Point of Care 3D printing Project

USE CASE 1: FOOT AND ANKLE

In this case, the patient suffered from pigmented villonodular synovitis (PVNS) of the right foot. The collection of PVNS to the plantar aspect of midfoot had resulted in bone erosion to the plantar aspects of the cuboid, navicular and all three cuneiform bones. Because there was a possibility that the surgical team would have to approach the area dorsally by removing bone, a full foot and ankle model was requested to clarify the severity and location of erosion and assist the surgical team with preoperative planning and surgical simulation. The model was printed in a material that permitted surgical simulation prior to surgery and with a reasonable approximation of bone-like properties. The model was printed with artificial connectors between the various foot and ankle bones so that they were presented in the correct anatomical locations and orientations relative to each other. However, in order to enhance the surgical team's understanding and effects of their chosen surgical procedure, the model was printed in such a way that the lateral, intermediate and medial cuneiform bones were removable from the main body of the foot.

Surgeon: Mr. James Davenport.

Material: High resolution (20um) acrylic Vero white and magenta build material.

3D printing technology: Polyjet Stratasys Objet Prime 30.

Imaging modality: CT Scan.

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USE CASE 2: FULL PELVIS AND LEFT FEMUR




An operable model of the full pelvis and left femur was requested to determine the need for a custom acetabular implant to guide and plan de-rotation and shortening osteotomy procedures. The hip joint centre (HJC) was calculated from the healthy femoro-acetabular joint (right hand side) and marked onto the opposite acetabulum. The marking consisted of two perpendicular lines, with the HJC being defined as the point at which these lines intersected. The surgeon could then assess whether the HJC had been restored in the correct location during surgical simulation. In addition, the full pelvis was printed with a connector section which replaced the sacrum; this allowed the model to be disassembled for surgical-simulation and re-assembled into the correct anatomical orientation.

Material: Operable bone-like material - Woodfill PLA.

3D printing technology: Ultimaker 3 Extended - Fused Deposition Modeling.

Imaging modality: CT Scan.

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USE CASE 3: HEMIPELVIS AND PROXIMAL FEMUR




Due to the patient complaining of continuing pain following a total hip arthroplasty, models of the proximal femur and hemipelvis were 3D printed to determine whether there was possible bone impingement on the psoas tendon. It was suspected that the anterior acetabular wall was causing the psoas irritation and subsequent pain, but it was initially decided that surgery was unnecessary. Upon review of the 3D printed model it was noted by the surgeon that there was a small boney protrusion located in the psoas tendon groove that had not been obvious from the scans. Once the existence of this protrusion was retrospectively confirmed from the CT scan, a review of surgical treatment was required.

Surgeon: Professor Tim Board.

Material: Operable bone-like material - Polywood PLA.

3D printing technology: Ultimaker 3 Extended - Fused Deposition Modeling.

Imaging modality: CT Scan.