insight surgery

Digital Planning & Personalized Solutions

3D SOLUTIONS FOR CARDIAC SURGERY

3D ANATOMICAL MODELS, MEDICAL DEVICE SIZING, SURGICAL SIMULATION SOLUTIONS

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Case Summary

In this rare case, cardiologists and surgeons at a specialist heart and chest hospital needed to treat a patient presenting with a large build-up of calcification around their mitral valve.

This model formed part of a series looking at Hypertrophic Cardiomyopathy (HCM) in patients, and the effectiveness of 3D modelling and printing as an adjunct to traditional scan interpretation for clinicians and surgeons during their pre-surgical planning.

Description

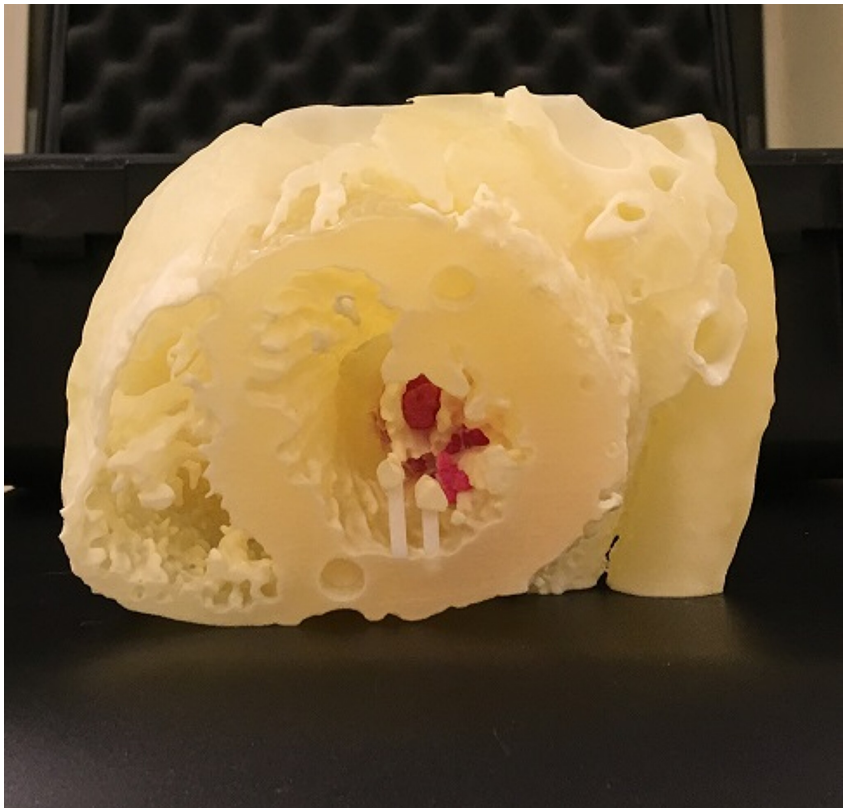
Insight Surgery segmented the patient's scan data and developed a virtual model of their heart. This model was then 3D printed in a softer material that provides a more realistic feel than more rigid options.

The multi-material model showed the mitral valve and its relation to the calcification in three separate parts.

INSIGHT SURGERY
CASE STUDY

CARDIOLOGICAL PRE-SURGICAL PLANNING

SPECIALITY: CARDIOLOGY
PROCEDURE: TREATMENT FOR HYPERTROPHIC CARDIOMYOPATHY
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL



OUTCOME / BENEFITS

The patient-specific anatomical models provided to the surgeon offer them a tactile representation of the pathology in front of them. They helped to facilitate an accurate diagnosis and aid the surgeon in developing an appropriate treatment plan.

This specialist now requests models as standard in the treatment of patients presenting with complex HCM.

Case Summary

A pediatric patient presented to this Hospital with multiple ventricular septal defects (VSD). The treatment plan for this congenital heart defect was comprised of multiple surgeries.

A unique model of the patient's anatomy was requested to support the team's surgical planning ahead of live theatre.

Description

Insight Surgery segmented the patient's data and produced a model based on the volume of blood within the heart's chambers rather than the heart itself. It was 3D printed in rigid white material for clear visualisation and handling by the whole team.

The model marked a significant innovative step as Insight Surgery moved beyond providing a copy of the heart to create something highly specific to this type of operation, proving to be of even greater use to the surgeon.

INSIGHT SURGERY
CASE STUDY

PEDIATRIC CARDIOLOGICAL PRE-SURGICAL PLANNING

SPECIALITY: CARDIOLOGY
PROCEDURE: MULTIPLE VENTRICULAR SEPTAL DEFECT PATCHING
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

The volume modelling application of 3D printing is an extremely useful technique to indirectly image malformations of the heart by printing the blood volume within structural cavities. The surgeon said *"this is a very impressive and imaginative way to use 3D printing for organ imaging. In this case, we were able to complement the visualisation of the cardiac defects and make the decision that it might be possible to perform a less invasive procedure"*.

The team decided no further patching of the perforations was necessary and these decisions resulted in a second surgery that was shorter, less complex and held lower risk.

Case Summary

A surgeon and his team at a children's hospital were required to treat a patient in need of an Aorto-Left Ventricular Tunnel (ALVT) repair. ALVT, an extremely rare congenital defect involving an extracardiac channel connecting the ascending aorta, above the sino-tubular junction, to the left or right ventricular cavity. Without surgical intervention, heart failure is highly likely.

A patient-specific anatomical model was requested to assist the team's pre-surgical planning and communication.

Description

Insight Surgery segmented the MRI scan of the patient's heart structure before calculating the blood volume flowing through it.

