MP4-13

Use of a Semi-Automated Cardiac Segmentation Tool Improves Reproducibility and Speed of Segmentation of Contaminated MRA Datasets

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Introduction:
Three-dimensional printing has increasing clinical applications in paediatric cardiology. Time required for segmentation and conversion of image data into a printable stereolithography (STL) file remains a significant limitation to widespread use. We investigated the impact of semi-automated cardiovascular-specific segmentation software on time and reproducibility of segmentation.
Methods:
Magnetic resonance angiograms (MRAs) of 19 patients undergoing intervention for right ventricular outflow lesions were segmented to demonstrate the right heart. STLs were created by two independent clinicians using semi-automated cardiovascular segmentation (SAS; inPrint 1.0.0.156 Beta, Materialise) and traditional manual segmentation (MS; Mimics 18.0.0.524, Materialise). Time taken was recorded and geometric STL disagreement was determined (0%=exact overlap, 100%=complete disagreement). MRAs were categorised as clean when only right heart structures were present in the MRA, or contaminated when left heart structures were also present and required removal.
Results:
18 (7 clean and 11 contaminated) cases were successfully segmented with both methods. Time to STL for clean datasets was faster with MS than SAS (median 209 s (IQR 192-252) vs. 296 s (272-317), p=0.018) while contaminated datasets were faster with SAS (455 s (384-561) vs. 866 s (310-1429), p=0.033). MS yielded STLs that were always larger than SAS by 4.9±0.89% (Figure 1B&D). Interobserver STL geometric disagreement was significantly lower using SAS than MS overall (0.70±1.15% vs. 1.31±1.52%, p=0.030), and for the contaminated subset (0.81±1.08% vs. 1.75±1.57%, p=0.036, Figure 1). However, there was no significant difference between techniques for clean datasets (0.53±1.40% vs. 0.60±1.36%, p=0.24). Most geometric disagreement occurred at areas where left heart contamination was removed.
Conclusions:
Semi-automated segmentation was faster and more reproducible for contaminated datasets, while manual segmentation was faster and equally reproducible for clean datasets. Semi-automated segmentation methods are preferable for contaminated datasets and continued refinement of these tools should be supported in conjunction with improved image acquisition methods to avoid arterial phase contamination.

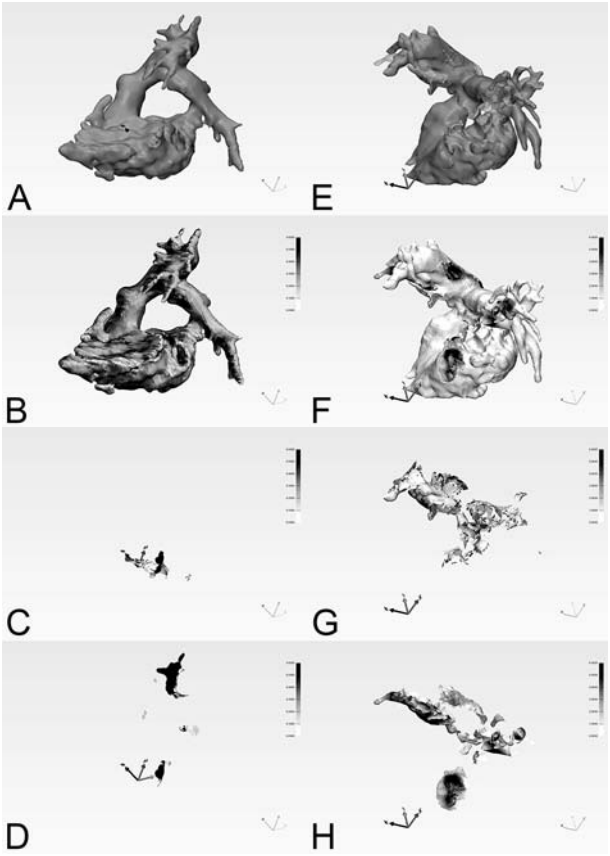

Figure 1. A clean (A-D) and contaminated (E-H) dataset. A&E show the anatomy; B-D and F-H show the thickness of any geometric disagreement (if present) for SAS and MS (B&F), interobserver SAS (C&G), and interobserver MS (D&H), scale 0-0.6 mm for B-D, 0-6mm for F-H.