95%CI: 56.9-79.5%) and 69.2% specificity (95% CI: 48.2-85.7%). At 2-min, an optimal cut-off value of 72.65 HU was found to best discriminate between malignant and benign breast lesions (AUC=0.654; 95%CI: 0.535-0.774; P=0.020) yielding 50.7% sensitivity (95%CI: 38.6-62.8%) and 80.8% specificity (95%CI: 60.6-93.4%). CE-CBCT helped differentiate between immunohistochemical subtypes of breast lesions with lowest enhancement for triple negative lesions. No differences in enhancement were found among histopathological subtypes lesions at 1-min (P=0.478) and 2-min (P=0.625).

Conclusion: CE-CBCT helps discriminate between malignant and benign breast lesions, with best capabilities obtained at 1-min after intravenous administration of contrast material. For malignant lesions, quantitative analysis of enhancement on CE-CBCT helps differentiate between immunohistochemical subtypes.

Link:

https://doi.org/10.1016/j.diii.2020.01.001

PUB-2020-03

Ma, Y., Liu, A., O'Connell, A.M. et al. Contrast-enhanced cone beam breast CT features of breast cancers: correlation with immunohistochemical receptors and molecular subtypes. Eur Radiol (2020). https://doi.org/10.1007/s00330-020-07277-8

Abstract:

Objectives

To investigate the association of contrast-enhanced cone beam breast CT (CE-CBBCT) features, immunohistochemical (IHC) receptors, and molecular subtypes in breast cancer.

Methods

In this retrospective study, patients who underwent preoperative CE-CBBCT and received complete IHC results were analyzed. CE-CBBCT features were evaluated by two radiologists. Observer reproducibility and feature reliability were assessed. The association between CE-CBBCT features, IHC receptors, and molecular subtypes was analyzed using the chi-square, Mann-Whitney, and Kruskal-Wallis tests. Multivariate logistic regression was performed to assess the ability of combined imaging features to discriminate molecular subtypes. ROC curve was used to evaluate prediction performance.

Results

A total of 240 invasive cancers identified in 211 women were enrolled. Molecular subtypes of breast cancer were significantly associated with focality number of lesions, lesion type, tumor size, lesion density, internal enhancement pattern, degree of lesion enhancement (ΔHU), mass shape, spiculation, calcifications, calcification distribution, and increased peripheral vascularity of lesion (all $p < 0.005$), some of which also helped to differentiate IHC receptor status. A multivariate logistic regression model showed that tumor size (odds ratio, OR = 1.244), mass shape (OR = 0.311), spiculation (OR = 0.159), and internal enhancement pattern (OR = 0.227) were associated with differentiation between luminal and non-luminal subtypes (AUC = 0.809). Combined CE-CBBCT features, including lesion type (OR = 0.118), calcifications (OR = 0.181), and ΔHU (OR = 0.962), could be significant indicators of triple-negative versus HER-2-enriched subtypes (AUC = 0.913).

Conclusions

CE-CBBCT features have the potential to help predict IHC receptor status and distinguish molecular subtypes of breast cancer, which could in turn help to develop individual treatment decisions and prognosis predictions.

Link:

https://doi.org/10.1007/s00330-020-07277-8

PUB-2020-02

Kamila Skalski, Patricia, Melendez, Avice O'Connell, Cone it Down: A Countdown of the Top 10 Cone Beam Breast CT Pearls, Gold Medal Award ARRS 2020 Annual Meeting, Chicago, USA

Abstract:

The purpose of this education exhibit is to explore the top 10 reasons why cone beam breast CT should be considered.

After taking part in this exhibition the learner will be able to compare the standard imaging modalities including mammogram, tomosynthesis, ultrasound and MR, with the emerging technology of CBCT.

Multimodality assessment of pathology will ultimately define the benefits and drawbacks of each imaging modality used in diagnostic breast imaging.

PUB-2020-01

Yueqiang Zhu, Yuwei Zhang, Yue Ma, Haijie Li, Aidi Liu, Peng Han, Lu Yin, Nan Lv, Zhijun Li, Hong Lu, Peifang Liu, Zhaoxiang Ye, Cone-beam breast CT features associated with HER2/neu overexpression in patients with primary breast cancer, Eur Radiol. 2020 May;30(5):2731-2739.

Abstract:

Objectives

To identify the relationship between human epidermal growth factor receptor 2 (HER2) status and cone-beam breast CT (CBBCT) characteristics in surgically resected breast cancer.

Methods

Preoperative CBBCT of patients with BI-RADS 4 or 5 lesions identified on mammography or ultrasound and dense or very dense breast tissue were retrospectively evaluated in 181 surgically resected breast cancer (triple-negative excluded) between May 2012 and November 2014. A set of CBBCT descriptors was semiquantitatively assessed by consensus double reading. Reader reproducibility was analyzed. Multivariable logistic regression analysis using backward elimination (BEA) with the Wald criterion was performed to identify independent predictive factors of harboring HER2/neu. Principle component analysis (PCA) was used to determine characteristics that might differentiate HER2 status. Receiver operating characteristic (ROC) curve analyses were conducted to determine the predictive capability.

Results

HER2 positive was found in 101 (55.8%) of 181 patients. Inter-observer agreement was high for characteristics' assessment. Based on BEA, pathologic grade, maximum dimension, lobulation, ΔCT, and calcification morphology were confirmed as independent predictive factors of HER2/neu overexpression. PCA showed that calcification- and border-related characteristics were the most important for differentiation. ROC curve analyses showed that CBBCT features (AUC = 0.853) were superior to clinicopathologic features (AUC = 0.613, $p < 0.001$) and comparable with combination (AUC = 0.856, $p = 0.866$).

Conclusions

CBBCT features could be used to prognosticate HER2 status independently, which are potentially complementary to histopathologic result and helpful in guiding biopsy.

Link:

https://doi.org/10.1007/s00330-019-06587-w

PUB-2019-07

Wenxiang Cong, Hongming Shan, Xiaohua Zhang, Shaohua Liu, Ruola Ning, and Ge Wang, "Deep-learning-based breast CT for radiation dose reduction", Proc. SPIE 11113, Developments in X-Ray Tomography XII, 111131L (10 September 2019)

Abstract:

Cone-beam breast computed tomography (CT) provides true 3D breast images with isotropic resolution and high contrast information, detecting calcifications as small as a few hundred microns and revealing subtle tissue differences. However, breast is highly sensitive to x-ray radiation. It is critically important

for healthcare to reduce radiation dose. Few-view cone-beam CT only uses a fraction of x-ray projection data acquired by standard cone-beam breast CT, enabling significant reduction of the radiation dose. However, insufficient sampling data would cause severe streak artifacts in images reconstructed using conventional methods. We propose a deep-learning-based method for the image reconstruction to establish a residual neural network model, which is applied for few-view breast CT to produce high quality breast CT images. In this study, we respectively evaluate the breast image reconstruction from one third and one quarter of x-ray projection views of the standard cone-beam breast CT. Based on clinical breast imaging dataset, we perform a supervised learning to train the neural network from few-view CT images to corresponding full-view CT images. Experimental results show that the deep learning-based image reconstruction method allows few-view breast CT to achieve a radiation dose <6mGy per cone-beam CT scan which is a threshold set by FDA for mammographic screening.

Link:

https://doi.org/10.1117/12.2530234

PUB-2019-06

Haijie Li, Lu Yin, Ni He, Peng Han, Yueqiang Zhu, Yue Ma, Aidi Liu, Hong Lu, Zhipeng Gao, Peifang Liu, Yaopan Wu, Zhaoxiang Ye, "Comparison of comfort between cone beam breast computed tomography and digital mammography", European Journal of Radiology, Volume 120, 2019, 108674

Abstract:

Purpose

To compare the comfort levels of cone beam breast computed tomography (CBBCT) and digital mammography.

Materials and methods

On 409 patients, CBBCT was performed within 1 week after conventional mammography. Patients evaluated their comfort by using an 11-point numerical rating scale (NRS-11) after completing the two examinations. The lower the score was, the more comfortable the examination modality was. The data was divided into different groups according to CBBCT scan mode (non-contrast mode, contrast-enhanced mode), age (⩽44, 45~59 and ⩾60), body mass index (BMI) (<18.5 kg/m2, 18.5~23.9 kg/m2, 24~27.9 kg/m2 and ⩾28 kg/m2), and breast density (fatty-breast, dense-breast) to evaluate the performance of CBBCT comfort in different groups and to analyse the influencing factor of patient comfort. The paired rank sum test was used to compare the comfort between CBBCT and mammography.

Results

Overall, the comfort of CBBCT was better than mammography (P < 0.05). CBBCT was more comfortable than mammography in both non-contrast and contrast-enhanced groups (P < 0.05). CBBCT was more comfortable than mammography in the ⩽44, 45~59 age groups (P < 0.05). There was no significant difference in the ⩾60 age group (P = 0.5433). CBBCT was more comfortable than mammography in the BMI groups of 18.5~23.9 kg/m2, 24~27.9 kg/m2and ⩾28 kg/m2 (P < 0.05). There was no significant difference in the <18.5 kg/m2 group (P = 0.43). CBBCT was more comfortable than mammography in both the fatty-breast and dense-breast groups (P < 0.05).

Conclusion

The comfort of CBBCT was better than mammography.

Link:

https://doi.org/10.1016/j.ejrad.2019.108674

PUB-2019-05

Wienbeck S, Uhlig J, Fischer U, et al, "Breast lesion size assessment in mastectomy specimens: Correlation of cone-beam breast-CT, digital breast tomosynthesis and full-field digital mammography with histopathology", Medicine (Baltimore). 2019;98(37):e17082.