The model was then 3D printed in a white and rigid material for the surgical team, enabling them to fully visualise the condition of the patient's heart, and formulate the best plan of approach for the upcoming repair.

INSIGHT SURGERY
CASE STUDY

PEDIATRIC CARDIOLOGICAL PRE-SURGICAL PLANNING

SPECIALITY: CARDIOLOGY
PROCEDURE: AORTO-LEFT VENTRICULAR TUNNEL REPAIR
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

This condition has an incidence rate as low as 0.001% of all congenital heart diseases. The facilitated in-depth planning for a complex and unfamiliar procedure which led to reduced overall planning time.

The model was described as being of great use in explaining this rare congenital condition to nurses, cardiologists, and to the patient's family. 3D printing in this case provided a superior method of communication than 2D scans alone.

Case Summary

A Consultant Pediatric Cardiologist requested 20 3D printed heart models to be used as part of a professional education course exploring Fetal Cardiology, MRI and Echocardiography.

In particular, the identification of congenital heart defects and treatment options were to be discussed.

Description

All models were printed in soft material for a more life-like handling experience. In some cases, inserts for small magnets were designed into the prints.

The use of small magnets embedded within the printed sections allowed for the models to be taken apart and reassembled. This enabled interior perspectives of the congenital defects the models were portraying for the attendees.

INSIGHT SURGERY
CASE STUDY

PEDIATRIC CARDIOLOGICAL EDUCATION & TRAINING

SPECIALITY: CARDIOLOGY
PROCEDURE: CONGENITAL HEART DEFECT IDENTIFICATION AND TREATMENT
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODELS

OUTCOME / BENEFITS

The 20 heart models, some of which could be taken apart and pieced together again, provided attendees with realistic, tactile teaching aids that could be passed around and explored as an adjunct to lectures and screen-based learning which formed the majority of the course. Combining haptics with visual learning is increasingly being seen as a more effective approach to teaching clinicians about complex pathologies and treatments than visual instruction alone.

The models are durable enough to be used for repeat courses in years to come, allowing the hospital to continue to deliver leading cardiac training to professionals from around the world.

Case Summary

Cardiologists at a children's hospital were inspired to explore the use of 3D modelling and printing as a way to bring their CT angiograms of pre and postnatal patients to life.

Producing 3D models of aortic abnormalities shown in anti- and post-natal scans proved to be a useful adjunct to traditional CT angiogram interpretation and use in communication with others involved with the patient's treatment. Explanation of the pathology and challenges inherent to each treatment pathway became much clearer in their conveyance.

Description

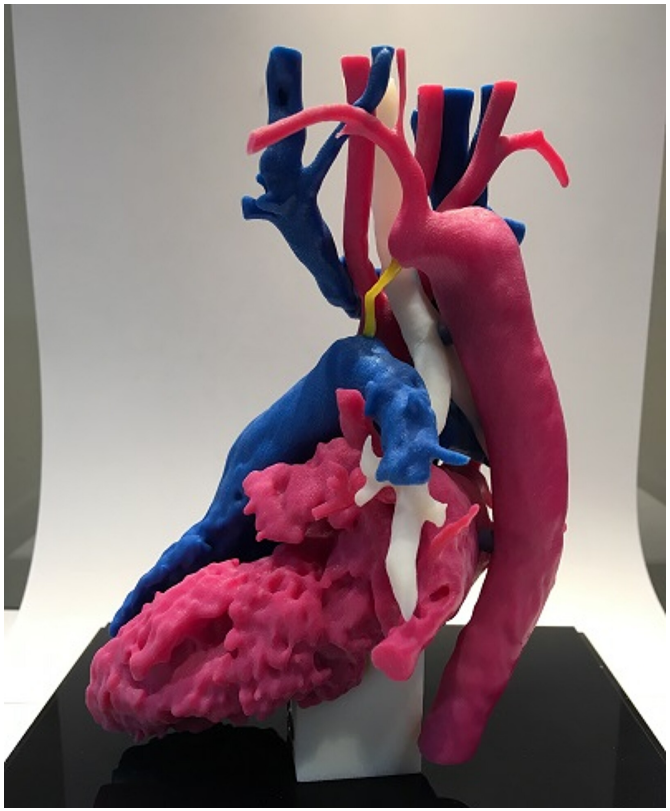
In this model, the main artery (pink) presents on the right-hand side of the patient's body, instead of the more common left-hand side. This is a right aortic arch. As the aorta descends, it joins other structures, such as the ductus ligament and the pulmonary artery, in encircling the trachea and oesophagus which can lead to breathing and feeding problems.

In terms of surgical planning, the decision to make is whether to divide the ductal ligament or consider removing the whole of the Kommerell diverticulum. The challenge in conducting surgery in an older patient such as this is that surgeons run the risk of compromising blood flow to the left arm. Earlier intervention could have created co-lateral blood supply, preventing the risk.

INSIGHT SURGERY
CASE STUDY

PEDIATRIC CARDIOTHORACIC EDUCATION AND TRAINING

SPECIALITY: CARDIOLOGY
PROCEDURE: INVESTIGATION INTO ANTI AND POST-NATAL AORTIC ARCH ABNORMALITIES
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODELS



OUTCOME / BENEFITS

Over time, a collection of models has been built to aid understanding and education at the hospital and is beginning to form part of a standardised pathway into aortic arch investigation. In each case, the model acts as a focal point for surgeons as they set out procedure choices to colleagues.

Particular value has also been found in their explanatory power for junior clinicians and surgeons still in training. Similarly, the patient's families benefit from a clear representation of what their child faces, what the proposed treatment pathway will be, and why it was chosen in their case.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