Effect of radiation dose on pulmonary nodule size measurements in chest tomosynthesis

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Objective: For chest tomosynthesis, a general reduction of the standard radiation dose may be considered for implementation in clinical praxis due to that previous studies have shown remained levels of detection of pulmonary nodules at lower radiation doses. If, at the same time, chest tomosynthesis is to be considered for use in pulmonary nodule follow up, it is important to investigate the effect of a reduced radiation dose on nodule size assessment. The aim of the present study was to investigate the dependency of the accuracy and precision of nodule diameter measurements on the radiation dose level in chest tomosynthesis.

Methods: Artificial ellipsoid shaped nodules with known dimensions were created and inserted in clinical chest tomosynthesis. The volume of the nodules corresponded to that of a sphere with a diameter of 4, 8 or 12 mm. Each size group included 27 nodules. Noise was added to the images in order to simulate different examination doses using a previously described method. Four thoracic radiologists were given the task of measuring the longest diameter of the nodules. The study was restricted to nodules located in areas of the tomosynthesis images not noticeably affected by high density structures such as the heart or diaphragm since measurements on nodules in these areas have been shown to suffer from low accuracy.

Results: The measurement accuracy, in terms of mean measurement error, as well as the intraobserver variability, showed little or no dependency on radiation dose level. There was as a tendency of increasing interobserver variability with decreasing radiation dose level for the smallest nodules. Of the smallest nodules, the observers found 6 – 11 of the nodules nonmeasurable due to poor visibility at the standard dose level. This number increased slightly with decreasing radiation dose level.

Conclusion: A dose reduction in chest tomosynthesis may be possible without significantly affecting the accuracy and precision of nodule diameter measurements. The increasing number of nonmeasurable nodules with decreasing radiation dose for small nodules may raise some concerns regarding an applied general dose reduction in the clinical praxis for chest tomosynthesis examinations, although small nodules are of less clinical importance.