insight surgery

Digital Planning & Personalized Solutions

3D SOLUTIONS FOR ONCOLOGY SURGERY BROCHURE

3D PRINTED ANATOMICAL MODELS,
VIRTUAL SURGICAL PLANNING,
PATIENT-SPECIFIC SURGICAL GUIDES

INSIGHT SURGERY
ONCOLOGY SOLUTIONS

SUMMARY / INDEX

WITHIN THE FOLLOWING AREAS

- Bone Sarcoma
- Cranio Maxillofacial
- Renal
- Paediatrics
- Hepatobiliary
- Spinal

SUMMARY OF ONCOLOGY PRODUCTS

3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODELS

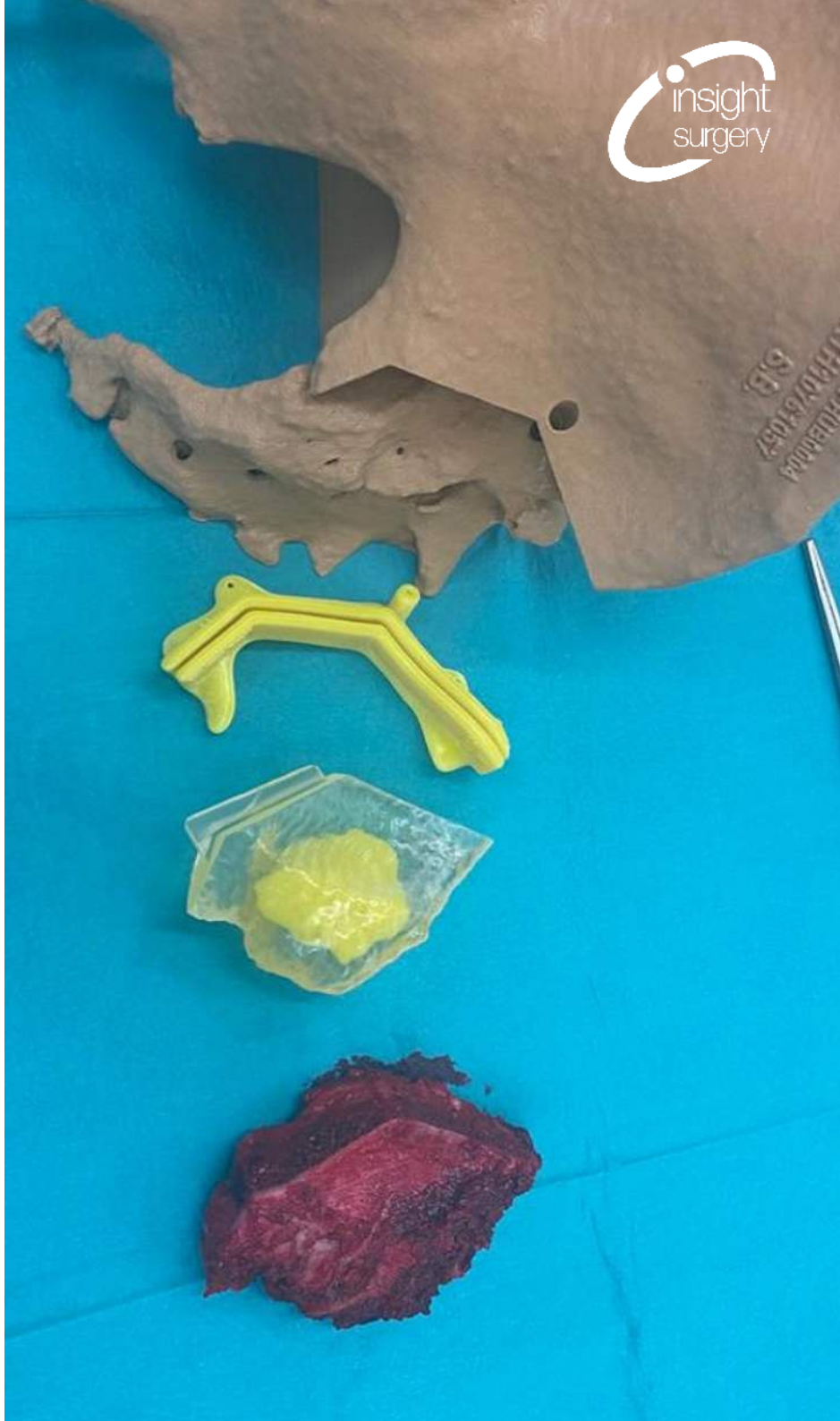
- Pre-surgical assessment, planning and simulation
- Intra-operative reference
- Patient communications
- Surgical simulation
- Short term implantation

VIRTUAL SURGERY AND SIMULATION

- Sarcoma margin definitions
- Sarcoma resection planes
- Virtual Surgical Planning

SURGICAL GUIDES

- Sarcoma cutting guides
- Orthopaedic cutting guides



CASE SUMMARY

A patient diagnosed with a highly malignant pleomorphic sarcoma in their right hemipelvis required surgery to remove it from the pelvis. The surgical team were presented with the challenge of resecting the tumour with a safe margin in order to preserve as much of the tissue as possible. A request was made for virtual simulation of the surgery, together with an anatomical model to be used for pre-surgical planning ahead of the live procedure.