Abstract:

To compare the accuracy of breast lesion size measurement of cone-beam breast-CT (CBBCT), digital breast tomosynthesis (DBT) and full-field digital mammography (FFDM).

Patients scheduled for mastectomy due to at least 1 malignant breast lesion were included. Mastectomy specimens were examined by CBBCT, DBT, FFDM, and histopathology.

A total of 94 lesions (40 patients) were included. Histopathological analyses revealed 47 malignant, 6 high-risk, and 41 benign lesions. Mean histopathological lesion size was 20.8 mm (range 2–100). Mean absolute size deviation from histopathology was largest for FFDM (5.3±6.7 mm) and smallest for CBBCT 50 mA, high-resolution mode (4.3±6.7 mm). Differences between imaging modalities did not reach statistical significance (P=.85).

All imaging methods tend to overestimate breast lesion size compared to histopathological gold standard. No significant differences were found regarding size measurements, although in tendency CBBCT showed better lesion detection and cT classification over FFDM.

Link:

https://dx.doi.org/10.1097%2FMD.0000000000017082

PUB-2019-04

Yue Ma, Yang Cao, Aidi Liu, Lu Yin, Peng Han, Haijie Li, Xiaohua Zhang, Zhaoxiang Ye, "A Reliability Comparison of Cone-Beam Breast Computed Tomography and Mammography: Breast Density Assessment Referring to the Fifth Edition of the BI-RADS Atlas", Acad Radiol. 2019 Jun;26(6):752-759

Abstract:

Rationale and Objectives

To evaluate the reliability of cone-beam breast computed tomography (CBBCT) in visual assessment of breast density referring to the fifth edition of the Breast Imaging Reporting and Data System compared to digital mammography.

Materials and Methods

Breast density assessments of 130 female patients were performed by five radiologists referring to the fifth edition of Breast Imaging Reporting and Data System atlas both on two-view mammograms and CBBCT images. Assessments were repeated by three radiologists with different experience more than 1 month after the initial evaluation. The inter- and intrareader agreements were compared by using the Cohen's weighted Kappa statistic and intraclass correlation coefficient. Weighted Kappa statistic was also used to analyze the agreement between CBBCT images and mammograms. The influence of radiologist experience for breast density assessment was analyzed using a chi-square test.

Results

For CBBCT images, the inter-reader agreement was 0.781, whereas the agreement on mammograms was 0.744, both demonstrating moderate agreement. The level of intrareader reliability was higher on the CBBCT images than mammograms for breast density evaluation, 0.856 versus 0.786. Based on the majority report, the agreement between these two modalities was on substantial agreement degree. There was a statistically significant difference among radiologists with different levels of experience, and higher density categories were reported more often by experienced reader.

Conclusion

CBBCT showed equal aptitude and better agreement for the breast density evaluation compared to mammography. CBBCT could be an effective modality for breast density assessment and breast cancer risk evaluation in routine diagnosis and breast cancer screening.

Link:

https://doi.org/10.1016/j.acra.2018.07.023

PUB-2019-03

Uhlig, J., Fischer, U., Biggemann, L. et al, "Pre- and post-contrast versus post-contrast cone-beam breast CT: can we reduce radiation exposure while maintaining diagnostic accuracy?", Eur Radiol. 2019 Jun;29(6):3141-3148.

Abstract:

Objectives

To evaluate whether post-contrast cone-beam breast CT (CBBCT) alone is comparable to the current standard of combined pre- and post-contrast CBBCT regarding diagnostic accuracy and superior regarding radiation exposure.

Material and methods

This study included 49 women (61 breasts) with median age 57.9 years and BI-RADS 4/5 lesions diagnosed on mammography/ultrasound in density type c/d breasts. Two radiologists rated post-contrast CBBCT and pre- and post-contrast CBBCT with subtraction images on the BI-RADS scale separately for calculation of inter- and intra-observer agreement and in consensus for diagnostic accuracy assessment. Sensitivity, specificity, and area under the curve (AUC) were compared via McNemar test and DeLong method, respectively. Subtraction imaging misregistration were measured from 1 (no artifacts) to 4 (artifacts with width > 4 mm).

Results

A total of 100 lesion (51 malignant; 6 high risk; 43 benign) were included. AUC, sensitivity, and specificity showed no significant differences comparing post-contrast CBBCT alone versus pre- and post-contrast CBBCT (AUC 0.84 vs. 0.83, p = 0.643; sensitivity 0.89 vs. 0.85, p = 0.158; specificity 0.73 vs. 0.76, p = 0.655). Inter- and intra-observer agreement was excellent (intra-class correlation coefficient ICC = 0.76, ICC = 0.83, respectively). Radiation dose was significantly lower for post-contrast CBBCT alone versus pre- and post-contrast CBBCT (median average glandular radiation dose 5.9 mGy vs. 11.7 mGy, p < 0.001). High-degree misregistrations were evident in the majority of subtraction images (level 1/2/3/4 16.9%/27.1%/16.9%/39%), in particular for bilateral exams (3.2%/29.2%/8.3%/58.3%).

Conclusion

Diagnostic accuracy of post-contrast CBBCT alone is comparable to pre- and post-contrast CBBCT in type c/d breasts, while yielding a significant twofold radiation dose reduction.

Link:

https://doi.org/10.1007/s00330-018-5854-8

PUB-2019-02

Pavlova, T. V., A. Yu Vasil'ev, and O. O. Manuylova, "Method of Cone-Beam Breast Computed Tomography (Literature Review)", Radiology — practice, 1 (2019): 73.

Abstract:

The review of foreign literature devoted to the method of cone-beam computed tomography of mammary glands is presented, the experience of which is absent in the scientific works of domestic scientists. Analyzing the results of using this technique in diagnosing various changes in the mammary

glands (including cancer), we can confidently state that the cone-ray computer tomography has a huge diagnostic and differential-diagnostic potential.

Link:

http://www.radp.ru/eng/pdf/19-1-2.pdf

PUB-2019-01

Uhlig, J., Uhlig, A., Biggemann, L. et al, "Diagnostic accuracy of cone-beam breast computed tomography: a systematic review and diagnostic meta-analysis", Eur Radiol (2019) 29: 1194.

Abstract:

Purpose

To review the published evidence on cone-beam breast computed tomography (CBBCT) and summarize its diagnostic accuracy for breast lesion assessment.

Materials and Methods

A systematic literature search was conducted using the EMBASE, MEDLINE and CENTRAL libraries. Studies were included if reporting sensitivity and specificity for discrimination of benign and malignant breast lesions via breast CT. Sensitivity and specificity were jointly modeled using a bivariate approach calculating summary areas under the receiver-operating characteristics curve (AUC). All analyses were separately performed for non-contrast and contrast-enhanced CBBCT (NC-CBBCT, CE-CBBCT).

Results

A total of 362 studies were screened, of which 6 with 559 patients were included. All studies were conducted between 2015 and 2018 and evaluated female participants. Four of six studies included dense and very dense breasts with a high proportion of microcalcifications. For NC-CBBCT, pooled sensitivity was 0.789 (95% CI: 0.66–0.89) and pooled specificity was 0.697 (95% CI: 0.471–0.851), both showing considerable significant between-study heterogeneity (I2 = 89.4%, I2 = 94.7%, both $p < 0.001$). Partial AUC for NC-CBBCT was 0.817. For CE-CBBCT, pooled sensitivity was 0.899 (95% CI: 0.785–0.956) and pooled specificity was 0.788 (95% CI: 0.709–0.85), both exhibiting non-significant moderate between-study heterogeneity (I2 = 57.3%, $p = 0.0527$; I2 = 53.1%, $p = 0.0738$). Partial AUC for CE-CBBCT was 0.869.

Conclusion

The evidence available for CBBCT tends to show superior diagnostic performance for CE-CBBCT over NC-CBBCT regarding sensitivity, specificity and partial AUC. Diagnostic accuracy of CE-CBBCT was numerically comparable to that of breast MRI with meta-analyses reporting sensitivity of 0.9 and specificity of 0.72.

Link:

https://doi.org/10.1007/s00330-018-5711-9

PUB-2018-06

Liu, A., Ye, Z., Ma, Y., & Cao, Y, "Reliability of breast density estimation based on cone beam breast CT", Chinese Journal of Clinical Oncology, 45(5), 246-250

Abstract:

Objective:

To investigate the accuracy of a threshold-based segmentation method based on cone beam breast CT (CBBCT) images in breast density measurement, and its value for breast-type classification and breast cancer screening.

Methods:

A retrospective analysis of 195 patients who had undergone CBBCT examination at Tianjin Medical University Cancer Institute and Hospital between May 2012 and August 2014 was performed. A total of 64 breasts were analyzed. On the basis of the classification criteria for breast density in BI-RADS, they

were classified into four types and the majority report was reported. Breast density was measured by the threshold-based segmentation method based on CBBCT images and corrected manually to obtain the corrected breast density. A month later, the procedure was repeated. Intra-class correlation coefficients (ICCs) were used to compare the intra-observer and inter-observer consistencies of threshold-based segmentation and manually corrected breast density measurement results for non-dense and dense breasts. Results: For threshold-based segmentation measurements the intra-observer and inter-observer ICC values were 0.0.9624 (95% CI: 0.9388 ~0.9770) and 0.9666 (95% CI: 0.9500 ~0.9785). For manually corrected measurements, the intra-observer and inter-observer ICC values were 0.9750 (95% CI: 0.9592 ~ 0.9847) and 0.9775 (95% CI: 0.9661 ~0.9855). The ICC between the threshold-based segmentation method and manual correction was 0.9962 (95% CI: 0.9983 ~0.9977). The ICC values of threshold-based and manually corrected measurement in non-dense and dense breasts were 0.9497 (95% CI:0.7072-0.9914) and 0.9983 (95% CI: 0.9971-0.9990), respectively.

