PATIENT SPECIFIC MEDICAL
DEVICES AND SOLUTIONS
AT THE POINT OF CARE

3DLIFE Prints

3D SOLUTIONS FOR ONCOLOGY SURGERY BROCHURE

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

3D LIFEPRINTS
ONCOLOGY SOLUTIONS

SUMMARY / INDEX

WITHIN THE FOLLOWING AREAS

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

SUMMARY OF ONCOLOGY PRODUCTS

1. 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODELS

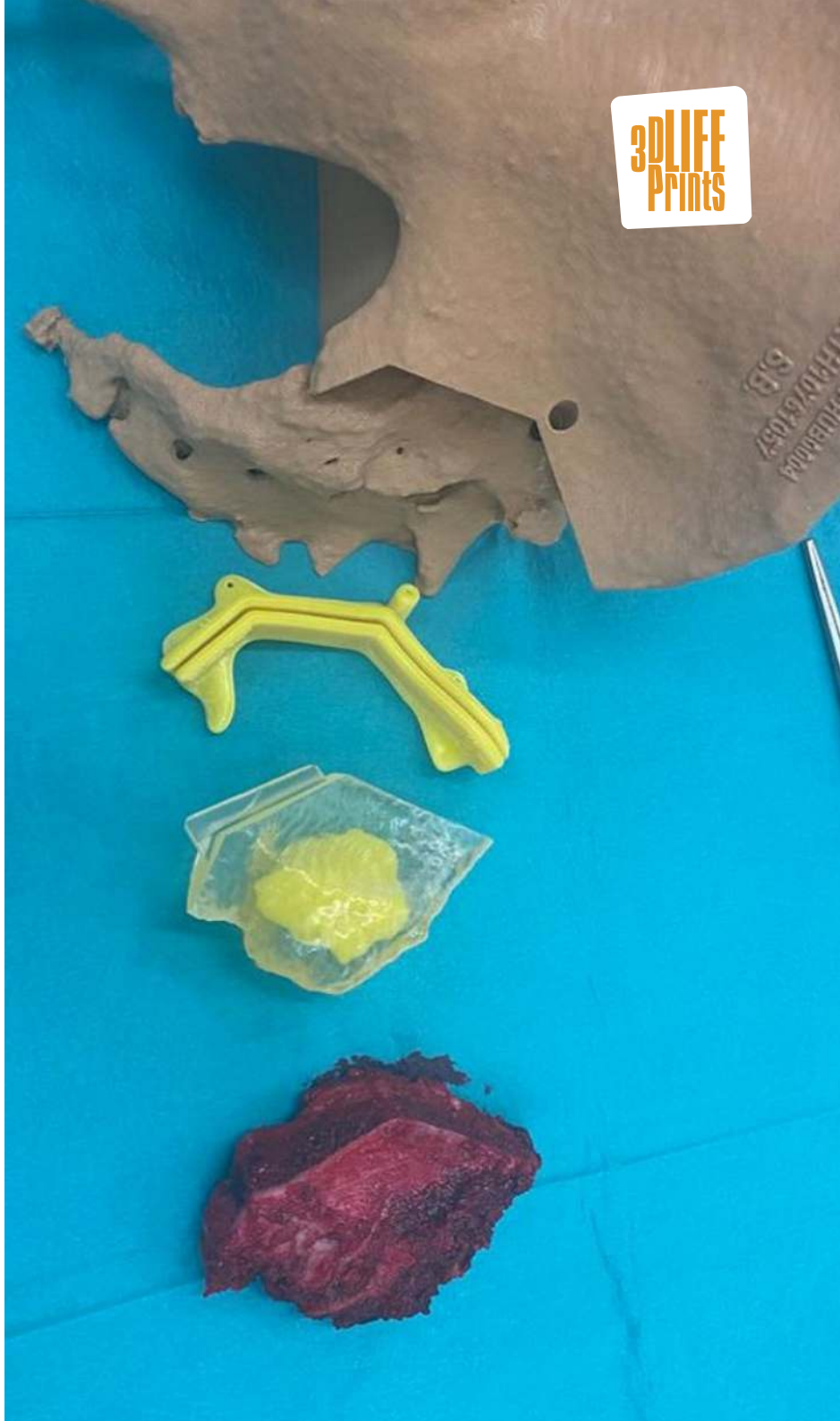
- Pre-surgical assessment, planning and simulation
- Intra-operative reference
- Patient communications
- Surgical simulation
- Short term implantation