DESCRIPTION

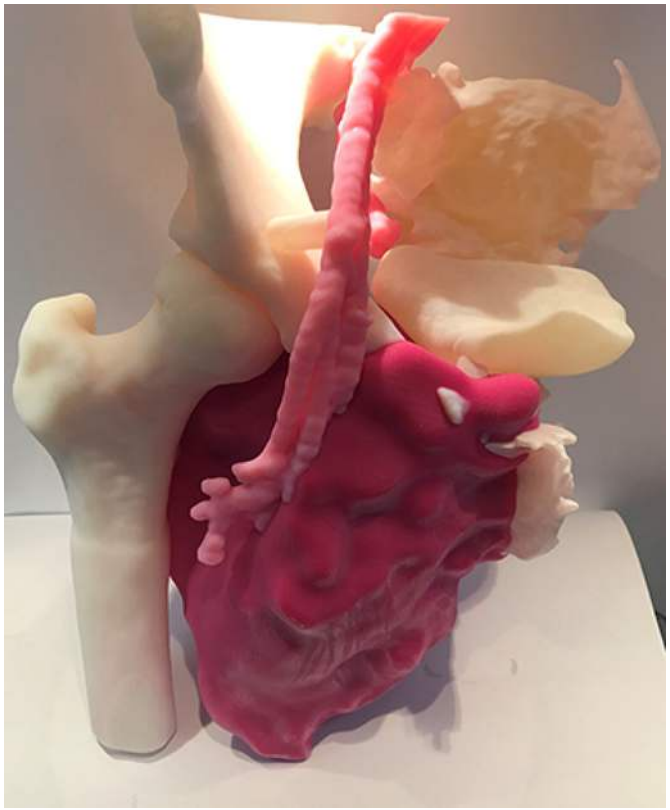
Insight Surgery first created a virtual model of the patient's right hemipelvis including the tumour, bone, rectum, uterus, cervix, vagina and labia. In order to obtain a complete picture, a merging of imaging modalities was required. The boundaries of the tumour were only visible on MRI and so this imagery was overlaid onto the CT data, which best shows the bone, to define the tumour's location and dimensions.

The relation of the large tumour to the surrounding tissue, specifically the vagina and labia tissue were areas of focus in the digital modelling phase. This allowed for the creation of a 3D printed surgical cutting guide for the left ilium, which was printed in sterilisable polyamide (above the yellow tumour model). The resected bone is beneath the model.

INSIGHT SURGERY
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION

SPECIALITY ONCOLOGY
PROCEDURE HIGHLY MALIGNANT PLEOMORPHIC SARCOMA REMOVAL
DEVICE 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL



OUTCOME / BENEFITS

The use of an anatomical model in the presurgical and intra-operative planning ensured a safe and accurate resection of the tumour. The surgeon commented "Access to the 3D model changed our plan to reconstruct to a staged reconstruction because of complexity of the tumour". For the patient, this meant less time under anaesthetic, lower risk while in surgery, and an opportunity for a better outcome post-surgery derived from the personalised treatment.

CASE SUMMARY

This patient presented with an Ependymoma; a large sacral sarcoma. The surgical plan involved an en bloc complete sacrectomy, plus an anterior and posterior reconstruction with V-Ram flap and free-fibula graft.

Insight Surgery was asked to provide a patient-specific anatomical model to assist in pre-surgical planning.

DESCRIPTION

Insight Surgery was provided with MRI and PET scans from which they were able to segment and develop a virtual model of the patient's sacral and pelvic anatomy.

In this case, Insight Surgery was able to pull out and highlight the patient's vasculature, bladder, sigmoid colon, and rectum, which were in close proximity to the tumour. This provided the surgical team with a detailed anatomical representation to enhance their surgical approach planning.

INSIGHT SURGERY
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING

SPECIALITY: ONCOLOGY
PROCEDURE: SACRECTOMY FOR EPENDYMOMA
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

Using this model the surgeon was able to gain a more thorough understanding of the patient's anatomy before considering the upcoming resection.

