HealthManagement
Promoting Management and Leadership

RSNA 2014: 3D Printing Guides Human Face Transplants

Computed tomography (CT) and 3D printing technology can be used to recreate life-size models of patients' heads to assist in face transplantation surgery, according to researchers at Brigham and Women's Hospital (BWH) in Boston. The surgery is performed on patients whose face has been damaged as a result of disease or injury. Results of the study were presented at the annual meeting of the Radiological Society of North America (RSNA), 30 November-5 December 2014, Chicago, Illinois.

The first full-face transplantation in the US was performed by BWH physicians in 2011. Four additional face transplants have subsequently been completed by doctors at the hospital. "This is a complex surgery and its success is dependent on surgical planning," said Frank J. Rybicki, MD, radiologist and director of the hospital's Applied Imaging Science Laboratory. "Our study demonstrated that if you use this (3D) model and hold the skull in your hand, there is no better way to plan the procedure."

The BWH team, led by Dr. Rybicki, together with Bohdan Pomahac, MD, lead face transplantation surgeon, and Amir Imanzadeh, MD, research fellow, evaluated the clinical impact of using 3D printed models of the recipient's head in the planning of face transplantation surgery.

Each of the transplant recipients underwent preoperative CT with 3D visualisation, the researchers said. To create each life-size skull model, the CT images of the transplant recipient's head were segmented and processed using customised software, creating specialised data files that were input into a 3D printer.

"In some patients, we need to modify the recipient's facial bones prior to transplantation," Dr. Imanzadeh explained. "The 3D printed model helps us to prepare the facial structures so when the actual transplantation occurs, the surgery goes more smoothly."

While the entire transplant procedure lasts as long as 25 hours, the researchers noted, the actual vascular connections from the donor face to the recipient typically takes about an hour, during which time the patient's blood flow must be stopped.

"If there are absent or missing bony structures needed for reconstruction, we can make modifications based on the 3D printed model prior to the actual transplantation, instead of taking the time to do alterations during ischemia time," Dr. Rybicki pointed out. "The 3D model is important for making the transplant cosmetically appealing."

Using the 3D models also helps to increase the surgeons' understanding of the anatomy of the recipient's face during the operation. "You can spin, rotate and scroll through as many CT images as you want but there's no substitute for having the real thing in your hand," Dr. Rybicki stressed. "The ability to work with the model gives you an unprecedented level of reassurance and confidence in the procedure."

Senior surgeons and radiologists involved in the five face transplantations at BWH agreed that the 3D printed models provided superior pre-operative data and allowed complex anatomy and bony defects to be better appreciated, reducing total procedure time. As Dr. Pomahac noted: "Less time spent in the operating room is better for overall patient outcomes."

Based on the results of this study, 3D printing is now routinely used for surgical planning for face transplantation procedures at BWH, and 3D printed models may also be used in other complex surgeries.

Top image
Toshiba Aquilion ONE dynamic volume CT scanner

Figure 1. 3D printed head model

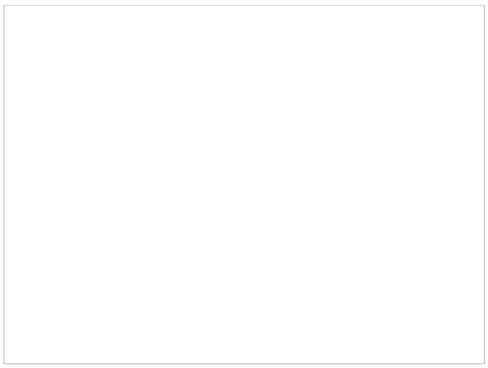

Figure 2. 3D printed facial model

Videos
Video, including animations of the face transplant process is available on the RSNA press release page.

Source: Radiological Society of North America
Image Credits: Frank J. Rybicki; Amir Imanzadeh/Brigham and Women's Hospital

Published on : Mon, 1 Dec 2014