3D Tractographic Printed Models and White Matter Dissections for Learning Visuospatial Orientation of Perisylvian Tracts

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Although the Klinger technique is the gold standard for white matter dissection, due to clear visualization of white matter tracts, it is difficult to execute and requires a significant amount of time to acquire accurate dissections. Incorporating 3D-printed models of both isolated tracts and completed dissections as part of guided dissections present a potential strategy for improving performance and enhancing anatomical knowledge. Here, we demonstrate the utility of 3D-printed models constructed from DICOM images and photogrammetric volumetric models of cadaveric dissections as an education tool for learning perisylvian tracts.
Magnetic resonance imaging (MRI) with diffusion tensor imaging (DTI) of white matter tracts were taken from a healthy patient. Perisylvian tracts, including the longitudinal fasciculus (ILF), inferior fronto-occipital fasciculus (IFOF), superior longitudinal fasciculus (SLF), and arcuate fasciculus (AF), were individually isolated and converted to 3D volumetric models. The Klinger technique was used to dissect five human cadaveric specimens to expose the ILF, IFOF, SLF, and AF. Photos of the dissected specimens were rendered into 3D volumetric models using Agisoft PhotoScan Pro. The DICOM images and photogrammetric models were then 3D printed with ABS filament.
RESULTS

The 3D-printed models created from the patient’s DICOM images and photogrammetric models from cadaveric dissection upheld structural accuracy and clarity. Both ABS and PLA filaments created high quality models however there were differences in level of acuity in the final product based on subjective feedback. The Taz-5 and Taz-6 printer were both user-friendly and had relatively short printing times. In a survey of residents, incorporation of these 3D printed models as part of guided dissections in residents were perceived as helpful for localization.
Figure 1. Cadaveric dissection of the arcuate fasiculus and an ABS-printed model isolating the AF with the posterior, anterior, and long segments connected.
Figure 2. Cadaveric dissection of the Inferior fronto-occipital fasiculus and PLA-printed model in ivory.
3D-printed models of isolated white matter tracts created from DICOM images and photogrammetric models of Klinger dissections are convenient and accurate tools for guided white matter dissections. These models allow the junior resident, access to concrete, full-scale models to improve fluency in tract anatomy, and facilitate proper execution of white matter dissections. ABS and PLA are low costs filaments that can be used on beginner-level 3D printers and creates models in a relatively short amount of time that upholds a high degree of accuracy and clarity of tract orientation.