Three-dimensional printed ultrasound and photoacoustic training phantoms for vasculature access (Conference Presentation)

Daniil I. Nikitichev, Wenfeng Xia, Univ. College London (United Kingdom); **Simeon J. West,** Univ. College Hospital (United Kingdom); **Adrien E. Desjardins, Sebastien Ourselin, Tom Vercauteren,** Univ. College London (United Kingdom)

ABSTRACT

Ultrasound (US) imaging is widely used to guide vascular access procedures such as arterial and venous cannulation. As needle visualisation with US imaging can be very challenging, it is easy to misplace the needle in the patient and it can be life threating. Photoacoustic (PA) imaging is well suited to image medical needles and catheters that are commonly used for vascular access. To improve the success rate, a certain level of proficiency is required that can be gained through extensive practice on phantoms. Unfortunately, commercial training phantoms are expensive and custom-made phantoms usually do not replicate the anatomy very well. Thus, there is a great demand for more realistic and affordable ultrasound and photoacoustic imaging phantoms for vasculature access procedures training. Three-dimensional (3D) printing can help create models that replicate complex anatomical geometries. However, the available 3D printed materials do not possess realistic tissue properties. Alternatively, tissue-mimicking materials can be employed using casting and 3D printed moulds but this approach is limited to the creation of realistic outer shapes with no replication of complex internal structures. In this study, we developed a realistic vasculature access phantom using a combination of mineral oil based materials as background tissue and a non-toxic, water dissolvable filament material to create complex vascular structure using 3D printing. US and PA images of the phantoms comprising the complex vasculature network were acquired. The results show that 3D printing can facilitate the fabrication of anatomically realistic training phantoms, with designs that can be customized and shared electronically.

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