Conclusions:

The threshold-based segmentation method based on CBBCT is a reliable and accurate computer-aided method of measuring breast density. It is expected to be applied in large-scale screening of breast cancer and to provide more information for predicting the risk of breast cancer.

Link:

https://doi.org/10.3969/j.issn.1000-8179.2018.05.167

PUB-2018-05

Johannes Uhlig, Annemarie Uhlig, Meike Kunze, Tim Beissbarth, Uwe Fischer, Joachim Lotz, and Susanne Wienbeck, "Novel Breast Imaging and Machine Learning: Predicting Breast Lesion Malignancy at Cone-Beam CT Using Machine Learning Techniques", American Journal of Roentgenology 2018 211:2, W123-W131

Abstract:

OBJECTIVE.

The purpose of this study is to evaluate the diagnostic performance of machine learning techniques for malignancy prediction at breast cone-beam CT (CBCT) and to compare them to human readers.

SUBJECTS AND METHODS.

Five machine learning techniques, including random forests, back propagation neural networks (BPN), extreme learning machines, support vector machines, and K-nearest neighbors, were used to train diagnostic models on a clinical breast CBCT dataset with internal validation by repeated 10-fold cross-validation. Two independent blinded human readers with profound experience in breast imaging and breast CBCT analyzed the same CBCT dataset. Diagnostic performance was compared using AUC, sensitivity, and specificity.

RESULTS.

The clinical dataset comprised 35 patients (American College of Radiology density type C and D breasts) with 81 suspicious breast lesions examined with contrast-enhanced breast CBCT. Forty-five lesions were histopathologically proven to be malignant. Among the machine learning techniques, BPNs provided the best diagnostic performance, with AUC of 0.91, sensitivity of 0.85, and specificity of 0.82. The diagnostic performance of the human readers was AUC of 0.84, sensitivity of 0.89, and specificity of 0.72 for reader 1 and AUC of 0.72, sensitivity of 0.71, and specificity of 0.67 for reader 2. AUC was significantly higher for BPN when compared with both reader 1 ($p = 0.01$) and reader 2 ($p < 0.001$).

CONCLUSION.

Machine learning techniques provide a high and robust diagnostic performance in the prediction of malignancy in breast lesions identified at CBCT. BPNs showed the best diagnostic performance, surpassing human readers in terms of AUC and specificity.

Link:

https://doi.org/10.2214/AJR.17.19298

PUB-2018-04

Boss, A, "Editorial comment: cone-beam and phase contrast CT: new horizons in breast imaging?", Eur Radiol (2018) 28: 3729

Abstract:

This Editorial Comment refers to the articles "Contrast-enhanced cone-beam breast-CT (CBBCT): clinical performance compared to mammography and MRI" by Wienbeck S et al, Eur Radiol. 2018 Mar 28. doi: 10.1007/s00330-018-5376-4 and "Diagnosis of breast cancer based on microcalcifications using grating-based phase contrast CT" by Li X et al, Eur Radiol. 2018 Jan 26. doi: 10.1007/s00330-017-5158-4

Link:

https://doi.org/10.1007/s00330-018-5456-5

PUB-2018-03

Avice M. O'Connell, Andrew Karellas, Srinivasan Vedantham, Daniel T. Kawakyu-O'Connor, "Newer Technologies in Breast Cancer Imaging: Dedicated Cone-Beam Breast Computed Tomography", Seminars in Ultrasound, CT and MRI, Volume 39, Issue 1, 2018, Pages 106-113, ISSN 0887-2171

Abstract:

Dedicated breast computed tomography (CT) is the latest in a long history of breast imaging techniques dating back to the 1960s. Breast imaging is performed both for cancer screening as well as for diagnostic evaluation of symptomatic patients. Dedicated breast CT received US Food and Drug Administration approval for diagnostic use in 2015 and is slowly gaining recognition for its value in diagnostic 3-dimensional imaging of the breast, and also for injected contrast-enhanced imaging applications. Conventional mammography has known limitations in sensitivity and specificity, especially in dense breasts. Breast tomosynthesis was US Food and Drug Administration approved in 2011 and is now widely used. Dedicated breast CT is the next technological advance, combining real 3-dimensional imaging with the ease of contrast administration. The lack of painful compression and manipulation of the breasts also makes dedicated breast CT much more acceptable for the patients.

Link:

https://doi.org/10.1053/j.sult.2017.09.001

PUB-2018-02

Wienbeck, S., Fischer, U., Luftner-Nagel, S. et al, "Contrast-enhanced cone-beam breast-CT (CBBCT): clinical performance compared to mammography and MRI", Eur Radiol (2018) 28: 3731.

Abstract:

OBJECTIVES:

To evaluate the diagnostic accuracy of contrast-enhanced (CE) cone-beam breast computed tomography (CBBCT) in dense breast tissue and compare it to non-contrast (NC) CBBCT, mammography (MG) and magnetic resonance imaging (MRI).

METHODS:

This prospective institutional review board-approved study included 41 women (52 breasts) with American College of Radiology (ACR) density types c or d and Breast Imaging Reporting and Data System (BI-RADS) 4 or 5 assessments in MG or ultrasound (US). Imaging modalities were independently evaluated by two blinded readers.

RESULTS:

A total of 100 lesions (51 malignant, 6 high-risk, and 43 benign) were identified. For readers 1/2, respectively, and p values comparing CE-CBBCT to other modalities: diagnostic accuracy (AUC) for CE-CBBCT was 0.83/0.77, for MRI 0.88/0.89 (p = 0.2272/0.002), for NC-CBBCT 0.73/0.66 (p = 0.038/ 0.0186) and for MG 0.69/0.64 (p = 0.081/0.0207). CE-CBBCT sensitivity (0.88/0.78) was 37-39% higher in comparison to MG (0.49/0.41, p < 0.001 both) but inferior to MRI (0.98/0.96, p = 0.0253/0.0027). CE-CBBCT specificity (0.71/0.71) was numerically higher compared to MRI (0.61/0.69, p = 0.0956/0.7389).

CONCLUSIONS:

CBBCT diagnostic performance varied with the respective reader and experience. CE-CBBCT improved AUC and sensitivity in comparison to MG and NC-CBBCT, and was comparable to MRI in dense breast tissue. In tendency, specificity was higher for CE-CBBCT than MRI.

KEY POINTS:

• CE-CBBCT diagnostic accuracy (AUC) was comparable to MRI in dense breasts. • CE-CBBCT improved sensitivity and AUC in comparison to MG and NC-CBBCT. • CE-CBBCT has inferior sensitivity but higher specificity than MRI. • CE-CBBCT is a potential imaging alternative for patients with MRI contraindications.

Link:

https://doi.org/10.1007/s00330-018-5376-4

PUB-2018-01

Uhlig J, Fischer U, Surov A, Lotz J, Wienbeck S, "Contrast-enhanced cone-beam breast-CT: Analysis of optimal acquisition time for discrimination of breast lesion malignancy", Eur J Radiol. 2018 Feb;99:9-16

Abstract:

Objective

To investigate the optimal acquisition time of contrast-enhanced cone-beam breast-CT (CBBCT) for best discrimination of breast lesion malignancy and whether contrast enhancement can aid in classification of tumor histology.

Material and methods

The study included patients with BI-RADS 4 or 5 lesions identified on mammography and/or ultrasound. All patients were examined by non-contrast (NC-CBBCT) and contrast-enhanced CBBCT (CE-CBBCT) at 2 and 3 min after contrast media (CM) injection. Lesion enhancement of suspicious breast lesions was evaluated in corresponding CBBCT slices.

Results

A total of 31 patients with 57 breast lesions, 30 malignant and 27 benign, were included. Malignant breast lesions demonstrated higher contrast enhancement than benign breast lesions at both 2 min and 3 min CE-CBBCT (2 min: 48.17 vs. 0.3 HU, p < 0.001; 3 min: 57.38 vs. 15.43 HU, p < 0.001). Enhancement differences between malignant and benign breast lesions were largest at 2 min CE-CBBCT. Ductal carcinoma in situ (DCIS) showed highest mean contrast enhancement among malignant breast lesions (100.93 HU at 3 min CE-CBBCT, p = 0.0314) compared to invasive carcinoma of no special type with DCIS component (55.82 HU at 3 min CE-CBBCT) and invasive ductal carcinoma (52.31 HU at 3 min CE-CBBCT).

Conclusions

The contrast enhancement on CE-CBBCT best discriminates between malignant and benign breast lesions at 2 min after CM injection. The enhancement has the potential to differentiate histopathological subtypes, with highest enhancement among malignant lesions seen for DCIS.

Link:

http://www.ejradiology.com/article/S0720-048X(17)30517-X/fulltext

PUB-2017-06

Susanne Wienbeck, Joachim Lotz, Uwe Fischer, "Review of clinical studies and first clinical experiences with a commercially available cone-beam breast CT in Europe", Clinical Imaging, Volume 42, 2017, Pages 50-59, ISSN 0899-7071

Abstract:

The dedicated cone-beam breast computed tomography (CBBCT) is a new and promising imaging modality which provides isotropic, 3D images of the breast with high spatial and contrast resolution. Non-contrast and contrast-enhanced CBBCT (CE-CBBCT) was superior to mammography for the visualization of breast masses, especially in patients with dense breast tissue. CE-CBBCT accurately detects DCIS and distinguishes it from benign causes of microcalcifications when compared with non-contrast CBBCT and mammography.