The surgeon was then able to plan the operation more accurately and effectively, identifying the areas most at risk from the procedure, minimising interference with surrounding structures, and avoiding the need for additional surgical steps.

The surgeon described it as *"(a) Fantastic model and 5 star service"*. The procedure was successful with no complications and the model was stated to have improved the operative outcome, enabling the team to confidently use an off-the-shelf implant rather than a patient-specific implant which would have incurred significant extra cost to the hospital.

INSIGHT SURGERY
CASE STUDY

PAEDIATRIC ONCOLOGICAL PRE-SURGICAL PLANNING / INTRA-OPERATIVE REFERENCE

SPECIALITY: ONCOLOGY
PROCEDURE: RESECTION OF COMPLEX TUMOUR
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

CASE SUMMARY

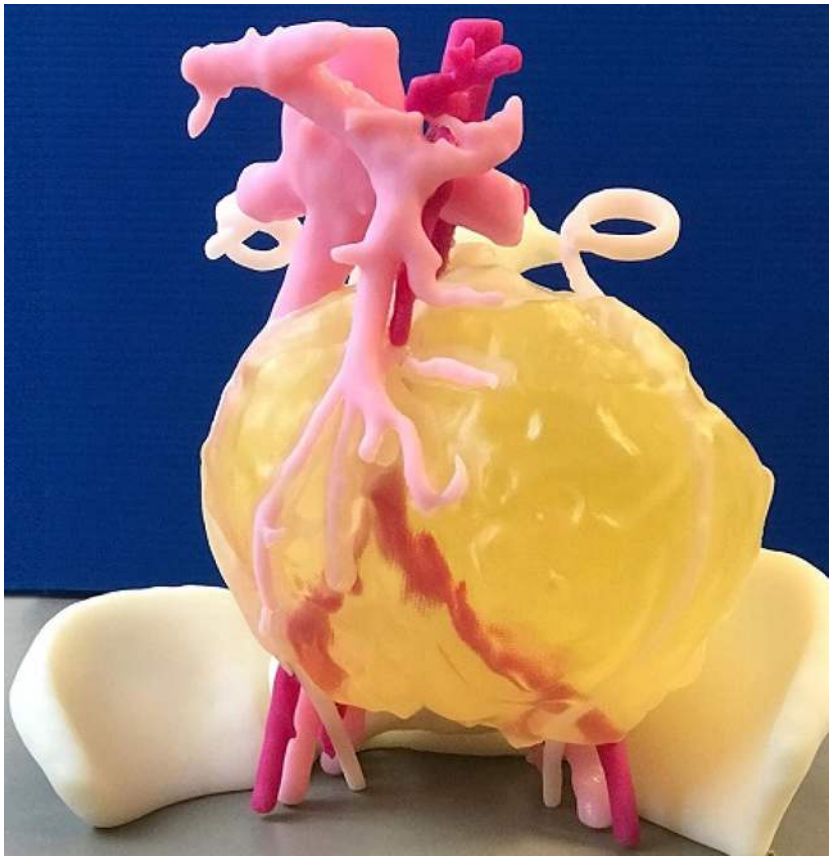
A paediatric patient's complex tumour had grown in close proximity to numerous important anatomical regions, including the spinal cord and superior mesenteric artery as well as enveloping large portions of important vessels such as the aorta and inferior vena cava. Surgery was considered 'impossible', with a 10% chance of survival given by some experts.

The 3D printed model was requested by the surgical team for patient communication and presurgical planning. The model detailed the tumour, major vessels and surrounding bony anatomy.

DESCRIPTION

The 3D model was printed using a variety of soft to hard materials for the tumour, bony anatomy & vessels. A variety of colours were used to highlight the spatial relationships between the tumour and the other important structures.

Design and manufacturing of the model were achieved in several days, owing to the urgency of the patient's condition.



OUTCOME / BENEFITS

Using the model, the surgical team were able to communicate the patient's condition to parents and agree the best approach to the procedure, increasing the chances of a safe and effective excision.

The surgeons were able to remove 90% of the tumour from the patient with no complications; a major success given the initial belief that surgery would not be viable at all.

A replica of the model now features in 'Cancer Revolution: Science, Innovation and Hope' at the UK's Science and Industry Museum.

Read about the Exhibition

Watch the BBC story

CASE SUMMARY

A patient diagnosed with a malignant peripheral nerve sheath tumour required drastic surgery in the form of an extremely complex hemicorporectomy.

The surgical team requested a patient-specific anatomical model, derived from PET CT, CT Angio, and MRI, to be presented at the MDT.

