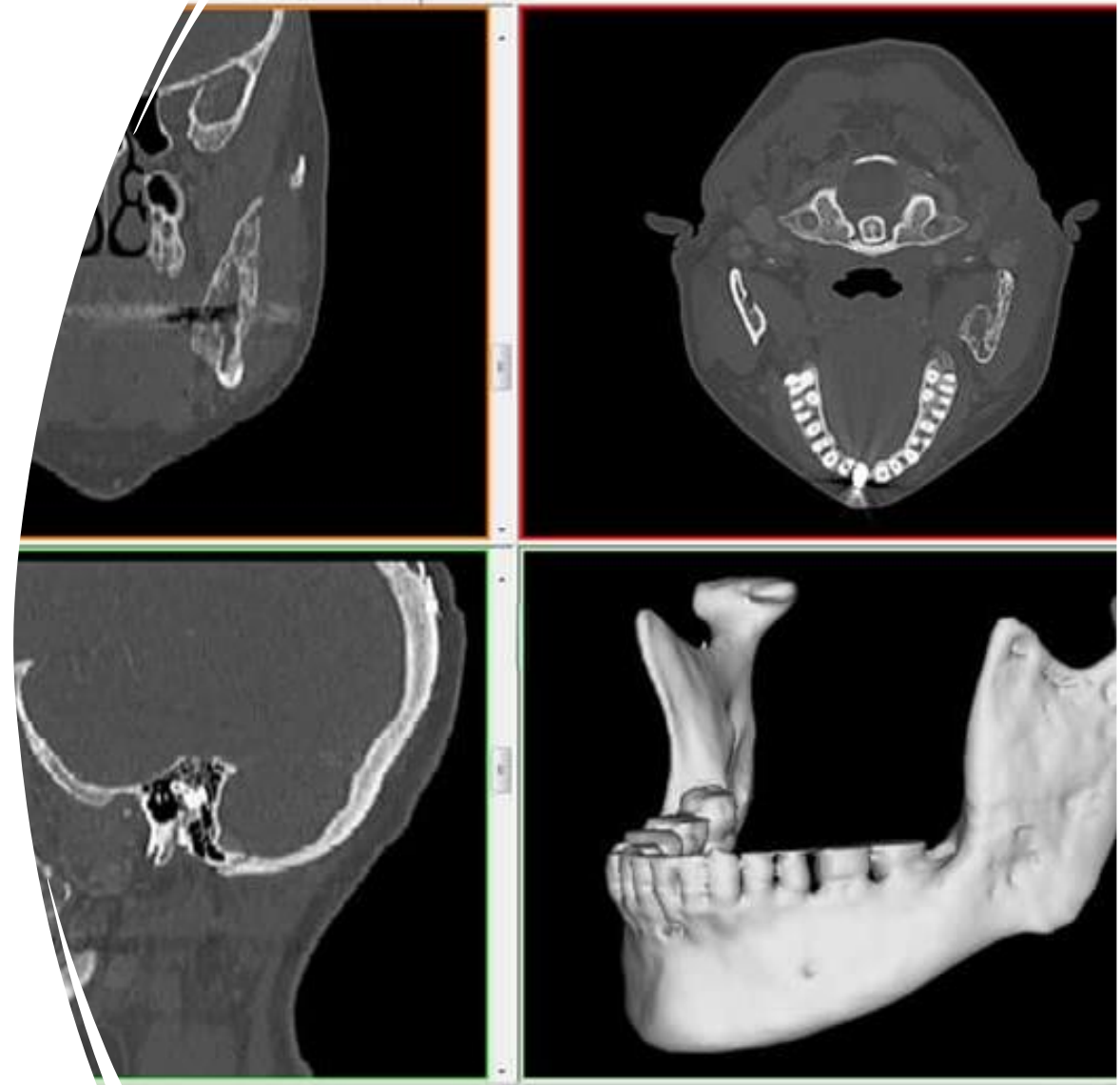




INTRODUCTION TO BIOMEDICAL ENGINEERING

Week 11: Computer-Assisted Surgical Planning



What is surgical planning?

