Automated Assessment of Breast Positioning and Image Quality in Digital Breast Tomosynthesis (DBT) Screening

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Background

Importance of Accurate Breast Positioning and Image Quality in DBT

- Digital Breast Tomosynthesis (DBT) is an important imaging technique used for breast cancer detection, relying on precise breast positioning and high-quality images.
- DBT image quality control involves equipment, operating technologists, radiologists and other links, and it is necessary to establish a set of perfect quality management system, standardize the examination process and evaluation criteria.
- Quality control of mammography images also helps to protect the health of patients and staff, reduces the risk of radiation exposure due to repeated imaging, reduces cost and resource, and improves work efficiency and satisfaction.

Purpose of the Study

To investigate the feasibility of an AI system in assessing breast positioning and image quality in DBT using synthetically reconstructed projection images.

To evaluate the accuracy of an AI-based tool for automated assessment of breast positioning and image quality in DBT.

To compare the AI system's performance with the assessments of radiographers.

Methods

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- A total of 150 mammography examinations were included, consisting of screening mammography with DBT and 2D-SM images.

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- Two radiographers and an AI system assessed the breast positioning and image quality.

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Image Quality Criteria:

- Appearance of the nipple
- Breast rotation
- Pectoral muscle
- Inframammary fold
- Pectoral nipple line
- Shoulder overlap shadow
- Abdominal skin
- Contralateral breast
- Foreign body

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Data Analysis:

- Accuracy, sensitivity, specificity, and Cohen's kappa coefficient were used to assess the performance and agreement between the AI system and human radiographers.

Results - Image Quality Assessment

Overall Accuracy

The AI algorithm demonstrated high accuracy in distinguishing between adequate and inadequate images, with an overall accuracy of 93% for FFDM and 92% for DBT with 2D-SM.

Sensitivity and Specificity

The AI system showed sensitivity of 94% and specificity of 92% for FFDM, and sensitivity of 95% and specificity of 91% for DBT with 2D-SM.

Image Quality

The AI system successfully predicted poor imaging quality based on incomplete gland, incomplete pectoralis muscle, and over or insufficient exposure.

Results - Breast Positioning Assessment

Overall Accuracy

The AI system showed sensitivity of 94% and specificity of 92% for FFDM, and sensitivity of 95% and specificity of 91% for DBT with 2D-SM.

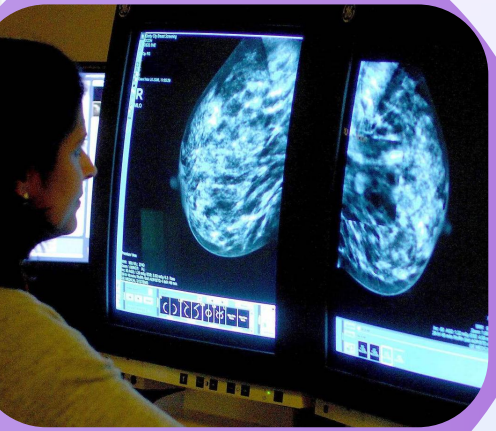
AUC Analysis

The AUC values for poor imaging quality prediction by the AI system were 0.903 for incomplete gland, 0.937 for incomplete pectoralis muscle, and 0.982 for over or insufficient exposure.

Inter-Observer Agreement

The inter-observer agreement between radiologists and the AI system using 2D-SM images was substantial, with a kappa coefficient of 0.82.

Discussion - Comparison and Performance



Agreement between Automated and Manual Assessments:

The results showed a high degree of agreement between the automated and manual assessments, indicating the performance of the AI tool in assessing breast positioning and image quality in DBT.

Comparison with FFDM:

The AI system's performance in DBT using 2D-SM images was comparable to that in FFDM.

Synthetic Projection Images:

The use of synthetic projection images proved to be a reliable option for the automated assessment of breast positioning and image quality in DBT screening. Caution should be noted in the interpretation of the diagnostic accuracy of DBT images obtained using synthetic projection images.

Future directions

Image Denoising

This direction aims to utilize artificial intelligence models to perform automatic noise removal from DBT images to improve the signal-to-noise ratio and detail performance of the images.

Image De-Artifacting

This direction aims to automate the removal of artifacts from DBT images using artificial intelligence models to improve the fidelity and accuracy of the images.

Image Enhancement

This direction aims to enhance low-quality or low-contrast mammography images using artificial intelligence models to improve the clarity and readability of the images

Image Alignment

This direction aims to improve the robustness and flexibility of alignment by utilizing artificial intelligence models to achieve alignment and matching between mammogram images at different time points or from different viewpoints.

THANKS