The purpose of this report is to describe the technology and its possible indications, and to present the first results from recent clinical studies, illustrating these with our own image examples.

Link:

https://doi.org/10.1016/j.clinimag.2016.11.011

PUB-2017-05

Wienbeck, S., Uhlig, J., Luftner-Nagel, S. et al, "The role of cone-beam breast-CT for breast cancer detection relative to breast density", Eur Radiol (2017) 27: 5185

Abstract:

Objectives

To evaluate the impact of breast density on the diagnostic accuracy of non-contrast cone-beam breast computed tomography (CBBCT) in comparison to mammography for the detection of breast masses.

Methods

A retrospective study was conducted from August 2015 to July 2016. Fifty-nine patients (65 breasts, 112 lesions) with BI-RADS, 5th edition 4 or 5 assessment in mammography and/or ultrasound of the breast received an additional non-contrast CBBCT. Independent double blind reading by two radiologists was performed for mammography and CBBCT imaging. Sensitivity, specificity and AUC were compared between the modalities.

Results

Breast lesions were histologically examined in 85 of 112 lesions (76%). The overall sensitivity for CBBCT (reader 1: 91%, reader 2: 88%) was higher than in mammography (both: 68%, $p<0.001$), and also for the high-density group ($p<0.05$). The specificity and AUC was higher for mammography in comparison to CBBCT ($p<0.05$ and $p<0.001$). The interobserver agreement (ICC) between the readers was 90% (95% CI: 86-93%) for mammography and 87% (95% CI: 82-91%) for CBBCT.

Conclusions

Compared with two-view mammography, non-contrast CBBCT has higher sensitivity, lower specificity, and lower AUC for breast mass detection in both high and low density breasts..

Link:

https://doi.org/10.1007/s00330-017-4911-z

PUB-2017-04

Johannes Uhlig, Uwe Fischer, Eva von Fintel, Vera Stahnke, Christina Perske, Joachim Lotz, Susanne Wienbeck, "Contrast Enhancement on Cone-Beam Breast-CT for Discrimination of Breast Cancer Immunohistochemical Subtypes", Translational Oncology, Volume 10, Issue 6, December 2017, Pages 904-910

Abstract:

PURPOSE:

To evaluate whether contrast enhancement on cone-beam breast-CT (CBBCT) could aid in discrimination of breast cancer subtypes and receptor status.

METHODS:

This study included female patients age >40 years with malignant breast lesions identified on contrast-enhanced CBBCT. Contrast enhancement of malignant breast lesions was standardized to breast fat tissue contrast enhancement. All breast lesions were approved via image-guided biopsy or surgery. Immunohistochemical staining was conducted for expression of estrogen (ER), progesterone (PR), human epidermal growth factor receptor-2 (HER2) and Ki-67 index. Contrast enhancement of breast lesions was correlated with immunohistochemical breast cancer subtypes (Luminal A, Luminal B, HER2 positive, triple negative), receptor status and Ki-67 expression.

RESULTS:

Highest contrast enhancement was seen for Luminal A lesions (93.6 HU) compared to Luminal B lesions (47.6 HU, P = .002), HER2 positive lesions (83.5 HU, P = .359) and triple negative lesions (45.3 HU, P = .005). Contrast enhancement of HER2 positive lesions was higher than Luminal B lesions (P = .044) and triple negative lesions (P = .039). No significant difference was evident between Luminal B and triple negative lesions (P = .439). Lesions with high Ki-67 index showed lower contrast enhancement than those with low Ki-67 index (P = .0043). ER, PR and HER2 positive lesions demonstrated higher contrast enhancement than their receptor negative counterparts, although differences did not reach statistical significance (P = .1714; P = .3603; P = .2166).

CONCLUSIONS:

Contrast enhancement of malignant breast lesions on CBBCT correlates with immunohistochemical subtype and proliferative potential. Thereby, CBBCT might aid in selecting individualized treatment strategies for breast cancer patients based on pre-operative imaging.

Link:

https://www.sciencedirect.com/science/article/pii/S1936523317302954

PUB-2017-03

Susanne Wienbeck, Joachim Lotz and Uwe Fischer, "Feasibility of Vacuum-Assisted Breast Cone-Beam CT–Guided Biopsy and Comparison with Prone Stereotactic Biopsy", American Journal of Roentgenology. 2017;208: 1154-1162

Abstract:

OBJECTIVE

The feasibility of breast vacuum-assisted biopsy (VAB) guided by conebeam CT (CBCT) was assessed. The initial clinical performance of CT-guided breast VAB
was compared with that of established prone stereotactic VAB.

MATERIALS AND METHODS

In this retrospective clinical trial, VABs were performed for women with mammographically suspicious breast lesions using a dedicated breast

CBCT protocol. The technical success rate, total intervention time, and complications were documented and compared with examinations performed by prone stereotactic VAB.

RESULTS

Between June 2015 and March 2016, 65 patients with 68 target lesions underwent image-guided VAB. CT-guided VAB was performed for 29 patients with 31 lesions. Thirty-six patients with 37 lesions underwent prone stereotactic VAB. The type of lesion was not different between the two groups ($p = 0.135$). Technical success rate was achieved in 31 of 33 lesions (93.9%) with CT-guided VAB versus 37 of 38 lesions (97.4%) with prone stereotactic VAB. The mean (± SD) total intervention time was 22.7 ± 8.4 minutes for CT-guided VAB versus 28.8 ± 9.4 minutes for prone stereotactic VAB ($p < 0.05$). Reidentifying and targeting lesions took about the same time for both systems ($p = 0.362$). The time for tissue sampling was signifcantly faster with CT-guided VAB ($p < 0.05$). No major complications were observed with either system.

CONCLUSION

CT-guided VAB is safe and feasible using the currently available breast CBCT protocol. The mean total intervention time to complete VAB and the time for tissue sampling was signifcantly faster using CT-guided VAB in comparison with prone stereotactic VAB.

Link:

https://www.ajronline.org/doi/abs/10.2214/AJR.16.16760

PUB-2017-02

Susanne Wienbeck, MD; Uwe Fischer, MD; Christina Perske; Susanne Luftner-Nagel; Joachim Lotz, MD; Johannes Uhlig, "Contrast-enhanced Cone-beam Breast-CT (CBCT) vs Non-contrast CBCT, Mammography and MRI: Diagnostic Accuracy for Breast Cancer Detection in Dense Breast Tissue", RSNA 2017 SSA02-07

Abstract:

PURPOSE

To evaluate the diagnostic accuracy of contrast-enhanced cone-beam breast-CT (CE-CBCT) in dense breast tissue and compare it to non-contrast CBCT, mammography (MG) and magnet resonance imaging (MRI).

METHOD AND MATERIALS

In this prospective ethics-board approved study, 41 women (52 breasts, 100 lesions), median age of 57.9 years (IQR 48.9-64.9, range 41.6-78.6 years) with ACR density type c or d and BI-RADS 4 or 5 assessment in MG and/ or ultrasound were included. Based on amended ACR BI-RADS criteria, MG, non-contrast CBCT, CE-CBCT and MRI were independently evaluated by two blinded readers. The area under the receiver operating curve (AUC), sensitivity and specificity were compared between the different imaging modalities. All data were evaluated by means of descriptive statistics. ANOVA-type statistics were used for comparison.

RESULTS

Histological examination was performed on 63 breast lesions (6 benign, 6 high-risk, 51 malignant). Follow-up imaging was performed for 37 lesions. The AUCs for breast cancer diagnosis for reader 1 and 2 were: 0.79/ 0.69 (CE-CBCT), 0.78/ 0.76 (MRI), 0.70/ 0.62 (non-contrast CBCT) and both 0.69 (MG). CE-CBCT improved breast cancer diagnosis sensitivity by 30-37% in comparison to MG, and was comparable to MRI (MG: 0.84/ 0.93 vs. MRI: 0.70/ 0.86). Associated ANOVA-type statistics for differences in AUC and sensitivity across imaging modalities were $p=0.0443$ and $p<0.001$, respectively.

CONCLUSION

This study showed that CE-CBCT can accurately identify malignant breast lesions in a diagnostic setting. CE-CBCT improved lesion detection in comparison to MG and non-contrast CBCT and was comparable to MRI in density type c and d breasts.

CLINICAL RELEVANCE/APPLICATION

The results show that CE-CBCT is a promising new method that may be a suitable alternative to MRI in patients with contraindications to MRI or in regions with limited MRI availability.

Link:

https://rsna2017.rsna.org/program/index.cfm?PAGE=1

PUB-2017-01

Posy J Seifert, Renee C Morgan, David L Conover, Andrea L Arieno, "Initial Experience with a Cone-beam Breast Computed Tomography-guided Biopsy System", Journal of Clinical Imaging Science, Vol 7(1), 2017

Abstract:

Objective:

To evaluate our initial experience with a cone-beam breast computed tomography (BCT)-guided breast biopsy system for lesion retrieval in phantom studies for use with a cone-beam BCT imaging system.

Materials and Methods:

Under the Institutional Review Board approval, a phantom biopsy study was performed using a dedicated BCT-guided biopsy system. Fifteen biopsies were performed on each of the small, medium, and large anthropomorphic breast phantoms with both BCT and stereotactic guidance for comparison. Each set of the 45 phantoms contained masses and calcification clusters of varying sizes. Data included mass/calcium retrieval rate and dose and length of procedure time for phantom studies.