Can engineers plan surgeries?



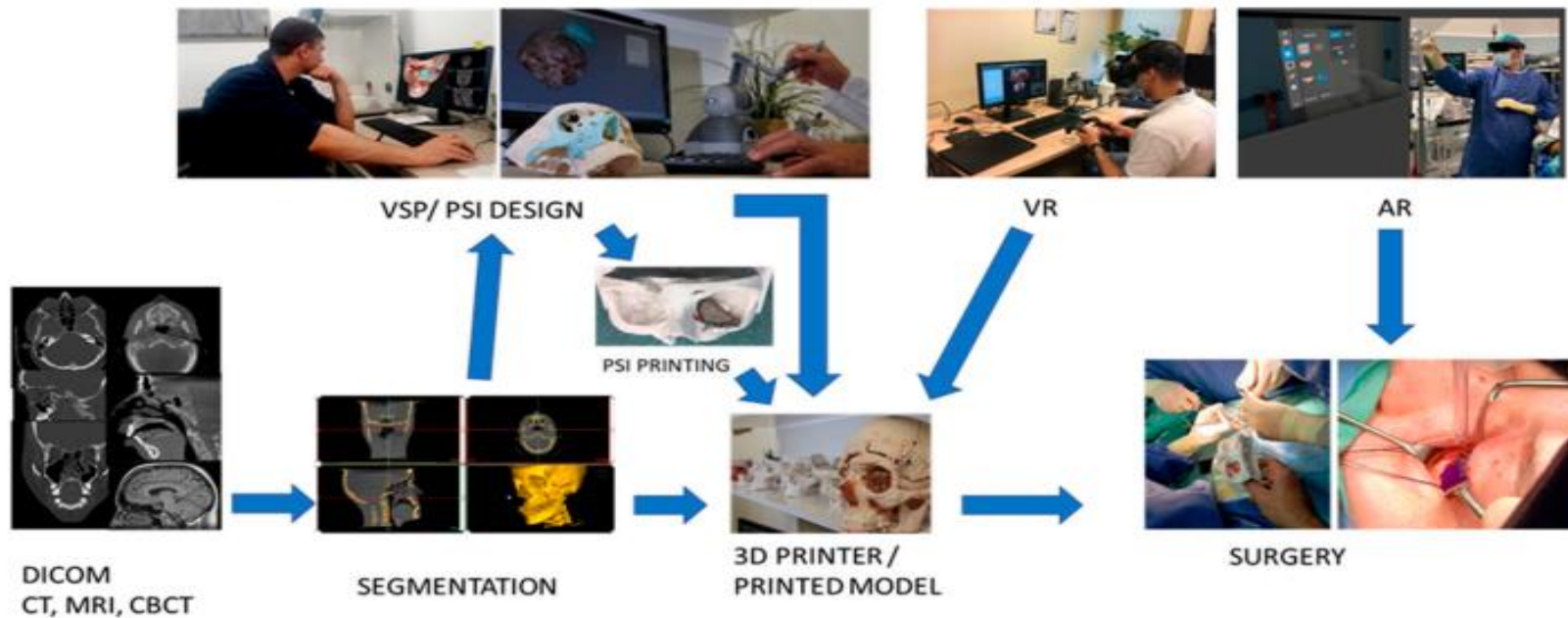
What is Computer-assisted surgical planning?

- **C**omputer-**a**ssisted **s**urgical **p**lanning (**CASP**) is a robust technology that is used to optimize precision and efficiency in complex reconstructions of the skull and jaws and any kind of defect in human body. This allows for shorter surgeries and less time under anesthesia.

Computer-assisted surgical planning

- Surgeons carry out operations according to the anatomical defects of the patients. Due to the improvements in medical imaging techniques such as **computed tomography (CT)** and **magnetic resonance imaging (MRI)**, diagnoses for anatomical defects have been made accurately and fast with high informative quality.
- However, CT or MRI can only provide two-dimensional (2D) images and these images are not sufficient to depict the three-dimensional (3D) complex anatomical structures. **These medical imaging techniques are inadequate to interpret the three-dimensional data of the patient's defect.** Although virtual 3D techniques can visualize anatomical defects, there is still a deviation between the real structure and 3D image.

