

Using Virtual Reality Modules to Teach Transposition of the Great Arteries: A Step Toward Scalable Processes for 3D Pediatric Cardiology Modeling and Education

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Background & Objective

- Cutting edge of medical innovation and in medical education.
- 3D-modeling is also increasingly used in Pediatric Cardiology. Models are commonly printed for pre-surgical evaluation and/or as educational tools for trainees.
- Segmentation process to build 3D heart models is time consuming, requiring expert operators and is expensive.
- Pilot project - using headset-driven virtual reality interfaces to educate about one of the five cyanotic congenital heart defects (Transposition of the Great Arteries) - is a novel concept at the University of Iowa Hospitals & Clinics (UIHC).
- Evaluated the effectiveness of a module series in comparison to traditional teaching methods, with a secondary aim of developing and standardizing the process of creating more disease specific heart modules for educational use in the department.

Methods

- Using Mimics Medical 22.0, CT-scan DICOM images were segmented.
- These 3D models were exported to open-source design software Blender for further processing.
- Using one dTGA model, an educational module series approximately 1-hour in length was developed utilizing the Enduvo software.
- Participants (n=12) recruited from within the University of Iowa Hospitals & Clinics consisted of medical students, residents, and fellows.
- Participants completed the module series and provided survey responses, qualitative and quantitative, regarding their experience. Quantitative questions asked for the extent of agreement to statements about the experience on a 10-point scale (10 maximal agreement).

Methods (cont.)

