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Development of a Tissue Equivalent Gelatine Phantom for Accuracy Verification of Tissue Elasticity Measurement Using Shear Wave Elastography Ultrasound

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RESEARCH

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ABSTRACT

Background

Shear Wave Elastography ultrasound (SWE) has been increasingly used in the recent decade to quantify tissue stiffness and viscoelastic properties correlate to a disease condition.

Aims

This study aimed to develop a low cost and reproducible gelatine phantom to verify the accuracy of tissue elasticity measurement using (SWE). The effect of lesion's size, stiffness and depth from the surface on the tissue elasticity measurement was also investigated.

Methods

A breast tissue-equivalent phantom embedded with spherical inclusions of different sizes, stiffness and depth from surface was constructed using gelatin. The elasticity of the spherical inclusions was determined using a commercial SWE system and compared to the elasticity determined using a high precision electromechanical the offset from the SWE measurement and to account for these differences.

Results

Statistically significant difference ($p<0.05$) was found between the elasticity measured using SWE and electromechanical microtester, whereby the SWE overestimated the tissue elasticity by a mean value of 22.8 ± 15.0 kPa. The size and depth of the spherical inclusions have not imposed any effect on the elasticity measured by SWE, but the depth of shear wave detection was found limited to 8 cm from the surface.

Conclusion

The gelatine phantom constructed in this study could be used to verify the accuracy of the elasticity measured using SWE. The tissue elasticity measured by the SWE appeared to be overestimated compared to the gold standard. Further research would need to be carried out to determine the offset from the SWE measurement and to account for these differences.

Key Words

Shear wave elastography, Ultrasound, Tissue elasticity, Tissue-equivalent phantom, Instron

What this study adds:

A breast tissue-equivalent phantom was developed to verify accuracy of tissue elasticity measurement using SWE.

SWE overestimated tissue elasticity by 22.8 ± 15.0 kPa compared to the standard electromechanical microtester.

Size and depth of lesions did not affect elasticity values, but the depth of shear wave detection was limited to 8 cm from the surface.

1. What is known about this subject?

SWE is a relatively new transient elastography technique using a real-time, non-invasive and reproducible method to map tissue stiffness.

2. What new information is offered in this study?