

Preparing a Library of Abnormal Masses for Designing a Long-Lasting Anatomical Breast Phantom for Ultrasonography Training

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Abstract : The ultrasonography method is actively used for the early diagnosis of various lesions in the human body, including the mammary gland. The incidence of breast cancer has increased by more than 20%, and mortality by 14% since 2008. The correctness of the diagnosis often directly depends on the qualifications and experience of a diagnostic medical sonographer. That is why special attention should be paid to the practical training of future specialists. Anatomical phantoms are excellent teaching tools because they accurately imitate the characteristics of real human tissues and organs. The purpose of this work is to create a breast phantom for practicing ultrasound diagnostic skills in grayscale and elastography imaging, as well as ultrasound-guided biopsy sampling. We used silicone-like compounds ranging from 3 to 17 on the Shore scale hardness units to simulate soft tissue and lesions. Impurities with experimentally selected concentrations were added to give the phantom the necessary attenuation and reflection parameters. We used 3D modeling programs and 3D printing with PLA plastic to create the casting mold. We developed a breast phantom with inclusions of varying shape, elasticity and echogenicity. After testing the created phantom in B-mode and elastography mode, we performed a survey asking 19 participants how realistic the sonograms of the phantom were. The results showed that the closest to real was the model of the cyst with 9.5 on the 0-10 similarity scale. Thus, the developed breast phantom can be used for ultrasonography, elastography, and ultrasound-guided biopsy training.

Keywords : breast ultrasound, mammary gland, mammography, training phantom, tissue-mimicking materials

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