Results:

Phantom mass and calcium retrieval rate were 100% for BCT and stereotactic biopsy. BCT dose for small and medium breast phantoms was found to be equivalent to or less than the corresponding stereotactic approach. Stereotactic-guided biopsy dose was 34.2 and 62.5 mGy for small and medium breast phantoms, respectively. BCT-guided biopsy dose was 15.4 and 30.0 mGy for small and medium breast phantoms, respectively. Both computed tomography biopsy and stereotactic biopsy study time ranged from 10 to 20 min. Conclusion: Initial experience with a BCT-guided biopsy system has shown to be comparable to stereotactic biopsy in phantom studies with equivalent or decreased dose.

Link:

http://www.clinicalimagingscience.org/article.asp?issn=2156-7514;year=2017;volume=7;issue=1;spage=1;epage=1;aulast=Seifert;type=0

PUB-2016-01

Ni He, Yao-Pan Wu, Yanan Kong, Ning Lv, Zhi-Mei Huang, Sheng Li, Yue Wang, Zhi-jun Geng, Pei-Hong Wu, Wei-Dong Wei, "The utility of breast cone-beam computed tomography, ultrasound, and digital mammography for detecting malignant breast tumors: A prospective study with 212 patients", European Journal of Radiology, February 2016, Volume 85, Issue 2, Pages 392–403

Abstract:

Purpose

Breast cone-beam computed tomography (BCBCT) is a flat-panel detector (FPD)-based X-ray imaging system that provides high-quality images of the breast. The purpose of this study was to investigate the ability to detect breast abnormalities using non-contrast BCBCT and contrast-enhanced BCBCT (BCBCT and CE-BCBCT) compared to ultrasound (US) and digital mammography (MG).

Materials and methods

A prospective study was performed from May 2012 to August 2014. Ninety-two patients (172 lesions) underwent BCBCT alone, and 120 patients (270 lesions) underwent BCBCT and CE-BCBCT, all the patients underwent US and MG.

Results

Cancer diagnosis was confirmed pathologically in 102 patients (110 lesions). BCBCT identified 97 of 110 malignant lesions, whereas 93 malignant lesions were identified using MG and US. The areas under the receiver operating curves (AUCs) for breast cancer diagnosis were 0.861 (BCBCT), 0.856 (US), and 0.829 (MG). CE-BCBCT improved cancer diagnostic sensitivity by 20.3% (78.4–98.7%). The AUC values were 0.869 (CE-BCBCT), 0.846 (BCBCT), 0.834 (US), and 0.782 (MG).

Conclusion

In this preliminary study, BCBCT was found to accurately identify malignant breast lesions in a diagnostic setting. CE-BCBCT provided additional information and improved cancer diagnosis in style c or d breasts compared to the use of BCBCT, US, or MG alone.

Link:

http://www.ejradiology.com/article/S0720-048X(15)30172-8/fulltext

PUB-2015-02

Elodia B. Cole, Amy S. Campbell, Srinivasan Vedantham, Etta D. Pisano, Andrew Karellas, "Clinical Performance of Dedicated Breast Computed Tomography in Comparison to Diagnostic Digital Mammography", RSNA 2015 SSA01-09

Abstract:

PURPOSE

To compare the clinical performance of a three-dimensional dedicated breast computed tomography system requiring no breast compression alone (dBCT), dBCT as adjunct to two-dimensional standard view screening mammography (SM), and two-dimensional diagnostic mammography (DxM).

METHOD AND MATERIALS

Eighteen radiologists interpreted 235 cases (52 negative, 104 benign, 79 cancer; 93/235 calcifications) that were randomly selected from 478 cases enrolled under 3 different clinical trial protocols, all in diagnostic population. Each case consisted of unilateral SM, DxM and dBCT images. Each case was randomized to 3 sessions and interpreted under 3 conditions: dBCT alone, dBCT plus SM, and DxM alone with at least a 4-week washout period. Each interpretation included an overall BIRADS score and continuous probability of malignancy (POM) score. For each case, any identified lesions assigned BIRADS category 3 or greater had its location, type, BIRADS and POM reported. Sensitivity, specificity and area under the ROC curve (AUC) were determined with either pathology or 1-year follow-up as truth.

RESULTS

All reported performance metrics were averaged across all readers. Results are reported from analysis using BIRADS score after dichotomizing at BIRADS 4. The sensitivity for dBCT alone was 81.78%, 87.93% for dBCT plus SM, and 84.07% for DxM. dBCT plus SM had significantly higher sensitivity than DxM ($p=0.0081$), and dBCT alone ($p<0.0001$). DxM and dBCT alone did not differ in sensitivity ($p=0.1753$). The specificity for dBCT alone was 49.67%, 39.65% for dBCT plus SM, and 44.84% for DxM. Neither dBCT alone ($p=0.1148$) nor dBCT plus SM ($p=0.0745$) statistically differed from DxM. dBCT alone had a significantly higher specificity than dBCT plus SM ($p<0.0001$). The AUC based on BIRADS (POM) were 0.716 (0.770) for dBCT, 0.723 (0.791) for dBCT plus SM, and 0.724 (0.792) for DxM. There were no statistically significant differences between the modalities based on POM ($p=0.3311$) or BIRADS ($p=0.8569$) score analyses.

CONCLUSION

The most effective use of dBCT for diagnostic imaging is as adjunct to standard view mammography.

CLINICAL RELEVANCE/APPLICATION

Dedicated Breast Computed Tomography has potential for use as a diagnostic breast imaging tool.

Link:

https://rsna2015.rsna.org/program/details/?publicid=SSA01

PUB-2015-01

Zhao B, Zhang X, Cai W, Conover D, Ning R. Cone beam breast CT with multiplanar and three dimensional visualization in differentiating breast masses compared with mammography. Eur J Radiol. 2015 Jan;84(1):48-53.

Abstract:

Objective

This pilot study was to evaluate cone beam breast computed tomography (CBBCT) with multiplanar and three dimensional (3D) visualization in differentiating breast masses in comparison with two-view mammograms.

Methods

Sixty-five consecutive female patients (67 breasts) were scanned by CBBCT after conventional two-view mammography (Hologic, Motarget, compression factor 0.8). For CBBCT imaging, three hundred (1024 × 768 × 16 b) two-dimensional (2D) projection images were acquired by rotating the x-ray tube and a flat panel detector (FPD) 360 degree around one breast. Three-dimensional CBBCT images were reconstructed from the 2D projections. Visage CS 3.0 and Amira 5.2.2 were used to visualize reconstructed CBBCT images.

Results

Eighty-five breast masses in this study were evaluated and categorized under the breast imaging reporting and data system (BI-RADS) according to plain CBBCT images and two-view mammograms, respectively, prior to biopsy. BI-RADS category of each breast was compared with biopsy histopathology. The results showed that CBBCT with multiplanar and 3D visualization would be helpful to identify the margin and characteristics of breast masses. The category variance ratios for CBBCT under the BI-RADS were 23.5% for malignant tumors (MTs) and 27.3% for benign lesions in comparison with pathology, which were evidently closer to the histopathology results than those of two-view mammograms, p value <0.01. With the receiver operating characteristic (ROC) curve analysis, the area under the curve (AUC) of CBBCT was 0.911, larger than that (AUC 0.827) of two-view mammograms, p value <0.01.

Conclusion

CBBCT will be a distinctive noninvasive technology in differentiating and categorizing breast masses under BI-RADS. CBBCT may be considerably more effective to identify breast masses, especially some small, uncertain or multifocal masses than conventional two-view mammography.

Link:

http://www.ncbi.nlm.nih.gov/pubmed/25439008

PUB-2014-03

Avice M. O'Connell, Andrew Karellas, Srinivasan Vedantham, "The Potential Role of Dedicated 3D Breast CT as a Diagnostic Tool: Review and Early Clinical Examples", The Breast Journal, Volume 20, Issue 6, pages 592–605, November/December 2014

Abstract:

Mammography is the gold standard in routine screening for the detection of breast cancer in the general population. However, limitations in sensitivity, particularly in dense breasts, has motivated the development of alternative imaging techniques such as digital breast tomosynthesis, whole breast ultrasound, breast-specific gamma imaging, and more recently dedicated breast computed tomography or "breast CT". Virtually all diagnostic work-ups of asymptomatic nonpalpable findings arise from

screening mammography. In most cases, diagnostic mammography and ultrasound are sufficient for diagnosis, with magnetic resonance imaging (MRI) playing an occasional role. Digital breast tomosynthesis, a limited-angle tomographic technique, is increasingly being used for screening. Dedicated breast CT has full three-dimensional (3D) capability with near-isotropic resolution, which could potentially improve diagnostic accuracy. In current dedicated breast CT clinical prototypes, 300–500 low-dose projections are acquired in a circular trajectory around the breast using a flat panel detector, followed by image reconstruction to provide the 3D breast volume. The average glandular dose to the breast from breast CT can range from as little as a two-view screening mammogram to approximately that of a diagnostic mammography examination. Breast CT displays 3D images of the internal structures of the breast; therefore, evaluation of suspicious features like microcalcifications, masses, and asymmetries can be made in multiple anatomical planes from a single scan. The potential role of breast CT for diagnostic imaging is illustrated here through clinical examples such as imaging soft tissue abnormalities and microcalcifications. The potential for breast CT to serve as an imaging tool for extent of disease evaluation and for monitoring neo-adjuvant chemotherapy response is also illustrated.