DESCRIPTION

This complex model involved the combination of the patient's PET CT scan and the CT angiogram data, with the arterial vasculature segmented from the CTA. The tumour itself was segmented from MRI data.

The active areas of the tumour were highlighted on both the virtual and 3D printed models for the surgical team to better visualise the tissue boundaries and plan their excision more thoroughly as part of the hemicorporectomy.

The model was 3D printed and delivered in time for the urgent surgery.

INSIGHT SURGERY
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING

SPECIALITY ONCOLOGY / GENERAL SURGERY
PROCEDURE HEMICORPORECTOMY
DEVICE 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

"Having the anatomical model available prior to and throughout surgery allowed specialists from all disciplines to discuss and visualise the surgery in a way that is was valuable indeed. We referenced the model throughout the process using it as a central discussion tool throughout, at least 10 times in all. Whilst it is difficult to quantify in a long and complex surgery like this if it actually saved time, there is no doubt that the surgery ran far more smoothly with it than it may have otherwise. Interestingly, the model was really useful in helping the ancillary staff understand what we were dealing with and trying to achieve, something that can be difficult. I have no doubt that the model helped achieve the best outcome for the patient"

Mr Duncan Whitwell, *Consultant Trauma and Orthopaedic Surgeon*

INSIGHT SURGERY
CASE STUDY

PAEDIATRIC ONCOLOGICAL PRE-SURGICAL PLANNING

SPECIALITY: ONCOLOGY
PROCEDURE: RESECTION OF COMPLEX TUMOUR
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

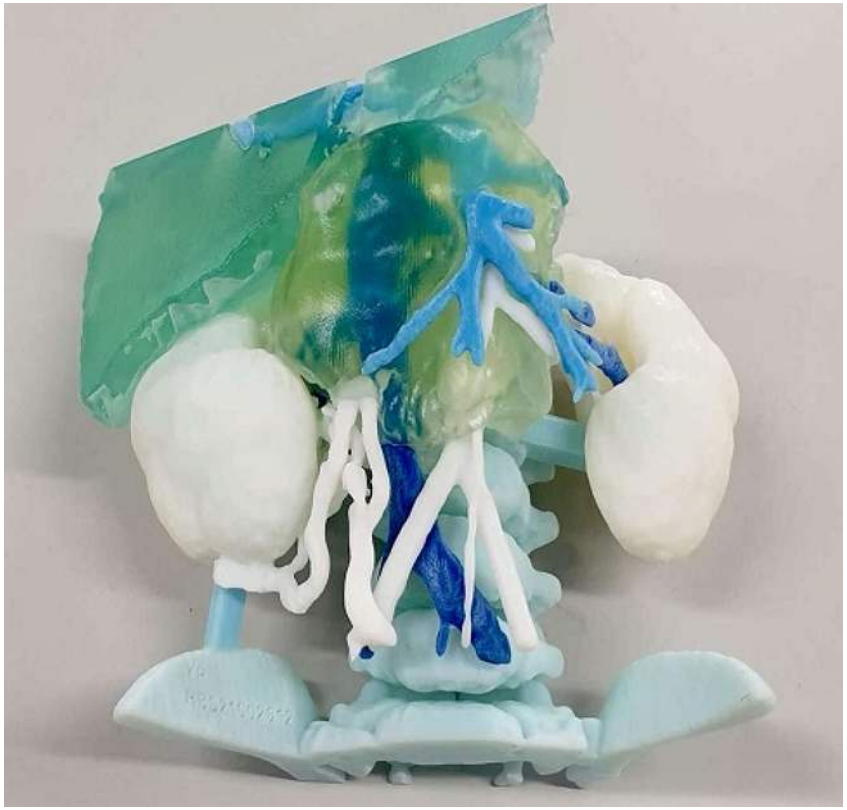
CASE SUMMARY

A paediatric patient presented with an extremely aggressive abdominal tumour and was initially given a 5% chance of survival. The tumour enveloped, or was in close proximity to, numerous important vessels (such as the IVC, aorta, portal vein, hepatic, mesenteric and renal arteries) and vital organs including the liver and kidneys.

Six months' worth of high dose chemotherapy shrunk the tumour, however, the patient still required highly complex surgery in order to survive. The surgical team requested a detailed model of the abdomen for study and planning, in order to increase the chances of a successful surgery.

DESCRIPTION

Utilising advanced 3D printing technology, a multi-material & multi-colour model was designed and printed to effectively show separation of important anatomical structures. A clear and soft material was used for the tumour, allowing for surgical simulation and viewing of the trajectory of important vessels through or close to it. A more rigid material was used for the bony anatomy & vessels in various colours.



