Utility of Creating 3D Anatomic Models of Paraesophageal Hernias

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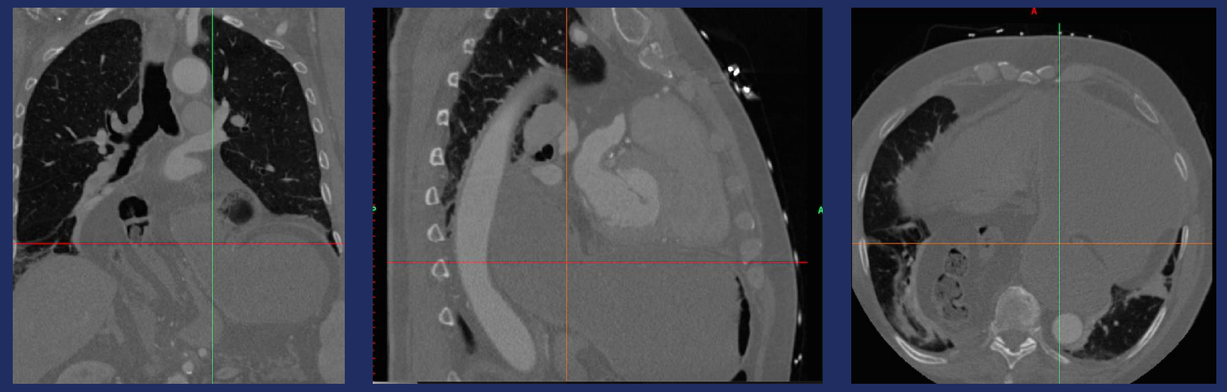
Introduction

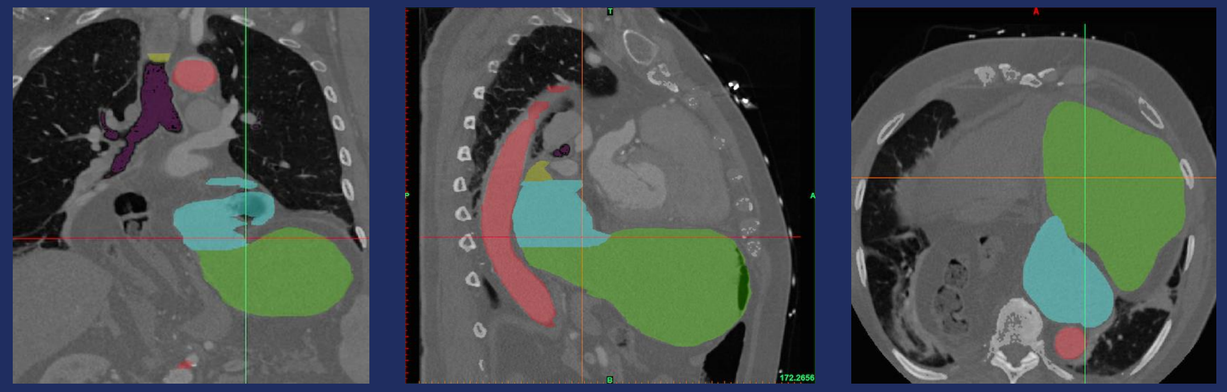
Background: Paraesophageal hernias are very rare and are found particularly in older patients. This type of hernia is next to the esophagus. In normal anatomy, the esophagus travels down through the diaphragm and meets the stomach. In the case of a paraesophageal hernia, part of the stomach comes up through the diaphragm and meets the esophagus. In most cases, this condition can be dangerous.

Types: There are two types of 3D Anatomic Models of Paraesophageal hernias: clinical and educational. Doctors use the clinical models to visually describe the process of the procedure that the patient will be undergoing. Doctors may also use the educational model for teaching students (particularly, medical) the right and wrong structure of the anatomy based off of the condition of the patient.

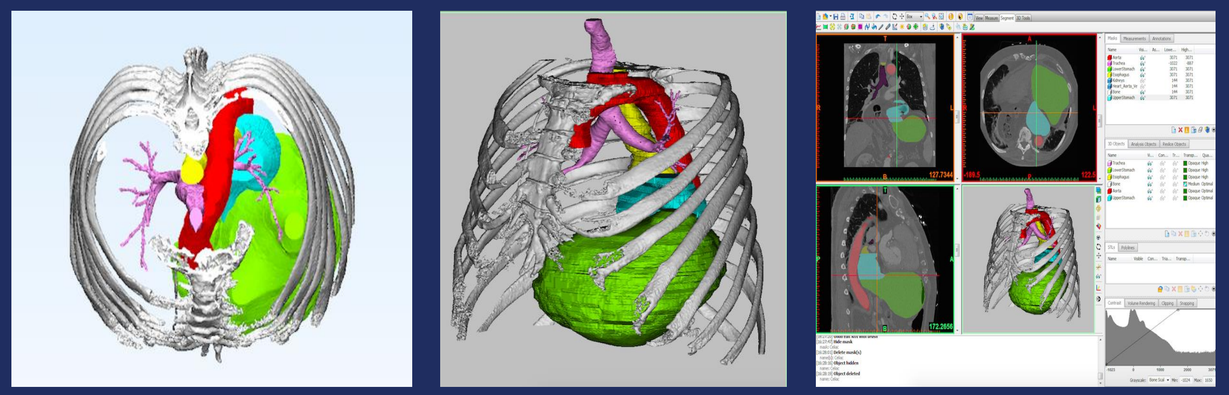
Model 1: CT Data



Model 2: Segmentation



Model 3: Virtual 3D Model



3D Printing Technology

3D printing technology is used to 3D print objects that surgeons request for educational or clinical purposes. These models were printed in color on the Stratasys Objet500 Connex3 PolyJet 3D printer. One of the many and only future applications to these three of the many cases of paraesophageal hernia repairs are 3D printing. There are five steps used to create an anatomic model through 3D printing. The first is the acquisition of a high quality computed tomography angiography (CTA) scan to highlight the bones, vessels, organs, cartilage, and airway. A magnatic resonance imaging (MRI) scan may also be needed to highlight nerves, tumors and other soft tissue. The second step is the segmentation which can be completed in Materialise Mimics® software; raw image data is input and specific anatomies are highlighted on 2D slices where are then compiled to create 3D objects. The third step is the computer aided design (CAD) which can be completed with Materialise 3-matic® to prepare the object for 3D printing. The fourth step is to output the Steriolithography (STL) file, which is contains the surface geometry data, to the 3D printer. The fifth step is to orient the part on within the 3D printer software and select build materials. This work flow represents the current process of 3D printing today for anatomic modelers around the world. Through this work flow, 3D printing can be used for educational and clinical applications regarding surgical procedures.

References

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