Link:

http://onlinelibrary.wiley.com/doi/10.1111/tbj.12327/abstract

PUB-2014-02

Seifert P, Conover D, Zhang Y, Morgan R, Arieno A, Destounis S, Somerville P, Murphy PF. Evaluation of malignant breast lesions in the diagnostic setting with cone beam breast computed tomography (Breast CT): feasibility study.Breast J. 2014 Jul-Aug;20(4):364-74.

Abstract:

To investigate the feasibility of noncontrast and contrast-enhanced cone beam breast Computed Tomography (CT) in demonstrating malignant breast lesions in the diagnostic setting. This Institutional Review Board approved, Health Information Portability and Accountability Act compliant, prospective study enrolled BI-RADS four and five patients from 2008 to 2010. Eighty-seven subjects had noncontrast breast CT, 42 had contrast-enhanced breast CT (CE-breast CT) with 70 pathologically confirmed cancer diagnoses. All 70 comprise the study cohort for noncontrast breast CT, and 23 who had CE-breast CT comprise the cohort for CE-breast CT. All had diagnostic work-up. Patient age, breast density, lesion size and characteristics, biopsy method, and core pathology were recorded. A Fisher's exact test was used to detect a difference in detectability. For agreement in size measurement between the imaging modalities, a paired t-test was employed. Reported p-values were based on 2-sided tests. Two one-sided tests were calculated to determine equivalence within ±0.3 cm at a 90% significance level. Noncontrast breast CT identified 67 of 70 malignant lesions, detected by diagnostic work-up. CE-breast CT identified 23 of 23 index malignant lesions and in addition, found three malignant lesions in three cases not previously detected. Noncontrast breast CT demonstrated the index lesion in 67 of 70 cases and CE-breast CT demonstrated the index lesion in all 23 cases. An additional three new malignant lesions not seen with conventional diagnostic work-up were detected. In this preliminary study, breast CT with or without contrast was shown to be accurate at identifying malignant breast lesions in the diagnostic setting.

Link:

http://www.ncbi.nlm.nih.gov/pubmed/24934253

PUB-2014-01

Srinivasan Vedantham, Avice M O'Connell, Linxi Shi, Andrew Karellas, Alissa J Huston, and Kristin A Skinner, Dedicated Breast CT: Feasibility for Monitoring Neoadjuvant Chemotherapy Treatment, J Clin Imaging Sci. 2014; 4: 64.

Abstract:

OBJECTIVES:

In this prospective pilot study, the feasibility of non-contrast dedicated breast computed tomography (bCT) to determine primary tumor volume and monitor its changes during neoadjuvant chemotherapy (NAC) treatment was investigated.

MATERIALS AND METHODS:

Eleven women who underwent NAC were imaged with a clinical prototype dedicated bCT system at three time points - pre-, mid-, and post-treatment. The study radiologist marked the boundary of the primary tumor from which the tumor volume was quantified. An automated algorithm was developed to quantify the primary tumor volume for comparison with radiologist's segmentation. The correlation between pre-treatment tumor volumes from bCT and MRI, and the correlation and concordance in tumor size between post-treatment bCT and pathology were determined.

RESULTS:

Tumor volumes from automated and radiologist's segmentations were correlated (Pearson's $r = 0.935$, $P < 0.001$) and were not different over all time points [$P = 0.808$, repeated measures analysis of variance (ANOVA)]. Pre-treatment tumor volumes from MRI and bCT were correlated ($r = 0.905$, $P < 0.001$). Tumor size from post-treatment bCT was correlated with pathology ($r = 0.987$, $P = 0.002$) for invasive ductal carcinoma larger than 5 mm and the maximum difference in tumor size was 0.57 cm. The presence of biopsy clip (3 mm) limited the ability to accurately measure tumors smaller than 5 mm. All study participants were pathologically assessed to be responders, with three subjects experiencing complete pathologic response for invasive cancer and the reminder experiencing partial response. Compared to pre-treatment tumor volume, there was a statistically significant ($P = 0.0003$, paired t-test) reduction in tumor volume at mid-treatment observed with bCT, with an average tumor volume reduction of 47%.

CONCLUSIONS:

This pilot study suggests that dedicated non-contrast bCT has the potential to serve as an expedient imaging tool for monitoring tumor volume changes during NAC. Larger studies are needed in future.

Link:

http://www.ncbi.nlm.nih.gov/pubmed/25558431

PUB-2013-06

A. O'Connell, "First clinical results with breast cone beam CT", presented at EUSOBI Annual Scientific Meeting 2013, Rome, Italy

Abstract:

Multiple applications of Cone Beam Breast CT were studied, including diagnosis, image guided biopsy, neoadjuvant therapy monitoring. Extensive comparison between Cone Beam Breast CT and other breast imaging modalities was made. Clinical images from multiple cases were demostrated.

Link:

PUB-2013-05

Fang, A, Chan, S, O'Connell, A, Cone-beam Breast Computed Tomography: A Promising Modality for Assessing Tumor Response Following Neoadjuvant Treatment of Breast Cancer. Radiological Society of North America 2013 Scientific Assembly and Annual Meeting, December 1 - December 6, 2013 ,Chicago IL.

Abstract:

PURPOSE

Accurate imaging is important for patients diagnosed with locally advanced breast cancer for monitoring tumor size and guiding treatment decisions. Currently utilized standard imaging and clinical breast examinations are not always accurate. The purpose of this exhibit is to highlight non-contrast cone-beam breast computed tomography (CBBCT) as a promising modality for evaluating tumor response during and following neoadjuvant treatment of breast cancer.

CONTENT ORGANIZATION

1) Briefly describe the current clinical and standard imaging modalities that are used to assess tumor response in patients undergoing neoadjuvant treatment of breast cancer. 2) Review CBBCT and compare it with other imaging modalities such as mammography, ultrasound, and magnetic resonance imaging. 3) Illustrate the advantages of using CBBCT to assess changes in tumor response prior to, during and following neoadjuvant treatment of breast cancer through a variety of image rich cases.

SUMMARY

CBBCT imaging before, during and after neoadjuvant treatment of breast cancer can provide more accurate imaging than clinical evaluation, better imaging for follow up and for tumor localization and potentially improve surgical and radiation therapy outcomes.

Link:

http://archive.rsna.org/2013/13015076.html

PUB-2013-04

Seifert, P, Arieno, A, Morgan, R, Cone Beam Breast Computed Tomography's Ability to Detect Mammographically Occult Lesions. Radiological Society of North America 2013 Scientific Assembly and Annual Meeting, December 1 - December 6, 2013, Chicago IL

Abstract:

PURPOSE

To review lesions that were mammographically occult and imaged with cone beam breast Computed Tomography (CT) with or without contrast.

METHOD AND MATERIALS

From June 2008 to December 2012, 411 subjects were prospectively enrolled in 2 IRB approved studies; all had non contrast CT (NCCT) and 69 had contrast enhanced CT (CECT). 27 lesions in 25 subjects were considered to be mammographically occult at diagnostic work-up and are the basis of this study; all had NCCT and 18 also had CECT. Data recorded included subject demographics, method of detection, lesion characteristics, core biopsy pathology and open surgical pathology when applicable.

RESULTS

25 subjects with 27 lesions were determined to be mammographically occult but detected by diagnostic work-up; all were masses. Of the 27 lesions, 19 were detected by breast CT. Average lesion size at diagnostic work-up was 1.5cm (range 0.3 to 4cm). Average lesion size on breast CT was 1.4cm (range 0 .3 to 4.5cm). Overall, 10 lesions were biopsy-proven malignant; 9 invasive and 1 non-invasive. Sixteen lesions were biopsy-proven benign and 1 atypical. Eight lesions were mammographically occult and also CT occult, but found on ultrasound. One was biopsy proven invasive ductal carcinoma, one was atypical

and 6 were biopsy proven benign. 8 mammographically occult lesions were detected by CT only; 6 seen on both NCCT and CECT, 1 only on CECT and 1 only on NCCT (this subject did not have CECT). After additional work-up, 5 were biopsy proven invasive carcinomas and 3 were benign. Two of the 5 malignancies were seen and biopsied with MRI, 2 were seen on MRI, but went directly to surgery; the fifth malignancy, seen only on CT, proceeded to surgery for final diagnosis. The 3 benign findings were seen and biopsied with US.

CONCLUSION

In this small study, breast CT (NCT and CECT) showed value in detecting mammographically occult lesions. CT detected 19 lesions that were not detected by mammography and additionally was able to detect one new lesion not detected on any other imaging. Out of all cancers in this cohort, only one was not seen by CT. This study showed that CT has the potential to have high sensitivity for the detection of breast lesions.

CLINICAL RELEVANCE/APPLICATION

Breast CT is a new imaging technology that may have a role in the detection of breast disease. In this small study cohort, breast CT demonstrated the ability to detect mammographically occult lesions.

Link:

http://archive.rsna.org/2013/13014608.html

PUB-2013-03

Seifert, P, Morgan, R, Arieno, A, Initial Experience with a Breast Computed Tomography Guided Biopsy System (BCT-GBx) for Cone Beam Breast CT (CBBCT). Radiological Society of North America 2013 Scientific Assembly and Annual Meeting, December 1 - December 6, 2013 ,Chicago IL.

Abstract:

PURPOSE

To prove the efficacy of using a BCT guided breast biopsy bracket system for lesion retrieval in phantom and subject studies.