Computer-assisted surgical planning



Patients' volumetric data obtained after medical imaging is translated to digital imaging and communication in medicine (DICOM) format, followed by segmentation and 3D rendering for virtual surgical planning (VSP) and patient specific implant (PSI) design. Both models and implants are 3D printed, sterilized and subsequently used for surgery. Virtual reality (VR) is used for further evaluation and simulation before surgery. Augmented reality (AR) may assist the surgical team during surgery.

What are the steps in CASP?

Digital imaging and communications in medicine (DICOM) images obtained from the patient

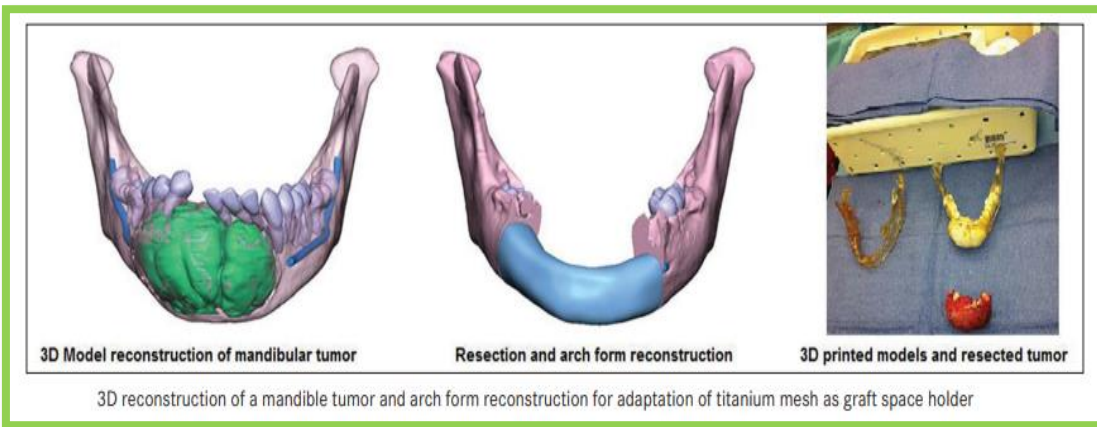
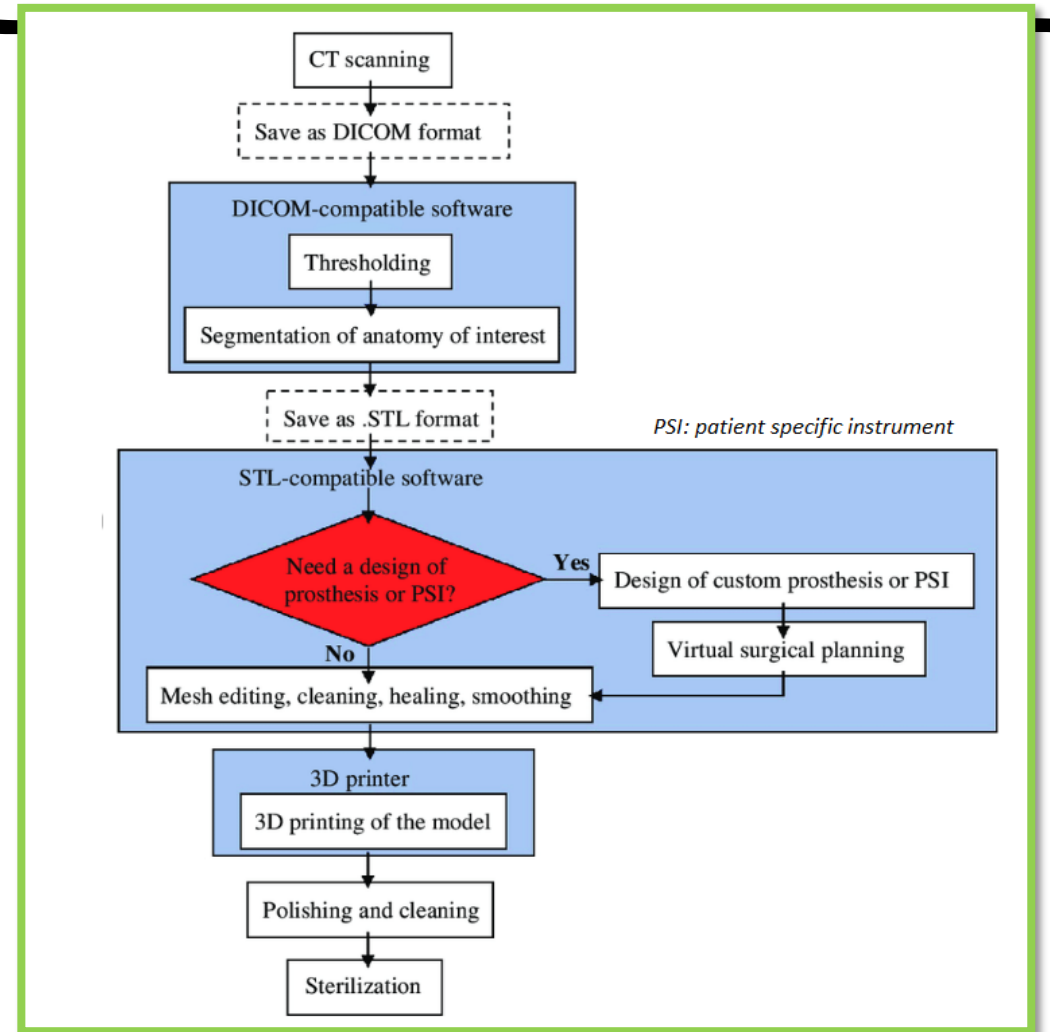
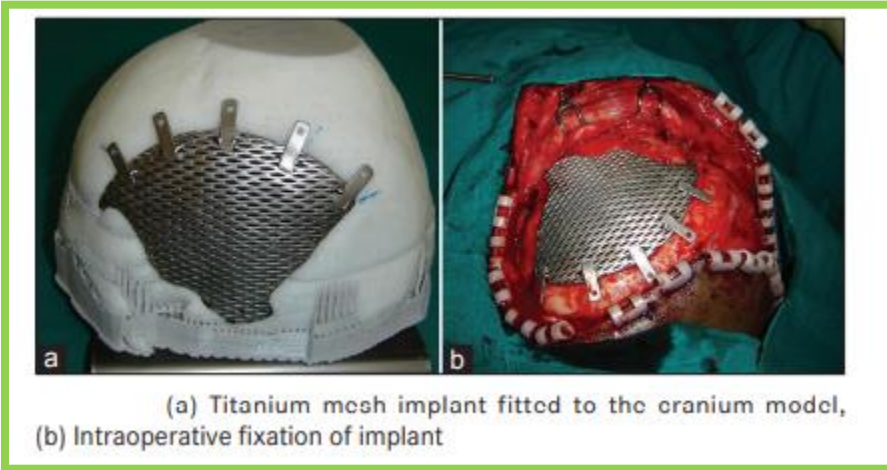
DICOM images are transferred to the software (e.g; Mimics Materialise, Belgium)

The defective parts are separated from the rest bone and tissue (thresholding and segmentation)

