Performance assessment of a shear wave elastography imaging system using the Leicester (Elastography) Pipe Phantom.

Background:

The imaging performance of conventional greyscale ultrasound scanners can be assessed by test objects and phantoms such as The Edinburgh Pipe Phantom. The purpose of this study was first, to develop a new test phantom to assess the performance of emerging elastography imaging modalities, and second to demonstrate its application by assessment of a shear wave elastography imaging system.

Methods:

Analogous to The  Edinburgh (B-mode) Pipe Phantom, The Leicester (Elastography) Pipe Phantom has been developed which consist of 5 soft pipes (made of PVA cryogel of diameters from 1 to 13mm), surrounded by a block of stiffer agar based tissue mimicking material (TMM). This was used to assess the imaging performance of a Shear Wave Elastography (SWE) scanner with L15-4 linear array probe (Supersonic Imagine, Aix en Provence, France). Longitudinal and transverse sections of each soft pipe were imaged at different depths and at different scanner settings.

Results:

The Leicester (Elastography) Pipe Phantom was able to quantify a number of image performance parameters and help determine optimum scanner settings. The Young’s Modulus of the surrounding agar TMM was measured as approximately 280kPa compared to the largest cryogel pipe of approximately 70kPa. A number of features or artefacts of SWE imaging were also highlighted and will be presented. Examples include:  penetration depth through the agar TMM block (4.5, 4 and 3.5cm for Penetration, Standard and Resolution optimisation settings respectively), and through different pipe diameters; resolution performance assessment capability; effect of pipe depth and diameter on Young’s Modulus estimates within a 2mm region of interest measurement circle. Interesting artefacts were visualised in prototype phantoms, related to scatter concentration and scanner settings.

Conclusions:

The Leicester (Elastography) Pipe Phantom was able to demonstrate interesting artefacts and features of SWE imaging and quantify performance aspects of a SWE scanner.