Utility of 3D printing in endovascular repair of endoleaks.

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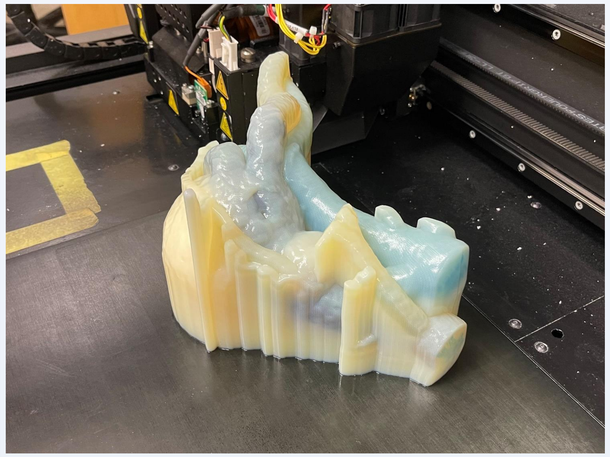
Introduction

Endoleaks, which are one of the most common complications following Endovascular Aneurysm Repair (EVAR), result from retrograde blood flow into the aneurysm sac. Adequate visualization of patient's unique anatomy, appropriate device selection, and prediction of intraoperative navigational difficulties are paramount to successful endovascular repair of endoleaks. The purpose of this abstract is to evaluate feasibility of using patient-specific 3D printed models for preprocedural planning, simulation, and approach selection prior to endovascular repair of endoleaks. While 3D printing has become increasingly prevalent in preprocedural planning of EVAR, to our knowledge, this is the first proposal describing the utility of 3D printing in endovascular repair of endoleaks.

Sagittal CT scan of our patient showing the aneurysmal sac and stent from prior abdominal aortic aneurysm (AAA) repair

Materials and Methods

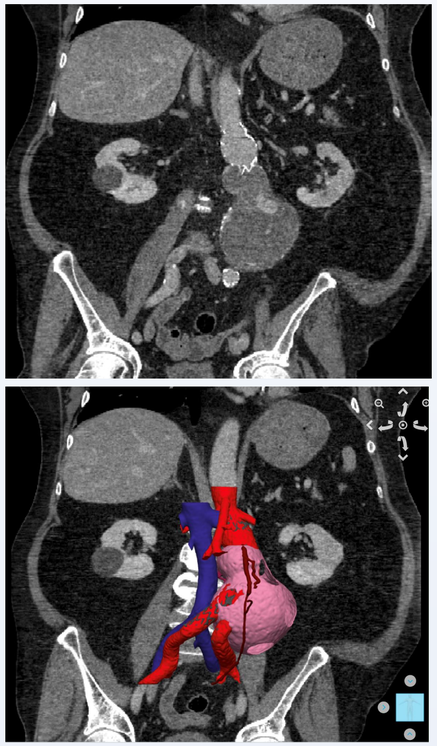
To evaluate feasibility of 3D printing, an 87-year-old male with large type II endoleak and expanding aneurysm sac status post EVAR was selected. The patient had embolization of one lumbar and inferior mesenteric artery via percutaneous translumbar approach. Pre-procedure images from computed tomographic angiography were converted into digital 3D objects using a segmentation software (Mimics: Materialize NV). A Poly jet 3D printer (Objet 260 Connex 3 Stratasys) was used to print a model of the aneurysm sac and aortic branch vessels using multicolor resin material. The intraoperative angiogram findings were used to assess anatomic accuracy of the printed model. An interventional radiologist used the 3D printed model to retrospectively simulate the procedure and compare observations to actual intraoperative findings.



Printed model prior to cleaning and drying process

Results

The 3D printed model was found to provide enhanced spatial understanding of the complex anatomy, provide a physical object to simulate the procedure on, and allow identification of potential navigational difficulties. The model allowed trial of various techniques and selection of optimal approaches/devices. In addition to simulation and surgical planning, the model was also helpful in trainee education.



Coronal CT scan of our patient. **Top**: CT demonstrated aneurysmal dilation of the abdominal aorta. **Bottom**: CT with 3D model overlay. Inferior vena cava (blue), aorta and associated branches (red), and aneurysmal sac (pink) shown.

Conclusions

3D printing is an emerging technology that offers advanced visualization of the unique anatomy of each patient, prediction of intraoperative navigational difficulties, simulation, and aids in the selection of presurgical devices and approaches. With the ongoing advancements in 3D printing, there is increasing opportunity to use printed models in many aspects of interventional radiology. Models have been helpful in patient and trainee education and could be used more frequently in surgical planning.

Completed 3D model after cleaning and drying process. **Left:** the aneurysmal sac and associated vessels (pink) can be seen connected to the aorta (yellow) and see in relation to the inferior vena cava (blue).

Right: previously placed graft (gray) used to treat AAA visualized within the aorta.

Contact

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