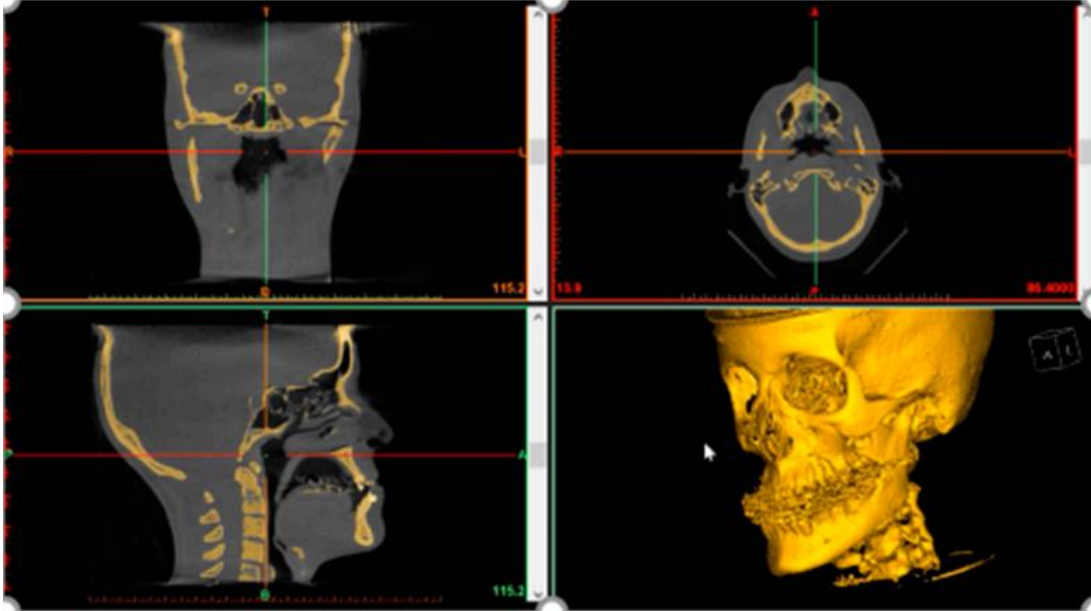
Segmented part is converted into a virtual 3D model

Virtual 3D model is exported from software (e.g. Materialise Mimics) as STL file

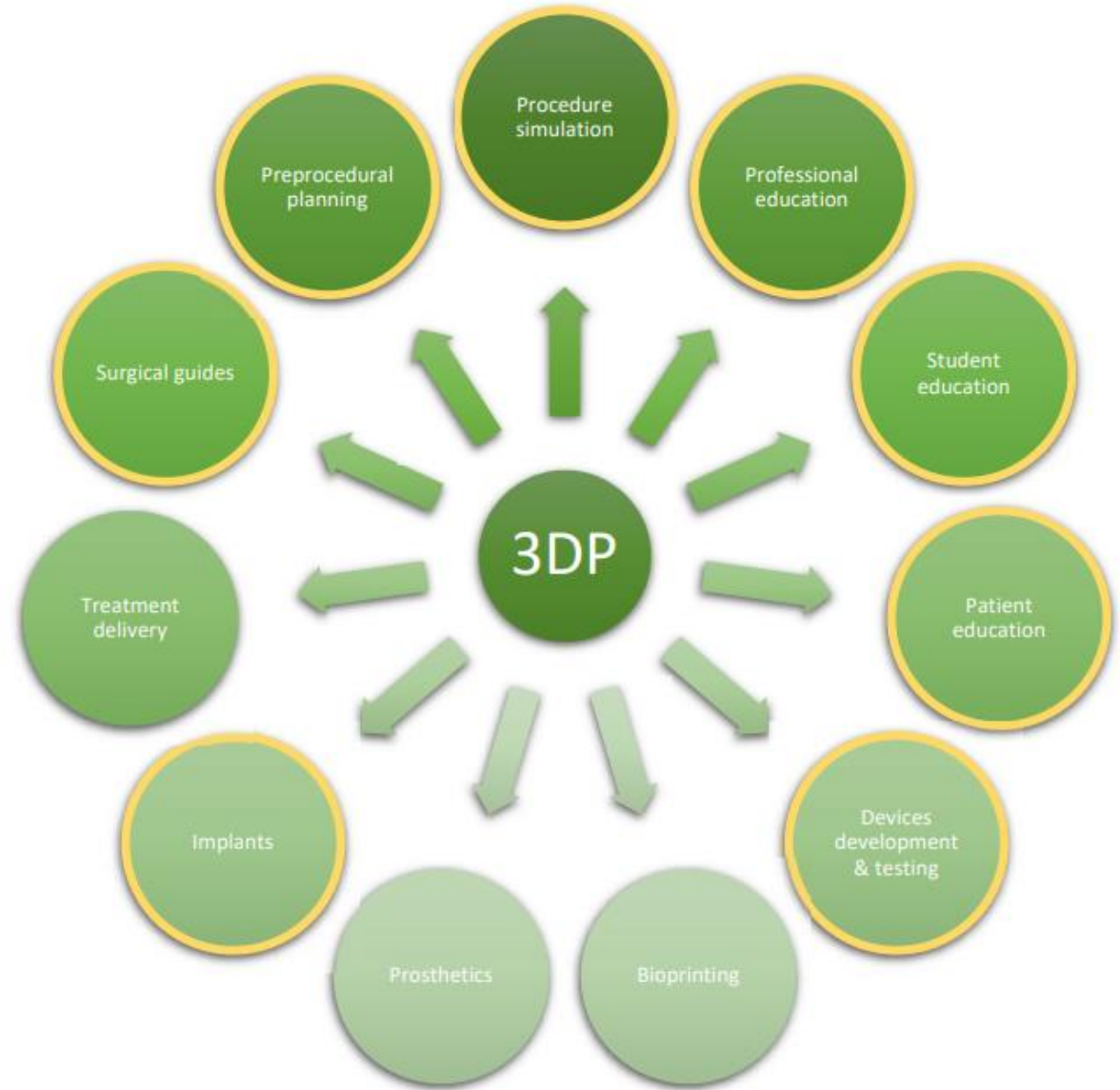
What are the steps in CASP?