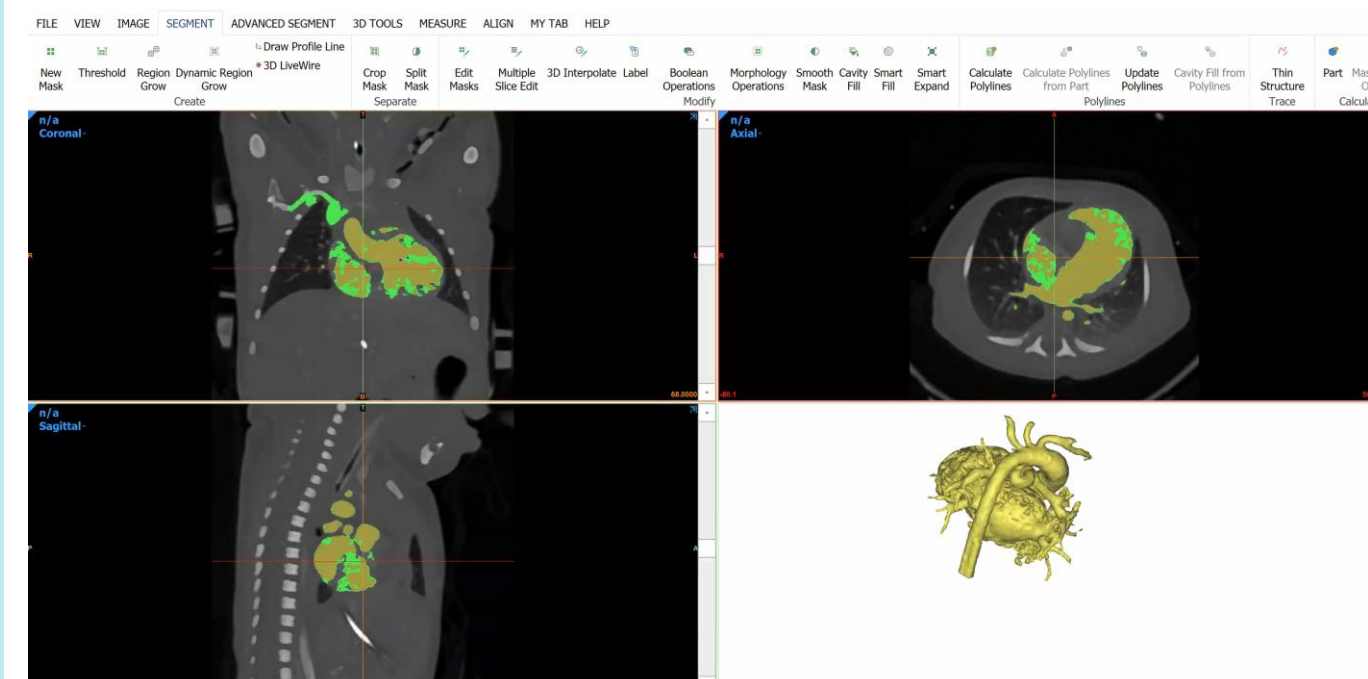


FIG1: Creating a 3-D Heart Model in Mimics 22.0 from CT Imaging

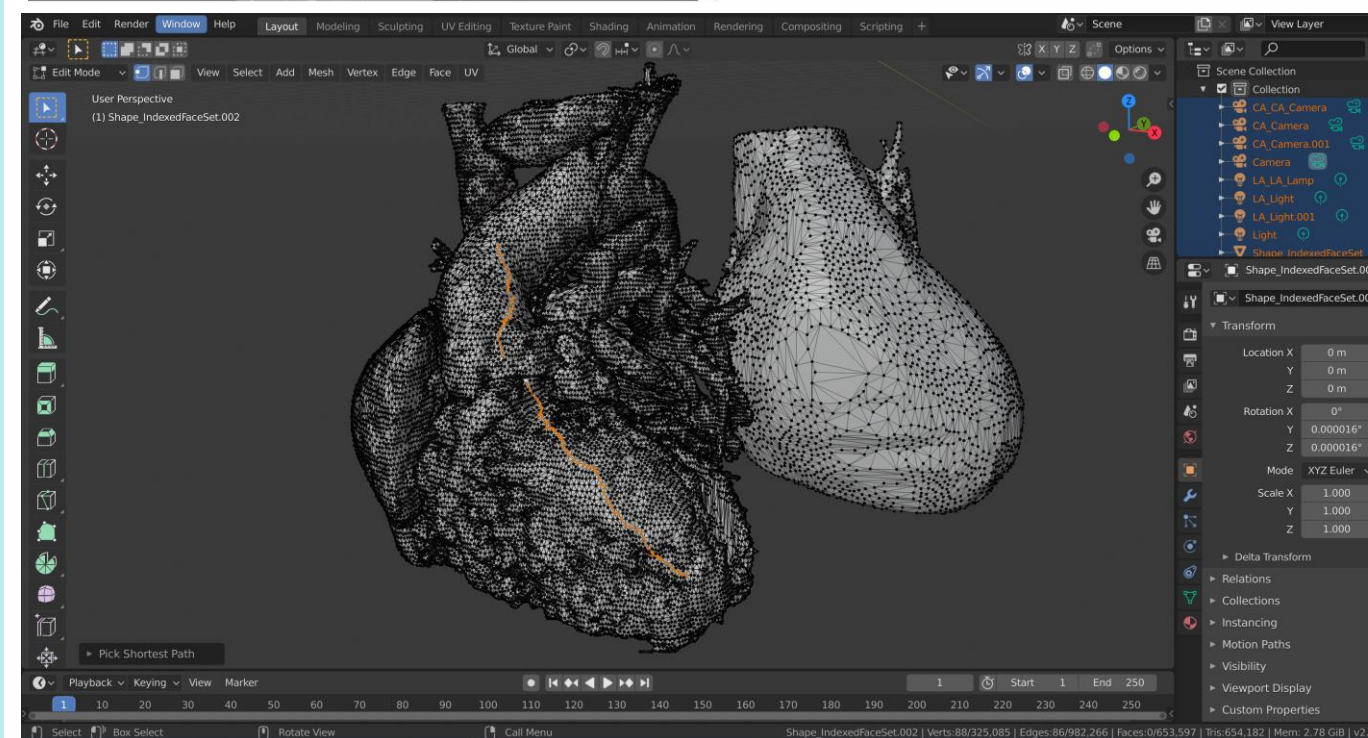


FIG 2: Processing a 3-D Heart Model using Blender



FIG 3: User Wearing HTC Vive VR Headset

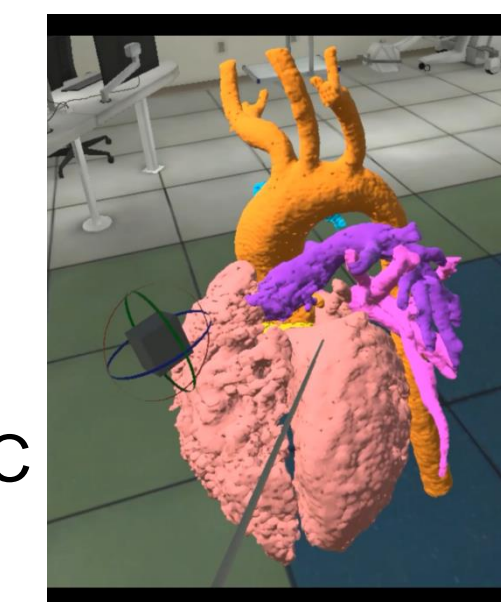


FIG 4: Heart Model on Enduvo VR Platform

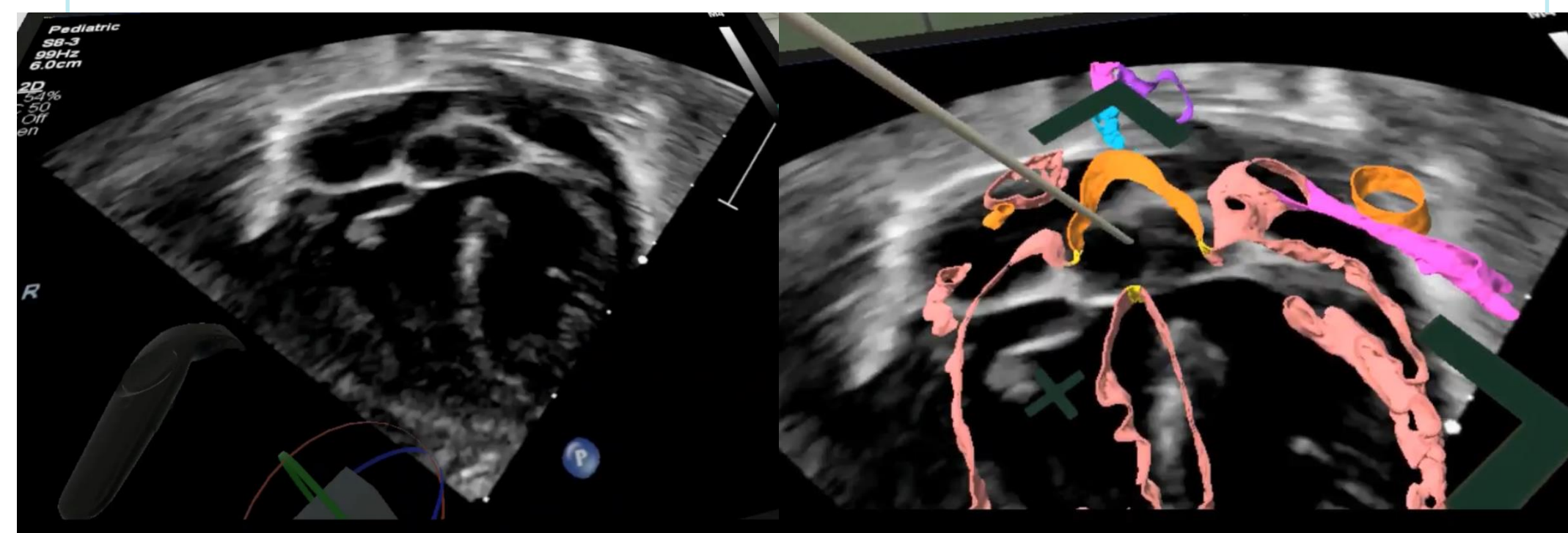


FIG 5: Overlay of Echocardiogram Image on 3-D Model in VR

Results

- Quantitative responses indicated participants perceived the experience positively.
- Participants agreed that the modules were easy to use (7.8/10, SD=1.9), efficient (9.0/10, SD=1.4), and more effective for their learning than lectures (8.5/10, SD=2.1), articles (9.1/10, SD=1.7), and even hands-on experience (7.6, SD=2.0). No participants experienced any nausea or dizziness.
- Qualitative responses to the Virtual Reality experience were mostly positive. Representative positive feedback included "This was amazing. A great way to learn..." and "Mind blowing experience."
- Critical feedback included discomfort with headset positioning and an issue with image rendering in one module.

Conclusions

- This study is promising in increasing the real value for VR in pediatric cardiology education and potentially beyond, both in terms of efficacy and being cost effective.
- The work suffers from the absence of a control condition for the knowledge evaluation.
- In contrast to past research indicating the need for expert operators for segmentation, this work indicates viability of less specialized staff in resource development, allowing for potential scalability and diversification of the resources built in this modality.
- Lastly, this research indicates that concern regarding nausea or dizziness in modern VR headsets should be minor.

2 min video TOF VR application

