



# Cutting Costs to the Bone

3D MODELS IMPROVE HOSPITAL'S ORTHOPAEDIC SURGERIES

*“3D printing allows in-depth assessment and pre-surgical rehearsal. Implants are more accurately fitted to the curvature of the patient’s bone.”*

*– Professor Kwok-sui Leung, Department of Orthopaedics and Traumatology, Chinese University of Hong Kong.*

## CASE STUDY



Pre-surgery planning and rehearsal using 3D printed models has reduced complex surgeries' time by an hour and improved success rates.

Professor Kwok-sui Leung is expanding his department of Orthopaedics and Traumatology, Faculty of Medicine of the Chinese University of Hong Kong (CUHK) beyond its traditional role as an academic clinical department. At the department's Prince of Wales Hospital, Leung is improving the success and accuracy of surgeries, boosting patient confidence and exploring new innovative surgical methods all at once. How? By using 3D printing to create bone models and surgical guides for orthopaedic surgery preparation.

3D printing is ideal for prototyping bones because the calcium in the human skeleton makes the scanned images very clear. A Computed Tomography (CT) scan generates the required files for 3D printing. Surgeons use the 3D printed bone models for consultation, assessment and surgical planning for conditions including bone cancer surgeries, degenerative arthritis, realignment of deformed limbs and reconstruction of fractured bones.

## Reduced Costs and Time for Surgeries

The Prince of Wales Hospital adopted a Fortus® 3D Production System that uses FDM Technology™ to print both surgical guides and surgical tools. Before using 3D models to prepare for surgical procedures, most surgeons at the Prince of Wales Hospital relied on their experience and CT scans to visualize and plan the operation. Validating their planned approach took place in the operating room. Preparing for an operation using 3D printed models shortens the surgical process and increases operation accuracy and success rate.

“Patients’ 3D printed bone models are used to test different positions of stabilizing plates or screws. 3D printing allows in-depth assessment and pre-surgical rehearsal, resulting in a smooth operation process in which implants are more accurately fitted to the curvature of the patient’s bone,” Leung said. “The risk of bleeding and subsequent infection is also reduced.”

One of the most common incision sites in bone cancer surgeries is at the end of the femur, close to the knee joint. Accuracy of an incision site is critical to completely remove the tumor and reconstruct a functioning extremity. Correcting pelvic fractures from car accidents – another routine hospital procedure – also requires extreme precision. For complex procedures, such as determining the angle of screw placement and location of metal implants, 3D models provide the trial space necessary to gain the accuracy desired.

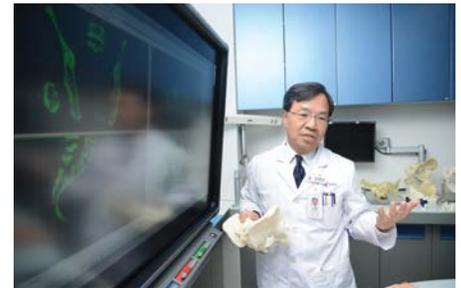
Prince of Wales Hospital uses 3D printing in cases ranging from corrective osteotomy (re-alignment of bone from deformity) to complex bone fractures from car accidents. On average, operation time was reduced by an hour when incorporating 3D printed parts in the pre-surgical process.

## Creating Innovative Approaches

Elvis Chun-sing Chui, biomedical engineer at the Orthopaedic Learning Centre of CUHK, said, “The adoption of 3D printing provides a platform to experiment with innovative surgical approaches. Moreover, it enhances the communication between medical practitioners and patients. Patients better understand the diagnosis and treatments with the aid of the 3D printed parts.”

In addition to printing surgical guides, CUHK and Prince of Wales Hospital have further extended their applications to printing small, single-use surgical tools.

For example, frequently it’s helpful for orthopaedic surgeons to use a guide to ensure accurate screw placement before inserting them into the bone. These small plastic guides are custom made for each individual patient, based on their unique anatomy and surgical procedure. And because the Fortus 3D Production System can build with PC-ISO®, a biocompatible thermoplastic that is sterilizable, the clinician can use the guides on patients directly from the 3D printer. In one case, the 3D printed guide only cost approximately HKD100 – several times less than traditional manufacturing costs, and much quicker as well.



Professor Kwok-sui Leung uses CT scans of patients as the blueprint to 3D print models of their bones.



Surgeons’s pre-surgery planning using 3D models increases accuracy during the actual surgery. One of the most common incision sites in bone cancer surgeries is at the end of the femur, close to the knee joint.



Prince of Wales uses 3D printing in cases ranging from corrective osteotomy (re-alignment of bone from deformity) to complex bone fractures from car accidents, like the above.

“3D printing helps us advance medical research and development,” said Leung. “It [3D printing] offers ample potential in both the surgical guides and surgical tools areas. And, the cost saved from using 3D printing can now be used for research and development, ultimately benefiting patients, surgeons and researchers.”



Correcting pelvic fractures requires extreme precision. For complex procedures like determining the angle of screw placement and location of metal implants, 3D models provide the trial time to gain the accuracy desired.

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