

3-D-printed bones are helping doctors prepare for surgeries

October 25 2018, by Nicoletta Lanese



A 3-D-printed spine was created from a clinical CT scan of a patient with a spinal deformity. Being able to see, hold and rotate a precise replica of their patient's bones gives surgeons a new angle on their cases. Credit: Barbara Ries

Orthopaedic surgeons can now get their hands on the bones of patients before they reach the operating table – with the help of 3-D printing.

Using scans of actual patient anatomy, the surgeons are able to print

model bones on which to plan and practice their procedures. Being able to see, hold and rotate a precise replica of their patient's bones gives surgeons a new angle on their cases, providing information that might be invisible on a flat scan.

These models can be shared with patients to give them a deeper understanding of their upcoming surgeries. In the operating room, they serve as a visual aid for the surgeons and their teams.

The technology is being used widely across UC San Francisco and affiliated health care organizations.

"The total number of orthopaedic surgeons using 3-D printing at UCSF is higher than anywhere else in the country," said Alan Dang, MD, assistant professor of orthopaedic surgery.

It's not just [orthopaedic surgeons](#) taking advantage of this technology – pediatric cardiologists, radiologists, maxillofacial surgeons, dentists and prosthetists are among the many incorporating 3-D prints in their work.

Beyond the operating room, the technology is enriching education and and being studied for how it may improve patient care.



Shane Burch (right), MD, a spinal surgeon in the Department of Orthopaedic Surgery, and Musa Zaid, MD, a research resident in Orthopaedic Surgery, discuss a use of a 3-D printed spine created from a clinical CT scan of a patient with a spinal deformity. Credit: Barbara Ries

3-D Printing as a Health Care Tool

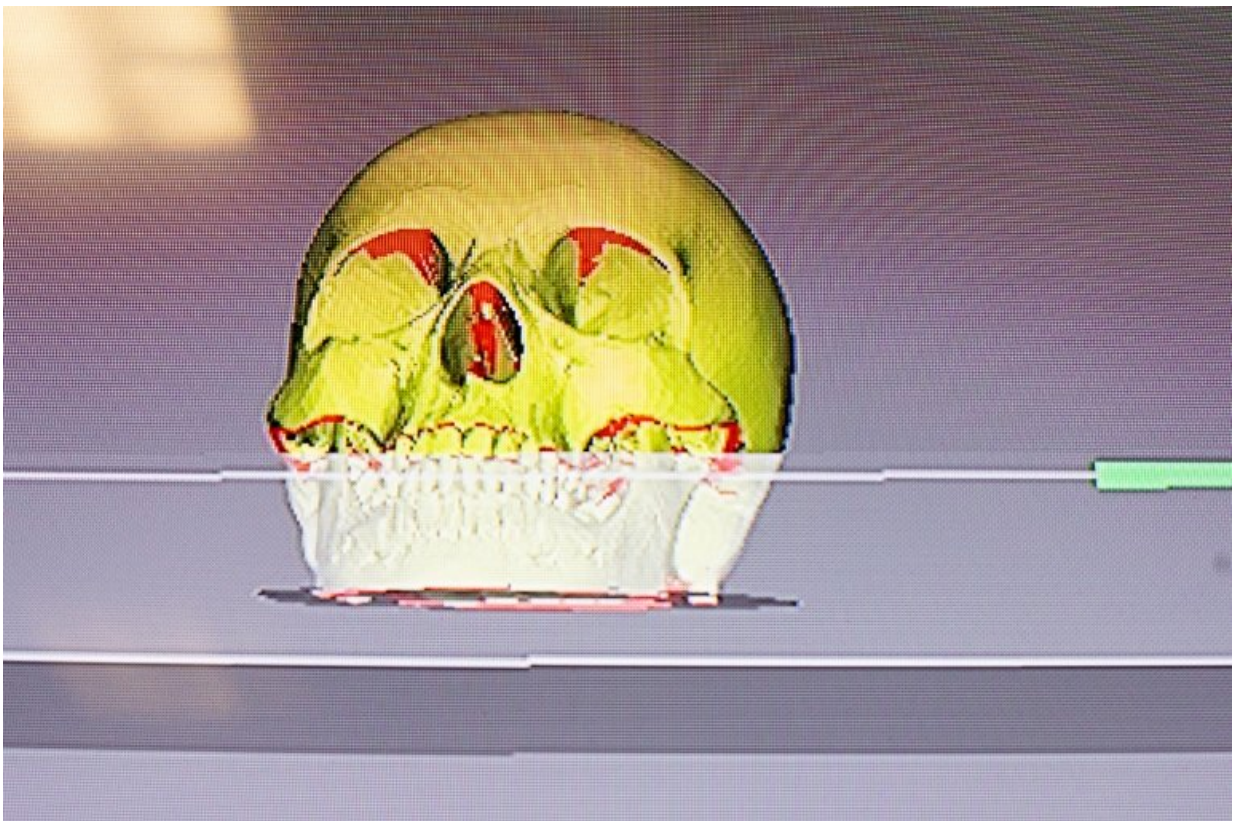
Printing onsite, at the hospital, renders the 3-D printing a helpful tool, rather than an expensive commodity. A single print can be turned around in less than 24 hours and made with sustainable materials, all for less than the cost of a pair of sterile gloves.