METHOD AND MATERIALS

Under IRB approval, 45 phantom biopsy studies were performed using the BCT-GBx bracket system. This consisted of small, medium, and large phantoms with 50%/50% glandular and adipose background composition. Each phantom contained 10 masses and 5 calcification clusters of varying sizes. All phantoms were biopsied under both BCT and stereotactic guidance following an imaging protocol. Post biopsy imaging was performed in all cases to confirm lesion retrieval. Dose comparison for phantom imaging was recorded for both modalities. After successful completion of phantom studies, 4 subjects consented to have breast lesions biopsied with the BCT-GBx bracket system. Subject data consisted of breast density, lesion characterizations, size, imaging-pathologic concordance and results of open surgical biopsy if performed.

RESULTS

Phantom mass and calcium retrieval was 100% for both BCT-GBx and stereotactic biopsy, evidenced by a specimen radiograph. Dose was found to be equivalent to or less than the standard stereotactic approach. Four subjects with masses; with an average size of 3.4 cm (range 2.3 to 4.8 cm), were successfully biopsied and had pathology results concordant with imaging.

CONCLUSION

Initial experience with BCT-GBx bracket system has shown to be equivalent to stereotactic biopsy in phantom studies with equivalent or decreased dose. Preliminary BCT subject biopsies show concordance to imaging.

CLINICAL RELEVANCE/APPLICATION

Breast CT is a new technology that may identify lesions not seen by other imaging modalities; CT guided breast biopsy may be necessary for diagnosis.

Link:

http://archive.rsna.org/2013/13044191.html

PUB-2013-02

Linxi Shi, Srinivasan Vedantham, Andrew Karellas, Avice M. O'Connell, Technical Note: Skin thickness measurements using high-resolution flat-panel cone-beam dedicated breast CT, Med. Phys. 40, 031913 (2013)

Abstract:

Purpose:

To determine the mean and range of location-averaged breast skin thickness using high-resolution dedicated breast CT for use in Monte Carlo-based estimation of normalized glandular dose coefficients.

Methods:

This study retrospectively analyzed image data from a clinical study investigating dedicated breast CT. An algorithm similar to that described byHuang et al. ["The effect of skin thickness determined using breast CT on mammographic dosimetry," Med. Phys.35(4), 1199–1206 (Year: 2008)10.1118/1.2841938] was used to determine the skin thickness in 137 dedicated breast CT volumes from 136 women. The location-averaged mean breast skin thickness for each breast was estimated and the study population mean and range were determined. Pathology results were available for 132 women, and were used to investigate if the distribution of location-averaged mean breast skin thickness varied with pathology. The effect of surface fitting to account for breast curvature was also studied.

Results:

The study mean (± interbreast SD) for breast skin thickness was 1.44 ± 0.25 mm (range: 0.87–2.34 mm), which was in excellent agreement with Huanget al. Based on pathology, pair-wise statistical analysis (Mann-Whitney test) indicated that at the 0.05 significance level, there were no significant difference in the location-averaged mean breast skin thickness distributions between the groups: benign vs malignant (p = 0.223), benign vs hyperplasia (p = 0.651), hyperplasia vs malignant (p = 0.229), and malignant vs nonmalignant (p = 0.172).

Conclusions:

Considering this study used a different clinical prototype system, and the study participants were from a different geographical location, the observed agreement between the two studies suggests that the choice of 1.45 mm thick skin layer comprising the epidermis and the dermis for breast dosimetry is appropriate. While some benign and malignant conditions could cause skin thickening, in this study cohort the location-averaged mean breast skin thickness distributions did not differ significantly with pathology. The study also underscored the importance of considering breast curvature in estimating breast skin thickness.

Link:

http://dx.doi.org/10.1118/1.4793257

PUB-2013-01

Vedantham S, Shi L, Karellas A, O'Connell AM, Conover DL. Personalized estimates of radiation dose from dedicated breast CT in a diagnostic population and comparison with diagnostic mammography.Phys Med Biol. 2013 Nov 21; 58(22):7921-36

Abstract:

This study retrospectively analyzed the mean glandular dose (MGD) to 133 breasts from 132 subjects, all women, who participated in a clinical trial evaluating dedicated breast CT in a diagnostic population. The clinical trial was conducted in adherence to a protocol approved by institutional review boards and the study participants provided written informed consent. Individual estimates of MGD to each breast from

dedicated breast CT was obtained by combining x-ray beam characteristics with estimates of breast dimensions and fibroglandular fraction from volumetric breast CT images, and using normalized glandular dose coefficients. For each study participant and for the breast corresponding to that imaged with breast CT, an estimate of the MGD from diagnostic mammography (including supplemental views) was obtained from the DICOM image headers for comparison. This estimate uses normalized glandular dose coefficients corresponding to a breast with 50% fibroglandular weight fraction. The median fibroglandular weight fraction for the study cohort determined from volumetric breast CT images was 15%. Hence, the MGD from diagnostic mammography was corrected to be representative of the study cohort. Individualized estimates of MGD from breast CT ranged from 5.7 to 27.8 mGy. Corresponding to the breasts imaged with breast CT, the MGD from diagnostic mammography ranged from 2.6 to 31.6 mGy. The mean (± inter-breast SD) and the median MGD (mGy) from dedicated breast CT exam were 13.9 ± 4.6 and 12.6, respectively. For the corresponding breasts, the mean (± inter-breast SD) and the median MGD (mGy) from diagnostic mammography were 12.4 ± 6.3 and 11.1, respectively. Statistical analysis indicated that at the 0.05 level, the distributions of MGD from dedicated breast CT and diagnostic mammography were significantly different (Wilcoxon signed ranks test, p = 0.007). While the interquartile range and the range (maximum-minimum) of MGD from dedicated breast CT was lower than diagnostic mammography, the median MGD from dedicated breast CT was approximately 13.5% higher than that from diagnostic mammography. The MGD for breast CT is based on a 1.45 mm skin layer and that for diagnostic mammography is based on a 4 mm skin layer; thus, favoring a lower estimate for MGD from diagnostic mammography. The median MGD from dedicated breast CT corresponds to the median MGD from four to five diagnostic mammography views. In comparison, for the same 133 breasts, the mean and the median number of views per breast during diagnostic mammography were 4.53 and 4, respectively. Paired analysis showed that there was approximately equal likelihood of receiving lower MGD from either breast CT or diagnostic mammography. Future work will investigate methods to reduce and optimize radiation dose from dedicated breast CT.

Link:

http://www.ncbi.nlm.nih.gov/pubmed/24165162

PUB-2012-04

S. Vedantham, L. Shi, A. Karellas, A. M. O'Connell, and D. Conover, "Dedicated Breast CT: Anatomic Power Spectrum," presented at the 2nd International Conference on Image Formation in X-ray Computed Tomography, Salt Lake City, UT, June 24-27, 2012

Abstract:

Dedicated breast CT is being actively investigated to overcome the tissue superposition problem present in mammography. Tissue superposition can result in missed cancers due to the masking effect of the anatomic background or can mimic the presence of a lesion resulting in additional imaging and potentially unnecessary biopsies. In this study, the anatomic power spectrum of coronal slices, parallel and adjacent to the chest wall was computed from 75 subjects, all women, who were scheduled to undergo tissue sampling (biopsy). The anatomic power spectrum at low spatial frequencies was observed to follow a power-law dependence of the form k/fβ, where the value of the exponent β was found to be 1.581. The standard error in estimate of β was 0.163.

Link:

http://m1.koningcorporation.com/Literature/Vedantham_CTMeeting_Paper_June20_2012.pdf

PUB-2012-03

Vedantham S, Shi L, Karellas A, O'Connell AM. Dedicated breast CT: Fibroglandular Volume Measurements in A Diagnostic Population, Med Phys.; 39(12):7317-28

Abstract:

PURPOSE:

To determine the mean and range of volumetric glandular fraction (VGF) of the breast in a diagnostic population using a high-resolution flat-panel cone-beam dedicated breast CT system. This information is important for Monte Carlo-based estimation of normalized glandular dose coefficients and for investigating the dependence of VGF on breast dimensions, race, and pathology.

METHODS:

Image data from a clinical trial investigating the role of dedicated breast CT that enrolled 150 women were retrospectively analyzed to determine the VGF. The study was conducted in adherence to a protocol approved by the institutional human subjects review boards and written informed consent was obtained from all study participants. All participants in the study were assigned BI-RADS(®) 4 or 5 as per the American College of Radiology assessment categories after standard diagnostic work-up and underwent dedicated breast CT exam prior to biopsy. A Gaussian-kernel based fuzzy c-means algorithm was used to partition the breast CT images into adipose and fibroglandular tissue after segmenting the skin. Upon determination of the accuracy of the algorithm with a phantom, it was applied to 137 breast CT volumes from 136 women. VGF was determined for each breast and the mean and range were determined. Pathology results with classification as benign, malignant, and hyperplasia were available for 132 women, and were used to investigate if the distributions of VGF varied with pathology.

RESULTS:

The algorithm was accurate to within ±1.9% in determining the volume of an irregular shaped phantom. The study mean (± inter-breast SD) for the VGF was 0.172 ± 0.142 (range: 0.012-0.719). VGF was found to be negatively correlated with age, breast dimensions (chest-wall to nipple length, pectoralis to nipple length, and effective diameter at chest-wall), and total breast volume, and positively correlated with fibroglandular volume. Based on pathology, pairwise statistical analysis (Mann-Whitney test) indicated that at the 0.05 significance level, there was no significant difference in distributions of VGF without adjustment for age between malignant and nonmalignant breasts ($p = 0.41$). Pairwise comparisons of the distributions of VGF in increasing order of mammographic breast density indicated all comparisons were statistically significant ($p < 0.002$).