OUTCOME / BENEFITS

Prior to commissioning the 3D printed model, there was an initial belief that surgery would be found to be too risky once the patient was in theatre. Using the model, the surgical team were able to fully understand the extent of the tumour in relation to the patient's surrounding anatomy, enabling them to plan their surgery in detail prior to theatre.

Surgeons were able to remove over 95% of the growth with no damage to the patient's surrounding anatomy.

Watch the BBC story

CASE SUMMARY

Surgeons approached Insight Surgery for assistance in preparation for a tumour removal surgery for a patient presenting with a growth that compromised their frontal sinus, amongst other structures. Following excision, reconstruction of the frontal bone would also be required, using bone taken from other areas of the patient's anatomy.

Two models were requested to help surgeons fully visualise and plan their approach to both procedures; resection and reconstruction.

DESCRIPTION

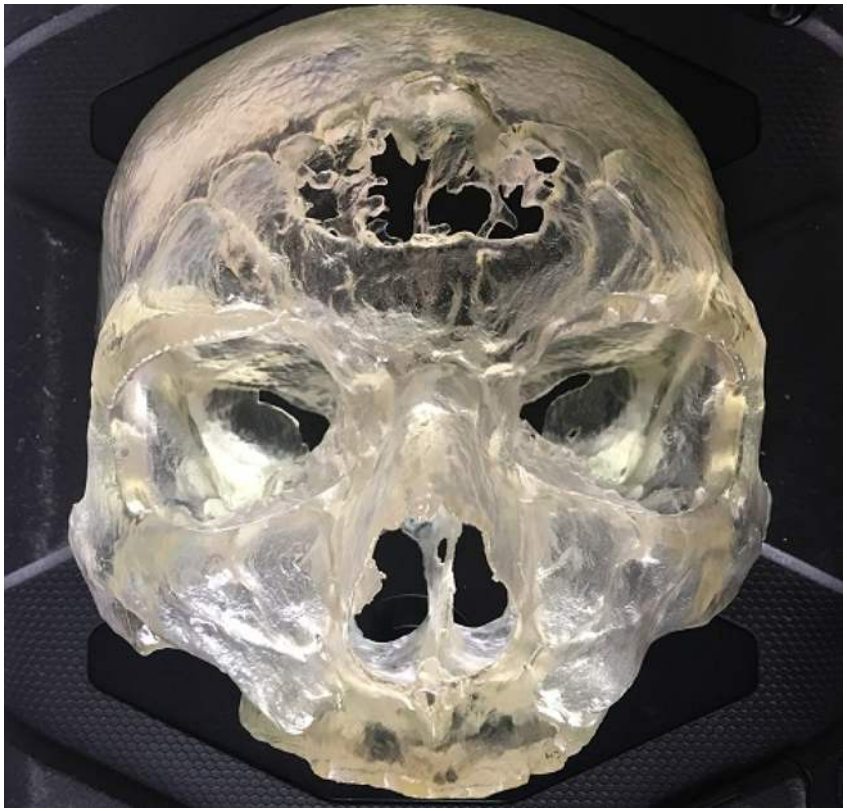
Insight Surgery segmented the patient's data and constructed virtual models of their anatomy. A transparent 3D printed skull was printed to show the position of the patient's tumour in relation to the frontal sinus.

Full-scale replicas of the patient's 6th and 7th ribs, as well as the left scapula, were also printed. These models were used to help the surgeons evaluate how best to reconstruct the frontal bone. These were printed in, a bone-like material, for a more realistic haptic feel.

INSIGHT SURGERY
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING AND INTRA-OPERATIVE REFERENCE

SPECIALITY ONCOLOGY
PROCEDURE COMPLEX TUMOUR EXCISION AND FRONTAL BONE RECONSTRUCTION
DEVICE 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODELS



OUTCOME / BENEFITS

With the provision of our complex patient-specific models, the surgeons were able to more effectively plan their tumour removal surgery ahead of the live procedure. The transparent material provided a clear view of the location of the tumour and a new perspective on how best to proceed in relation to the bone that would require subsequent reconstruction.

Surgeons were able to successfully gauge the most appropriate size and areas of bone to cut for use in the reconstruction of the frontal bone following removal of the cranial tumour.

CASE SUMMARY

A patient diagnosed with a sarcoma of the distal radius required surgery to remove it from the forearm. The surgical team were presented with the challenge of resecting the tumour with a safe margin in order to preserve as much of the distal radius and the radiocarpal joint as possible.

