3D PRINTING IN ORTHOPAEDICS

Case studies by ShapeCrunch
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Shapecrunch Technology Pvt. Ltd. specializes in fulfilling doctor’s customization needs through 3D printing.

We have worked on numerous cases where we have helped doctors by providing custom surgical guides and patient specific models for surgical simulations.

In this booklet, you will find certain cases that we have worked on.
A TKR involves removing the end of the thigh bone, and the top of the shinbone, and replacing them with prostheses (artificial knee implants). The artificial knee is usually made of metal alloy and high density plastic.

Before implanting these metal pieces onto bones, these bones needed to be cut at certain angles and depth. So patient specific 3D printed Guides are used to guide the tool at a certain angle and depth.

Process:

1. CT scan is converted into 3D Model.
2. Standard implants are selected.
3. Guides are designed onto patient specific 3D model using these standard implant angles and sizes.

For more info, visit www.shapecrunch.com
The challenges of complex primary hip arthroplasty (dysplastic hip, ankylosing spondylitis, protrusio, post fracture reconstructions) and revision hip arthroplasty include assessing the bone defect and reconstructing the same. The primary goal is optimal placement of the acetabular component in the anatomic position, equalizing leg lengths, preserving, augmenting or restoring pelvic bone stock, and ensuring a stable fixation.

Process:

1. CT scan is converted into 3D Model.
2. Standard implants are selected.
3. Guides are designed onto patient specific 3D model using these standard implant angles and sizes.
With 3D printing technology, we can simulate the shape of the vertebra, which is much stronger and more convenient than traditional methods.

A tumour was discovered when a patient injured his neck while heading the ball in a football match. He was subsequently diagnosed with bone cancer. Surgeons removed second vertebra, before inserting the implant between the first and third vertebrae.

Patients CT scan was sent to Shapecrunch which was later converted into 3D model, and then a real size model was 3D printed.

The whole implant surgery was simulated on the 3D printed replica of the bones before the final operation, which reduced the chances of complications and infection.
Orbital hypertelorism is a condition where there is an abnormally large distance between the eyes, and it refers specifically to the position of the bony orbits – or ‘eye sockets’ – which provide protection and support for the eyes lie within the skull.

It can be due to abnormal development of the bones of the forehead and the base of the skull, can occur due to premature fusion of the bony plates of the skull, or can be caused by a variety of syndromes, such as Edwards, duplication, basal cell nevus, DiGeorge, and Loeys-Dietz syndromes, among other potential causes.

Shapecrunch was provided with a CT Scan of the patient’s skull and we helped in this surgery by providing a 3D printed model to successfully plan and perform a surgical procedure which used a pair of techniques called ‘Box Osteotomy’ and ‘Facial Bi-Partition’ to take on the problem.
CASE V:
3D PRINTED BEND PLATE TEMPLATE FOR FRACTURED BONES

The production of a copy of the fracture or a deformity in a bone with a complex geometry can be one of the important applications of the integration between two modern computer-based technologies, reverse engineering (RE) and rapid prototyping (RP).

And Acetabular Fracture is one its kind. Due to its complex geometry, it is difficult to treat the fracture and put the bend plate.

Process:

1. CT scan is converted into 3D Model.
2. Standard Plates are selected according to the size of the fracture.
3. Model is 3D printed and a bend plate is extracted from the digital mode.
4. Metal plate is bent using the template.
5. And bended plate is simulated on the 3d printed pelvis model.
Osteotomies around the knee have been used to correct lower limb mal-alignment and the same procedure is to be performed for radius and ulnar deformation. The procedure is technically demanding and carries risks of neurovascular injury and inadequate fixation. In recent years, with the advent of locking plates, fixation techniques have improved significantly but the correct planning and execution of the operation remains difficult.

Despite the availability of computer tomography (CT) and magnetic resonance imaging (MRI) which can generate virtual three-dimensional images (3D), surgical planning is still commonly performed on two-dimensional (2D) conventional radiographs. This in part may be because of the difficulty in appreciating the 3D information during a surgical procedure.

Now, especially in case of multi-planar deformities, the old 2D technique is obsolete and prone to error. In addition, it can be argued that the traditional intra-operative
tools such as rulers and protractors for checking the achieved geometrical correction are relatively crude and inaccurate.

Process:

1. Patient’s CT/MRI is converted into 3D model using FDA approved regeneration software.
2. Then incorrect and correct bones are matched to get the desired angle and correction in the misaligned bone.
3. Virtual simulation is done on 3D software to get the proper cut and bend plate screws.
4. Surgical guides and bones are 3D printed which can be used for surgical simulation.

For more info, visit www.shapecrunch.com
Proper use of surgical guides can improve clinical outcomes in dental implant surgeries by facilitating detailed presurgical planning and precise placement of implant bodies. Definitive prosthetic design can be used during presurgical planning to determine the appropriate location for the implant, leveraging cone-beam computed tomography (CBCT) technology to evaluate topography and identify vital structures. Guide use can help relieve clinicians of several preoperative decisions and reduce intraoperative time.

Process:

1. Patient CBCT data is taken.
2. Standard implant guides are chosen and required angle and depth are calculated.
3. Intra oral scan is also taken and is superimposed with CBCT data.
4. Surgical guide are designed that will fit on to the patient’s teeth and gums.
5. Metal guides are inserted into the plastic guides.
6. These guides then assist dentists to perform accurate surgery.
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GET IN TOUCH

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