The Effects of Different Types of Scattering Agents on 3D Ultrasound Imaging

Henry Bruin, Adam Rankin, John Moore and Terry M Peters
Robarts Research Institute, Medical Biophysics, University Of Western Ontario

Abstract

Introduction

Scattering agents have been used in many different types of PVA cryogel phantoms. The purpose of these additives is to give the phantom a more realistic look when an ultrasound is used. The reason they give the phantoms a more tissue like look is because of the particles suspended in the substance. These microscopic particles cause the ultrasound to reflect and rebound, showing a much less than uniform texture. As the structure of human tissue is not a uniform composition, adding scattering agents is imperative for accurate tissue replicas. Although different agents cause different effects, there has not been very much research into other options. What I am trying to do is narrow down the substances and the concentrations that create the optimal tissue replica. I believe that if a substance that can be mixed with the PVA has both hydrophilic and hydrophobic properties, it will be able to mix evenly without clumping or dissolving. The rationale behind this project is to find the most efficient, optimal, and affordable substance for scattering agent use in PVA C phantoms.

Materials and Methods

Before experimentation was able to begin, there were many different obstacles to overcome. The first main challenge was designing and testing a suitable mold to set the PVA in, while in the environment chamber. This took several trials, changing the amount of points attached between the sides, as well as where the contact points of the M5 screws should be to create the least amount of leakage. The first design consisted of 4 connection points, two on either side. The issue with this design was that the bottom leaked, since there was nothing to squeeze that joint together. I started experimenting with different screw placement along the bottom, and I ended up with a design consisting of three bottom screws, and two side screws on either side, for a total of seven connection points. This gave me an almost watertight seal, which was more than enough to stop PVA from leaking. Next, I spent time designing a mixer for larger batches of PVA. After some research and experimentation, I settled on a design where the bottom was 3D printed, and attached to a stainless steel rod. The bottom part consisted of two sections, with perpendicular cross pieces. Between each of these pieces, plastic twisted up between them, creating a unique vortex model. I have yet to make a large enough batch of PVA for the mixer to be required, so it

has not been thoroughly tested. The final step of preparation before phantoms could start being made was designing a way to store them. I used plastic sheeting cut on the bandsaw so that it would interlock, creating a grid to be placed in a large plastic container. This was filled with water, and the grid was placed inside, so that the phantoms could be organized and stored for future imaging research. Now that I was prepared to start experimentation, I printed 7 molds, and got started.

Results

Discussion

Acknowledgments

Literature Cited

Appendices