The surgeons requested that 3D LifePrints virtually simulate the surgical resection of the tumour in order to create a highly accurate surgical cutting guide to determine the exact location and angle of the incisions. An anatomical model was requested alongside the surgical guide to assist with the planning of the surgical approach.

DESCRIPTION

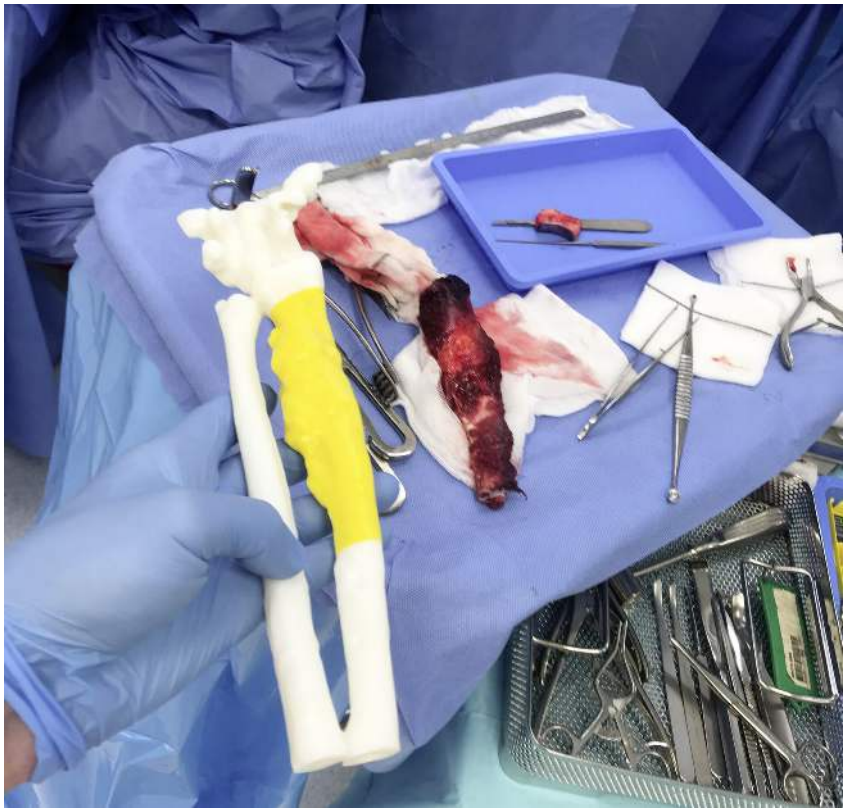
Insight Surgery developed a virtual model of the patient's anatomy, including the tumour, from the high-resolution CT scan. A 1cm margin was added at the surgeons' request to the extremities of the tumour in order to determine the ideal cutting planes for the patient-specific surgical guide which would be used to resect the tumour.

An anatomical model was 3D printed in multicolour to vividly show tumour boundaries while the surgical guide was 3D printed in sterilisable material for the surgery, shown in the picture adjacent to the model.

INSIGHT SURGERY
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDE

SPECIALITY: ORTHOPAEDIC ONCOLOGY
PROCEDURE: PARTIAL RADIAL OSTEOTOMY
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL AND SURGICAL GUIDE



OUTCOME / BENEFITS

The surgeon commented that is was *"Superb to have the design engineers embedded within the hospital. Very responsive and ended up with a model that really accurately reflected our patient's pathology which was of huge assistance both intra-operatively and for pre-operative consenting and discussion." And in respect of the guide "The intra-operative guide hugely assisted the intra-operative resection and ensured we had an adequate margin around the tumour."*

This time in theatre for this complex surgery was reduced by over an hour and 15 minutes by the use of the anatomical model and guide.

CASE SUMMARY

A patient diagnosed with a sarcoma of the distal radius required surgery to remove it from the forearm. The surgical team were presented with the challenge of resecting the tumour with a safe margin in order to preserve as much of the distal radius and the radiocarpal joint as possible.

The surgeons requested that Insight Surgery virtually simulate the surgical resection of the tumour in order to create a highly accurate surgical cutting guide to determine the exact location and angle of the incisions. An anatomical model was requested alongside the surgical guide to assist with the planning of the surgical approach.