What are the steps in CASP?

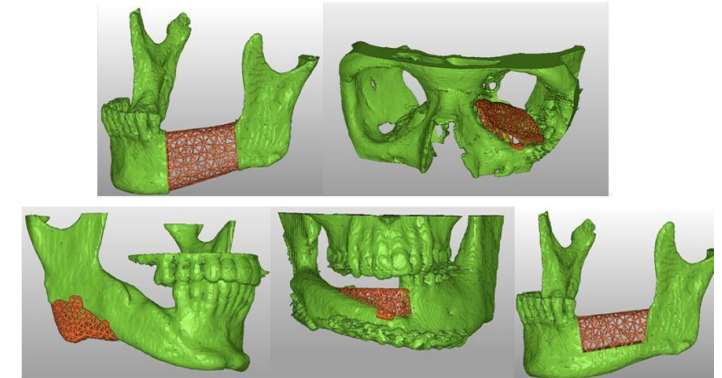
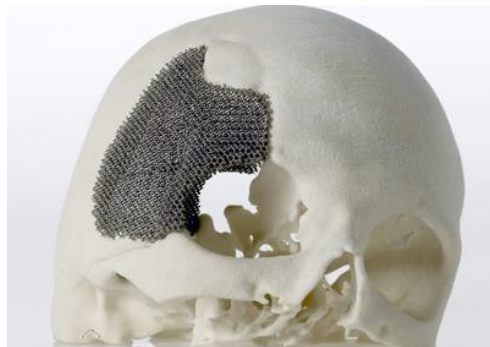


Shortly, What is 3D Printing?