Three-dimensional prints help doctors save precious time in the operating room. For example, with a patient's printed anatomy in their hands, surgeons can test the fit of surgical implants in advance. Besides saving time on the table, this practice can save money by helping doctors visualize whether a patient needs a pricey custom implant, or just a standard size.

Surgeons and their trainees can also use 3-D printing to practice procedures.

"The trainees can actually perform the case on a replica of the patient's anatomy before the first incision is made," said Aenor Sawyer, MD, assistant professor of orthopaedic surgery.

As both seasoned surgeons and future doctors make use of the technology, Sawyer and her colleagues are researching if and how its application is improving patient care. They want to know which procedures are rendered safer, cheaper and faster by the use of 3-D printing.



Software prepares a scan of a skull to be sent to a 3D printer at the Makers Lab in the UCSF Library. Credit: Susan Merrell

"We anticipate," said Sawyer, "that patient-specific 3-D printed models will become a standard tool in precision medicine."

The growth of 3-D printing's use across UCSF and affiliated [health care organizations](#) was spurred in part by an initiative known as EDGE Labs in the UCSF Department of Orthopaedic Surgery. Founded by Alexis Dang, MD, Alan Dang, MD, and Aenor Sawyer, MD, EDGE Labs has established onsite 3-D printing at the UCSF Medical Centers at Parnassus and Mission Bay, Zuckerberg San Francisco General Hospital and the San Francisco VA Medical Center.

Along with his EDGE Lab co-founders, Dang aims to make 3-D printing equally accessible to UCSF surgeons and proceduralists of all specialties.

Educating Future Health Care Professionals

The next generation of [health care professionals](#) are also stepping into the 3-D printing technology mix through access to devices in the UCSF Library and in the classroom.

Anyone with a UCSF ID has access to the Makers Lab – a creative space housed on the main floor of the UCSF Library at Parnassus that has 10 3-D printers open for business. UCSF students, faculty, staff, researchers, and practitioners can use the printers, print-planning software and necessary materials at no cost and can print just about anything they can imagine.



A finished version of the 3D printed skull sits inside of a lightbox. Credit: Susan Merrell

This fall, some of the Lab's printers will venture beyond the library and into the classroom.

Through a partnership with the Department of Anatomy, the Makers Lab will launch a new 3-D printing elective this fall, called "3-D Printing for Health Science Students." Through the course, the students will learn to transform a common CT scan into a 3-D model, from start to finish. They can then take that knowledge forward to tackle their own, more complex projects.

The new 10-week elective – produced by Anatomy Learning Center Director Derek Harmon, Ph.D., Makers Lab Manager Dylan Romero, and medical student Cecilia Im – boosts the momentum of 3-D printing across campus.

"We're aiming to get 3-D printing adopted across all health care systems," said Sawyer. "Not just here at UCSF."

Paving the Way for 3-D Technology

To cultivate the use of 3-D technologies in [health care](#), the UCSF School of Medicine awarded a grant to establish the Center for Advanced 3-D+ Technologies. The center – formed by EDGE Labs, the Division of Pediatric Cardiology, and the Department of Radiology – fosters the development of onsite 3-D printing, as well as visualization technologies such as virtual and augmented reality.



A 3-D model of a skeletal foot sits on the instruction table during an Anatomy 3-D Printing class. The model is one of many UCSF uses to teach Physical Therapy students how to generate 3-D printed models from CT scans. Credit: Susan Merrell

Besides developing 3-D technologies for patient care, the center supports their use for designing and prototyping new medical devices. Onsite 3-D printing allows prototyping to be done easily, in-house, rather than outsourced.

Three-dimensional prints can serve as molds for bone grafts, custom splints or patient-specific implants. Alan Dang is currently designing and printing spinal implant prototypes from PEEK, a common implantable material. Sigurd Berven, MD; Safa Herfat, Ph.D.; and Aenor Sawyer are also prototyping spinal implants onsite at Zuckerberg San Francisco General Hospital.

"In the next couple of years, I think we will see an explosion in UCSF-

designed medical devices," said Alexis Dang, "thanks to the benefits of 3-D printing."

Provided by University of California, San Francisco

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