DESCRIPTION

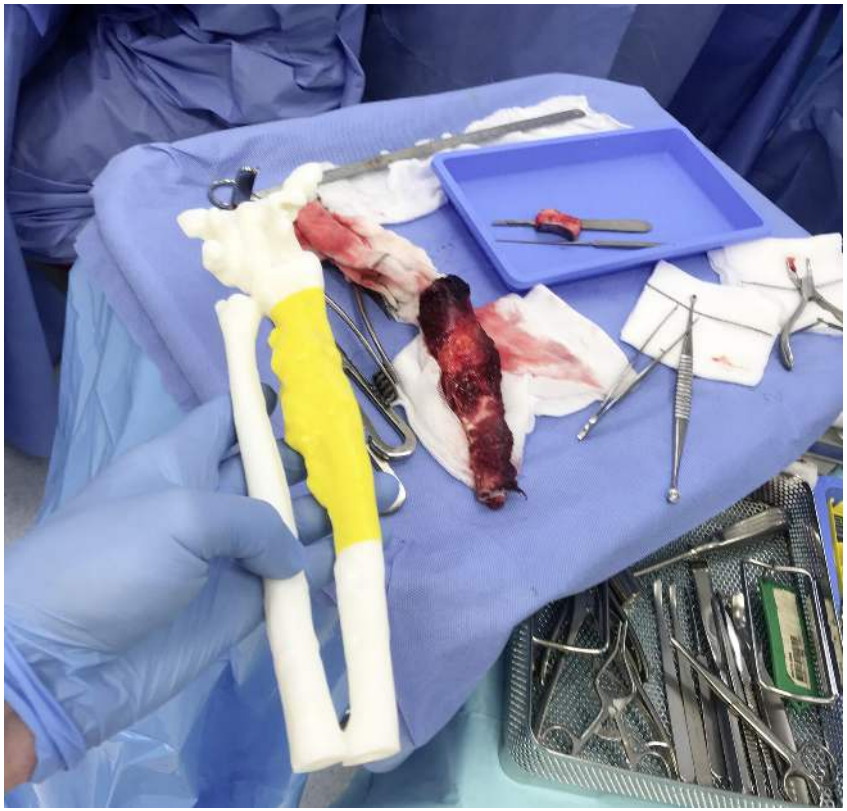
Insight Surgery developed a virtual model of the patient's anatomy, including the tumour, from the high-resolution CT scan. A 1cm margin was added at the surgeons' request to the extremities of the tumour in order to determine the ideal cutting planes for the patient-specific surgical guide which would be used to resect the tumour.

An anatomical model was 3D printed in multicolour to vividly show tumour boundaries while the surgical guide was 3D printed in sterilisable material for the surgery, shown in the picture adjacent to the model.

INSIGHT SURGERY
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDE

SPECIALITY: ORTHOPAEDIC ONCOLOGY
PROCEDURE: PARTIAL RADIAL OSTEOTOMY
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL AND SURGICAL GUIDE



OUTCOME / BENEFITS

The surgeon commented that is was *"Superb to have the design engineers embedded within the hospital. Very responsive and ended up with a model that really accurately reflected our patient's pathology which was of huge assistance both intra-operatively and for pre-operative consenting and discussion." And in respect of the guide "The intra-operative guide hugely assisted the intra-operative resection and ensured we had an adequate margin around the tumour."*

This time in theatre for this complex surgery was reduced by over an hour and 15 minutes by the use of the anatomical model and guide.

CASE SUMMARY

A patient diagnosed with a chordoma, a rare type of sarcoma growing in the thoracic region (T2-T4) of their spine, required timely surgery to remove it due to its close proximity to the spinal cord and its affecting of the structural integrity of the spinal column.

The surgical team were presented with the difficulty of resecting the tumour and affected tissue in an extremely challenging location in the body. Additionally, artificial support would need to be implanted to maintain the patient's structural mobility and strength. A request was made for an anatomical model to be used for pre-surgical planning and virtual surgical simulation ahead of the live procedure.

ANATOMICAL MODEL

Insight Surgery used segmentation software to develop a virtual model of the patient's spine, spinal cord, oesophagus, airway, blood volume and tumour.

As the accurate boundaries of the tumour were only visible on the MRI, the imagery was overlaid onto the CT data to define its location and severity.

INSIGHT SURGERY
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING AND VIRTUAL SURGICAL SIMULATION

SPECIALITY ONCOLOGY
PROCEDURE CHORDOMA RESECTION AND SPINAL CAGE INSERTION
DEVICE 3D VIRTUAL AND PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

CHANGING THE POINT OF ENTRY

Using the model in pre-surgical planning brought immediate benefit to the team as assessment made it clear how close the tumour was to the patient's oesophagus.

An oesophageal surgeon was brought in and the location of the surgical entry site altered to address this concern. This dramatically increased the accuracy of the team's plan and the patient's chances of survival, with less time in theatre anticipated.

