

Contrast-to-Noise Ratio Comparison of Different Calcification Types in Dual Energy Breast Imaging

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Abstract : Various substitute materials of calcifications are used in phantom measurements and simulation studies in mammography. These include calcium carbonate, calcium oxalate, hydroxyapatite and aluminum. The aim of this study is to compare the contrast-to-noise ratio (CNR) values of the different calcification types using the dual energy method. The constructed calcification phantom consisted of three different calcification types and thicknesses: hydroxyapatite, calcite and calcium oxalate of 100, 200, 300 thicknesses. The breast tissue equivalent materials were polyethylene and polymethyl methacrylate slabs simulating adipose tissue and glandular tissue, respectively. The total thickness was 4.2 cm with 50% fixed glandularity. The low- (LE) and high-energy (HE) images were obtained from a tungsten anode using 40 kV filtered with 0.1 mm cadmium and 70 kV filtered with 1 mm copper, respectively. A high resolution complementary metal-oxide-semiconductor (CMOS) active pixel sensor (APS) X-ray detector was used. The total mean glandular dose (MGD) and entrance surface dose (ESD) from the LE and HE images were constrained to typical levels (MGD=1.62 mGy and ESD=1.92 mGy). On average, the CNR of hydroxyapatite calcifications was 1.4 times that of calcite calcifications and 2.5 times that of calcium oxalate calcifications. The higher CNR values of hydroxyapatite are attributed to its attenuation properties compared to the other calcification materials, leading to higher contrast in the dual energy image. This work was supported by Grant E.040 from the Research Committee of the University of Patras (Programme K. Karatheodori).

Keywords : calcification materials, CNR, dual energy, X-rays

Conference Title : ICRPPD 2017 : International Conference on Radiological Physics and Radiation Dosimetry

Conference Location : London, United Kingdom

Conference Dates : May 25-26, 2017