CONCLUSIONS:

This study used a different clinical prototype breast CT system than that in previous studies to image subjects from a different geographical region, and used a different algorithm for analysis of image data. The mean VGF estimated from this study is within the range reported in previous studies, indicating that the choice of 50% glandular weight fraction to represent an average breast for Monte Carlo-based estimation of normalized glandular dose coefficients in mammography needs revising. In the study, the distributions of VGF did not differ significantly with pathology.

Link:

http://www.ncbi.nlm.nih.gov/pubmed/23231281

PUB-2012-02

O'Connell AM, Kawakyu-O'Connor D. "Dedicated Cone-beam Breast Computed Tomography and Diagnostic Mammography: Comparison of Radiation Dose, Patient Comfort, And Qualitative Review of Imaging Findings in BI-RADS 4 and 5 Lesions", J Clin Imaging Sci. 2012;2:7.

Abstract:

OBJECTIVE:

This pilot study was undertaken to compare radiation dose, relative visibility/conspicuity of biopsy-proven lesions, and relative patient comfort in diagnostic mammography and dedicated cone-beam breast computed tomography (CBBCT) in Breast Imaging-Reporting and Data System (BI-RADS)(®) 4 or 5 lesions.

MATERIALS AND METHODS:

Thirty-six consecutive patients (37 breasts) with abnormal mammographic and/or ultrasound categorized as BI-RADS(®) 4 or 5 lesions were evaluated with CBBCT prior to biopsy. Administered radiation dose was calculated for each modality. Mammograms and CBBCT images were compared side-by-side and lesion visibility/conspicuity was qualitatively scored. Histopathology of lesions was reviewed. Patients were administered a survey for qualitative evaluation of comfort between the two modalities.

RESULTS:

CBBCT dose was similar to or less than diagnostic mammography, with a mean dose of 9.4 mGy (±3.1 SD) for CBBCT vs. 16.9 mGy (±6.9 SD) for diagnostic mammography in a total of 37 imaged breasts (P<0.001). Thirty-three of 34 mammographic lesions were scored as equally or better visualized in CBBCT relative to diagnostic mammography. Characterization of high-risk lesions was excellent. Patients reported greater comfort in CBBCT imaging relative to mammography.

CONCLUSION:

Our experience of side-by-side comparison of CBBCT and diagnostic mammography in BI-RADS(®) 4 and 5 breast lesions demonstrated a high degree of correlation between the two modalities across a variety of lesion types. Owing to favorable radiation dose profile, excellent visualization of lesions, and qualitative benefits including improved patient comfort, excellent field-of-view, and more anatomical evaluation of lesion margins, CBBCT offers a promising modality for diagnostic evaluation of breast lesions.

Link:

http://www.ncbi.nlm.nih.gov/pubmed/22439131

PUB-2012-01

Avice M. O'Connell, The Evolution and Future of Dedicated Breast CT, Breast Diseases A Year Book Quarterly 01/2012; 23(2):131-133.

Abstract:

Breast computed tomography (CT) is not a new idea, but perhaps now its time has come. Recently, there has been renewed interest in this modality for a number of reasons. One reason is that 3-dimensional (3D) imaging of the breast has become the subject of great interest since the arrival on the scene of digital breast tomosynthesis (DBT), which allows for 3D reconstruction of tomographic images obtained as an extension of digital mammography. DBT was approved by the U.S. Food and Drug Administration (FDA) in February 2011 and is now being introduced into many centers in the United States as well as in Europe and Canada.

Link:

http://www.breastdiseasesquarterly.com/article/S1043-321X%2812%2900133-6/abstract

PUB-2011-02

J. Duda, R. Shaw, and A. O'Connell, "Current and Future Imaging of Breast Implant Complications," presented at the Association of University Radiologists 59th Annual Meeting, Boston, MA, 2011

Abstract:

A review of the basic structure of silicone and saline breast implants is provided, as well as subsequent physiologic postimplantation changes, including capsule formation. Cases featuring normal findings and

imaging signs of intra- and extracapsular rupture are presented, with an emphasis on MRI, and are correlated with similar findings on cone-beam CT. A series of cases is presented illustrating complications of breast implants. Findings and their relevance to management by the referring surgeon are emphasized.

Link:

http://m1.koningcorporation.com/Literature/Duda_AUR_Poster_Apr12_2011.pdf

PUB-2011-01

Yang X, Sechopoulos I, Fei B. Automatic Tissue Classification for High-resolution Breast CT Images Based on Bilateral Filtering, Proc SPIE Int Soc Opt Eng. 2011 Mar 14;7962:79623H.

Abstract:

Breast tissue classification can provide quantitative measurements of breast composition, density and tissue distribution for diagnosis and identification of high-risk patients. In this study, we present an automatic classification method to classify high-resolution dedicated breast CT images. The breast is classified into skin, fat and glandular tissue. First, we use a multiscale bilateral filter to reduce noise and at the same time keep edges on the images. As skin and glandular tissue have similar CT values in breast CT images, we use morphologic operations to get the mask of the skin based on information of its position. Second, we use a modified fuzzy C-mean classification method twice, one for the skin and the other for the fatty and glandular tissue. We compared our classified results with manually segmentation results and used Dice overlap ratios to evaluate our classification method. We also tested our method using added noise in the images. The overlap ratios for glandular tissue were above 94. 7% for data from five patients. Evaluation results showed that our method is robust and accurate.

Link:

http://www.ncbi.nlm.nih.gov/pubmed/24027608

PUB-2010-01

O'Connell A, Conover DL, Zhang Y, Seifert P, Logan-Young W, Lin CF, Sahler L, Ning R, "Cone-beam CT for breast imaging: Radiation dose, breast coverage, and image quality", AJR Am J Roentgenol. 2010 Aug;195(2):496-509

Abstract:

OBJECTIVE:

The primary objectives of this pilot study were to evaluate the radiation dose, breast coverage, and image quality of cone-beam breast CT compared with a conventional mammographic examination. Image quality analysis was focused on the concordance of cone-beam breast CT with conventional mammography in terms of mammographic findings.

SUBJECTS AND METHODS:

This prospective study was performed from July 2006 through August 2008. Twenty-three women were enrolled who met the inclusion criteria, which were age 40 years or older with final BI-RADS assessment category 1 or 2 lesions on conventional mammograms within the previous 6 months. The breasts were imaged with a flat-panel detector-based cone-beam CT system, and the images were reviewed with a 3D visualization system. Cone-beam breast CT image data sets and the corresponding mammograms were reviewed by three qualified mammographers. The parameters assessed and compared in this pilot study were radiation dose, breast tissue coverage, and image quality, including detectability of masses and calcifications. The mammograms and cone-beam breast CT images were independently reviewed side by side, and the reviewers were not blinded to the other technique. The observed agreement and Cohen's kappa were used to evaluate agreement between the mammographic and cone-beam breast CT findings

and interobserver agreement. Each subject responded to a questionnaire on multiple parameters, including comfort of the cone-beam breast CT examination compared with mammography.

RESULTS:

For a conventional mammographic examination, the average glandular radiation dose ranged from 2.2 to 15 mGy (mean, 6.5 [SD, 2.9] mGy). For cone-beam breast CT, the average glandular dose ranged from 4 to 12.8 mGy (mean, 8.2 [SD, 1.4] mGy). The average glandular dose from cone-beam breast CT was generally within the range of that from conventional mammography. For heterogeneously dense and extremely dense breasts, the difference between the mean dose of conventional mammography and that of cone-beam breast CT was not statistically significant (7.0 vs 8.1 mGy, p = 0.06). Breast tissue coverage was statistically significantly better with cone-beam breast CT than with mammography in the lateral (p < 0.0001), medial (p < 0.0001), and posterior (p = 0.0002) aspects. Mammography had statistically significantly better coverage than cone-beam breast CT in the axilla and axillary tail (p < 0.0001). Overall, most calcifications and all masses detected with mammography were also detected with cone-beam breast CT. The interobserver agreement on cone-beam breast CT was 83.7% in the detectability of imaging findings. The overall interobserver agreement on type of findings, size of findings (<1, 1-4.99, and > or = 5 mm), and location of findings was 77.2%, 84.8%, and 78.3%, respectively.

CONCLUSION:

The results of this study show that cone-beam breast CT can be used to image the entire breast from chest wall to nipple with sufficient spatial and contrast resolution for detection of masses and calcifications at a radiation dose within the range of that of conventional mammography.

Link:

http://www.ncbi.nlm.nih.gov/pubmed/20651210

PUB-2009-01

Avice M. O'Connell, David L. Conover, Chuen-Fu Linda Lin, "Cone-Beam Computed Tomography for Breast Imaging", Journal of Radiology Nursing, March 2009, Volume 28, Issue 1, Pages 3–11

Abstract:

This article reviews the many modalities used today in the screening and diagnostic work-up of breast cancer, the second most common cause of cancer (after skin cancer) and the second most common cause of cancer death (after lung cancer) in women in the United States today.

Newer technologies in breast imaging are also described, in particular the Cone Beam Computed Tomography (CBCT) as developed at the University of Rochester Medical Center. CBCT is a three-dimensional imaging modality which has potential in the screening and diagnostic work-up of women who may have breast cancer. Pilot studies show good coverage of the breast with adequate visualization of parenchymal detail and acceptable radiation dose in comparison with the gold standard of mammography

Link:

http://www.radiologynursing.org/article/S1546-0843%2808%2900172-7/abstract

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