DESIGNING THE CAGE

Virtual planning of the surgery also allowed for the subsequent design of a set of custom patient-specific implants, consisting of a carbon fibre spinal cage, bespoke rods, and screws which would fixate onto the remaining boney anatomy post-osteotomy.

Insight Surgery's embedded biomedical engineer, under direction from the surgical team, designed these patient-specific implants to fit the patient's anatomy while taking into account the anatomical situation once the vertebrae and tumour were surgically removed.

RESECTION CHALLENGE

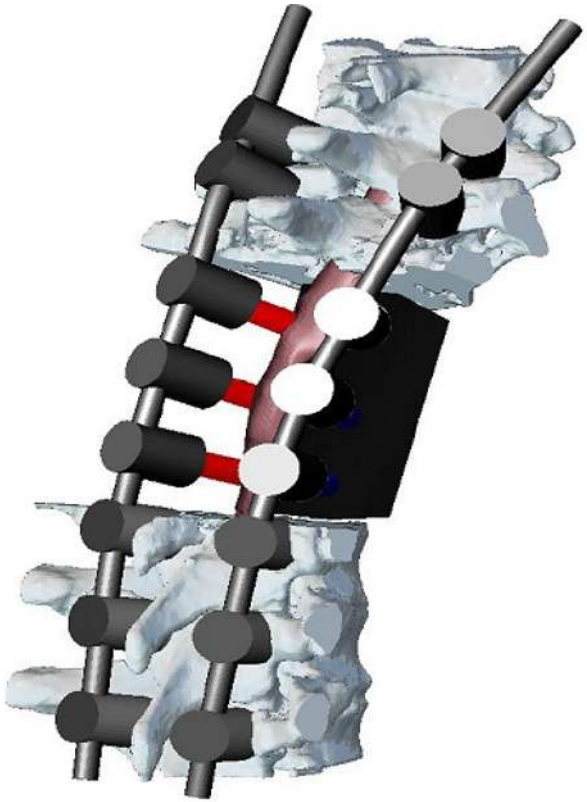
In surgery, the aggressive nature of the tumour became clear, having grown an additional 1.5cm in the interim month between virtual surgery and live theatre.

It was impossible to remove a safe margin of tissue around the tumour site without resulting in quadriplegia for the patient as the growth was sitting on the spinal cord. Inevitably, cancer cells would be left behind. However, the Carbo-Fix rod, screws and cage made targeted proton therapy possible.

INSIGHT SURGERY
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING AND VIRTUAL SURGICAL SIMULATION

SPECIALITY ONCOLOGY
PROCEDURE CHORDOMA RESECTION AND SPINAL CAGE INSERTION
DEVICE 3D VIRTUAL AND PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL



CUSTOM ROD IMPLANTATION

Carbo-Fix carbon fiber rods were chosen to fix the cage in place owing to their level of fatigue strength and suitability for follow up radiation therapy; producing no backscattering, no attenuation, and allowing precise radiation planning. The rods fit "absolutely perfectly" as a result of Insight Surgery's tailoring and the surgical team was able to finish the surgery in the second session, without the need to operate for a third straight day and compromise the patient further. Virtual planning of the screw lengths resulted in accurate recreation during live surgery with no deviation from the pre-determined lengths in theatre. The only deviation from the virtual plan was a decision to shorten the carbon cage in theatre.

OUTCOME / BENEFITS

After a total operation time of 31 hours, spread over two days with more than 5 surgeons, the surgery was considered a complete success and the patient has begun recovery. The Virtual Surgical Planning service provided by Insight Surgery to the surgeons for use in their pre-surgical planning proved to be extremely beneficial in allowing them to conduct an efficient and accurate set of procedures.

ONCOLOGY SOLUTIONS

insight surgery

Digital Planning & Personalized Solutions

WE PRIDE OURSELVES ON PROVIDING OUTSTANDING CLIENT SERVICE AND ARE ALWAYS AVAILABLE FOR A DISCUSSION

EMAIL US
info@insightsurgery.com

CALL US
+1 281 7332568 (Houston office)
+44 (0) 151 528 8749 (Liverpool office)
+44 (0) 1865 52 2767 (Oxford office)
+44 (0) 207 193 5630 (London office)

FIND US
Texas Medical Center
2450 Holcombe Blvd, Suite X, Houston, Tx 77021, USA
Alder Hey Children's Hospital
Eaton Road, Liverpool L12 2AP, UK
Nuffield Orthopaedic Centre
Old Road, Oxford OX3 7LD, UK
Wrightington Hospital
Hall Lane, Appley Bridge, Wigan WN6 9EP, UK
Leeds General Infirmary
Great George Street, Leeds, LS1 3EX, UK