



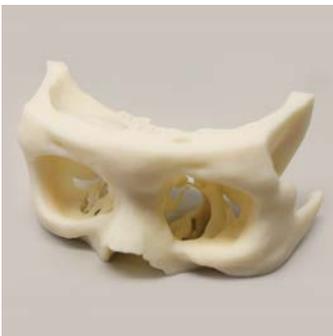
# Second Sight

HONG KONG POLYTECHNIC UNIVERSITY USES 3D PRINTING TO IMPROVE EYE ORBITAL IMPLANT SURGERY

*“Ophthalmologists could benefit from the precision offered by 3D printing, creating accurate implants before an operation instead of having to manually adjust and test it during the operation.”*

*– Dr. Martin Chung-ming Wong,  
Hong Kong Polytechnic University*

## CASE STUDY



3D printed prototypes used for eye orbital implant surgeries help improve accuracy and shorten the operation.

Eye surgery can be complex, lengthy and nebulous, since each patient's eye socket is uniquely shaped. Now the Hong Kong Polytechnic University's Industrial Centre (IC) is using a way to improve those conditions: 3D printing.

Founded in 1976, IC provides hands-on learning experiences to engineering and civil engineering students. IC also offers industrial and engineering support services to the community and local industrial companies on various fronts including infrastructure, energy and aviation maintenance, repair and overhaul.

## Greater Precision Through 3D Printed Orbital Implants

Orbital fracture repair and implant insertions are performed on patients suffering from different types of orbital fracture, the commonest being orbital floor (blow-out) fracture, due to sports injuries, motor vehicle accidents or hits from direct blunt objects.

Orbital surgeons need to shape the implant of choice, like a titanium mesh, thin piece of porous polyethylene or a combination of both, manually before inserting it into the space after all unstable bone fragments are removed and the prolapsed tissues are reduced. The implant often requires several adjustments during the operation until it fits the curvature of the patient's orbit. This time-consuming process relies heavily on ophthalmologists' clinical experience: Any mismatch between the implant and the orbit in size or shape would lead to orbital volume.

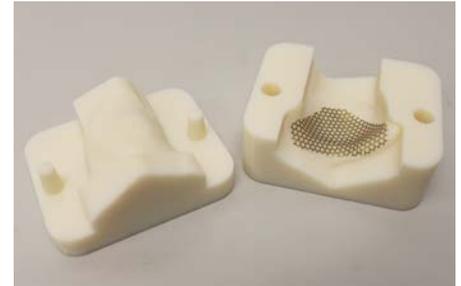
Dr. Martin Chung-ming Wong, senior engineer and Mr. Louis Kwan-Yik Sze, assistant engineer at Hong Kong Polytechnic University, recommended using 3D printing technology to enhance precision and shorten operation times for severe fractures. "We believed that ophthalmologists could benefit from the precision offered by 3D printing, creating accurate implants before an operation instead of having to manually adjust and test it during the operation," said Wong.

In 2009, IC began using a Fortus® 3D Production System to create orbital implant molds for ophthalmologists from the Prince of Wales Hospital and Alice Ho Miu Ling Nethersole Hospital. Using a patient's CT scan and X-ray images, Wong and his team reconstructed that patient's orbital floor in CAD software. They then 3D printed two thermal layers – the upper and lower parts of the mold – and pressed a thin titanium sheet between the two mold parts to form the shape.

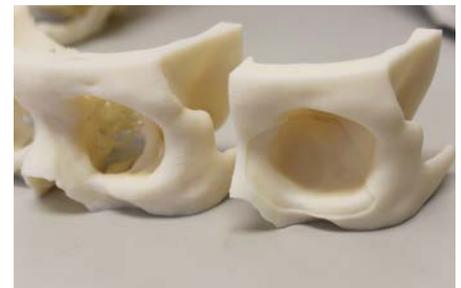
## Customized Implant with Sterilizable Material

Dr. Kelvin Chong, assistant professor at the Chinese University Department of Ophthalmology and Visual Science, and the coordinator of Orbital and Oculoplastic Surgery at the Prince of Wales Hospital and Alice Ho Miu Ling Nethersole Hospital, was pleased with the availability of patient-specific orbital implants. "Apart from using ready-made implants, which is the most common surgical approach at present, 3D printing has provided us with an alternative and more precise way to reconstruct different orbital bones. Customized molds can be 3D printed within three to four hours and we can simply press the two halves together to create the necessary shape for patient," he said.

3D printed molds allow much faster implant shaping with unparalleled precision and significantly shortened operative time. Surgeons are eager to see if clinical trials can improve surgical outcome and safety, particularly in complicated cases like complex fractures involving multiple orbital walls and rims.



Hong Kong Polytechnic University now 3D prints customized molds of all shapes and sizes, leading to a higher implant surgery success rate and faster recovery rates.



3D printing helps visualize a patient's missing orbital floor (left) versus original shape before impact (right).

The Fortus' material options played a key role in improving surgeries. Since artificial parts are placed inside a patient's orbit, everything from the implant to surgical guides needs to be completely decontaminated. PC-ISO™, a bio-compatible thermoplastic used to print strong, heat-resistant surgical parts, became the immediate answer. Because the material is bio-compatible in its raw state (it complies with ISO 10993 USP Class VI) and can further be gamma or EtO sterilized, it's ideal for the medical industry. "Surgeons would only need to sterilize the mold and form the implant shape by pressing the two parts together, resulting in an accurate customized implant," said Sze.

## More Innovative Applications

IC currently is the registered Hong Kong Hospital Authority supplier of customized surgical guides such as orbital implants, orthopaedic pre-surgery models and dental models. However, Wong continues to incorporate 3D printing technology into his other projects. For instance, he said that the Fortus 3D Production System has become one of IC's most used instrument for research, student projects and trainings.

"The Fortus has brought a lot of convenience to us as engineers, and we are glad that it also helps eliminate unnecessary risks for medical practitioners. I look forward to further applying 3D printing technology into our other projects," said Wong.



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