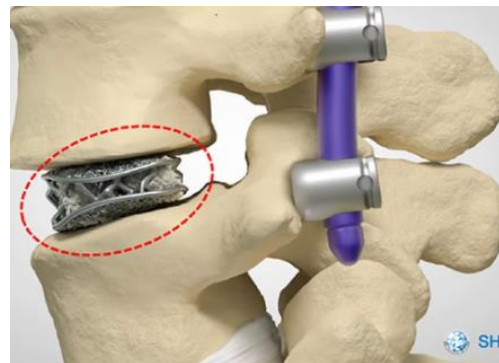
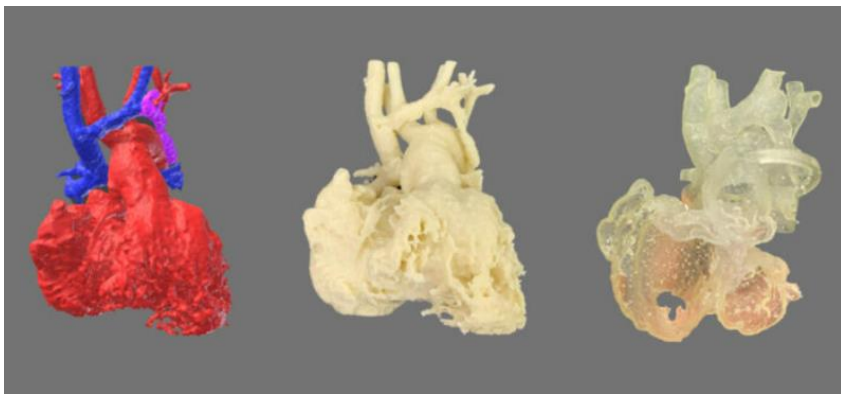


3D Printing?

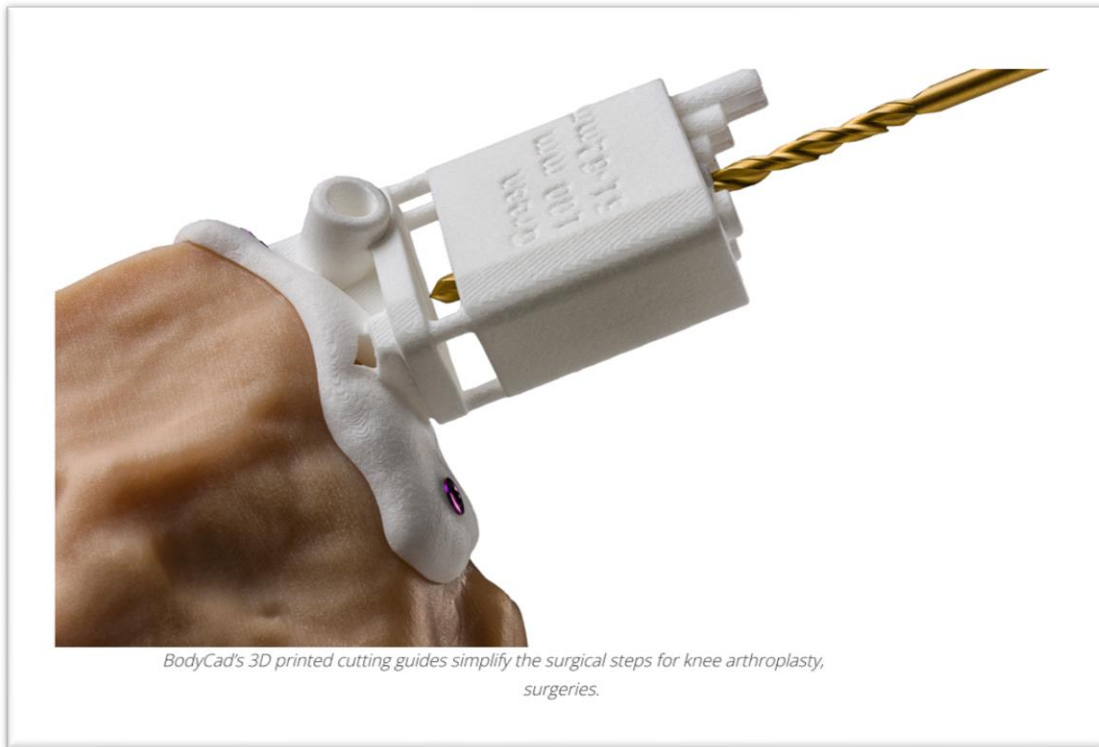
What you see is what you built



© Mika Salmi / TKK / BIT Research Centre / IDM



Not only implants but also cutting guides....



Thank you!

Questions?