Optimal beam quality selection based on contrast-to-noise ratio and mean glandular dose in digital mammography

Type: Article

Abstract:

The performance of a digital mammography system (Siemens Mammomat Novation) using different target/filter combinations and tube voltage has been assessed. The objective of this study is to optimize beam quality selection based on contrast-to-noise ratio (CNR) and mean glandular dose (MGD). Three composition of breast were studied with composition of glandular/adipose of 30/70, 50/50, and 70/30. CNR was measured using 2, 4 and 6 cm-thick simulated breast phantoms with an aluminium sheet of 0.1 mm thickness placed on top of the phantom. Three target/filter combinations, namely molybdenum/molybdenum (Mo/Mo), molybdenum/rhodium (Mo/Rh) and tungsten/rhodium (W/Rh) with various tube voltage and mAs were tested. MGD was measured for each exposure. For 50/50 breast composition, Mo/Rh combination with tube voltage 26 kVp is optimal for 2 cm-thick breast. W/Rh combination with tube voltage 27 and 28 kVp are optimal for 4 and 6 cm-thick breast, respectively. For both 30/70 and 70/30 breast composition, W/Rh combination is optimal with tube voltage 25, 26 and 27 kVp, respectively. From our study it was shown that there are potential of dose reduction up to 11% for a set CNR of 3.0 by using beam quality other than that are determined by AEC selection. Under the constraint of lowest MGD, for a particular breast composition, calcification detection is optimized by using a softer X-ray beam for thin breast and harder X-ray beam for thick breast. These experimental results also indicate that for breast with high fibroglandular tissues (70/30), the use of higher beam quality does not always increase calcification detection due to additional structured noise caused by the fibroglandular tissues itself.

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