2. VIRTUAL SURGERY AND SIMULATION

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

3. 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

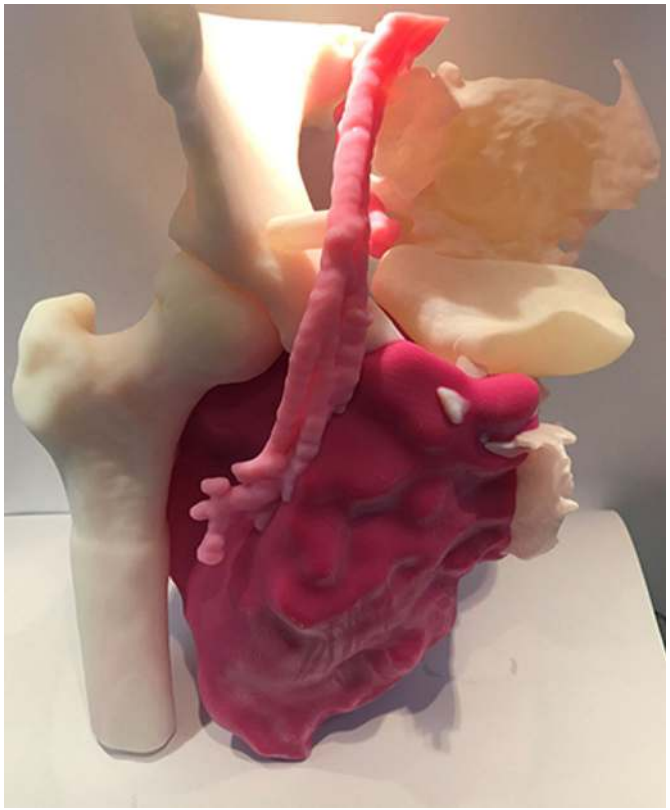
3D LifePrints first created a virtual model of the patient's right hemipelvis including the tumour, bone, rectum, uterus, cervix, vagina and labia. In order to obtain a complete picture, a merging of imaging modalities was required. The boundaries of the tumour were only visible on MRI and so this imagery 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.

3D LIFEPRINTS
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 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

A pediatric patient's complex tumour had grown in close proximity to a number of 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 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.

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

3D LIFEPRINTS

CASE STUDY

PEDIATRIC ONCOLOGICAL PRE-SURGICAL PLANNING / INTRA-OPERATIVE REFERENCE

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

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 pediatric patient presented with an extremely aggressive abdominal tumour and was initially given a 5% chance of survival. The tumour enveloped and was in close proximity to 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.

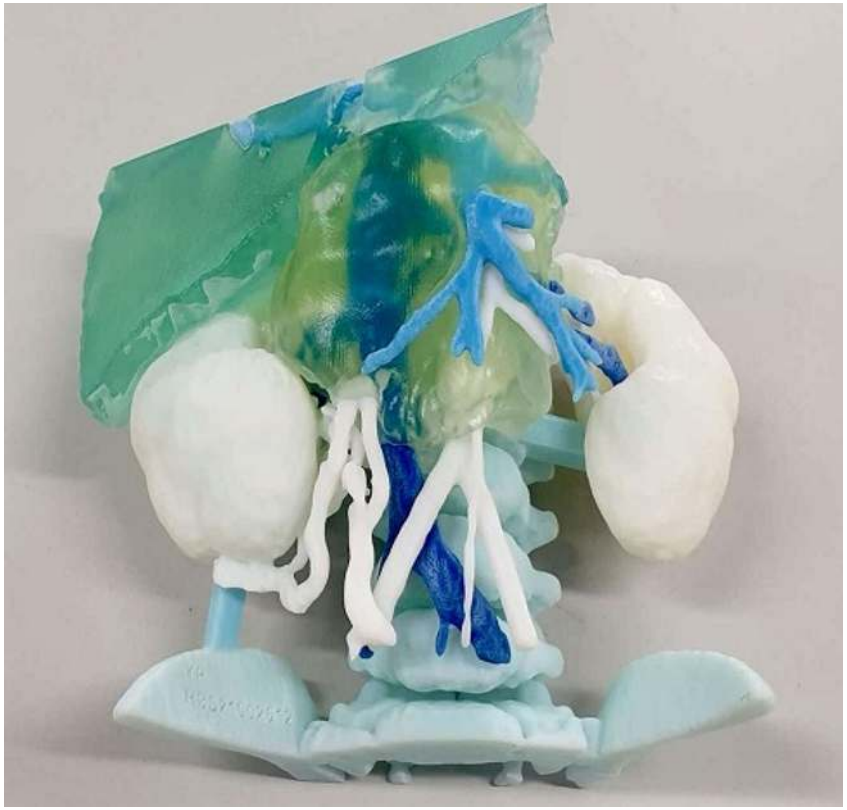
Description

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.

3D LIFEPRINTS
CASE STUDY

PEDIATRIC ONCOLOGICAL PRE-SURGICAL PLANNING

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



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

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.

3D LIFEPRINTS
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*

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

3D LifePrints 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 overlain onto the CT data to define its location and severity.

3D LIFEPRINTS
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 fiber spinal cage, bespoke rods, and screws which would fixate onto the remaining boney anatomy post-osteotomy.

3DLP'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

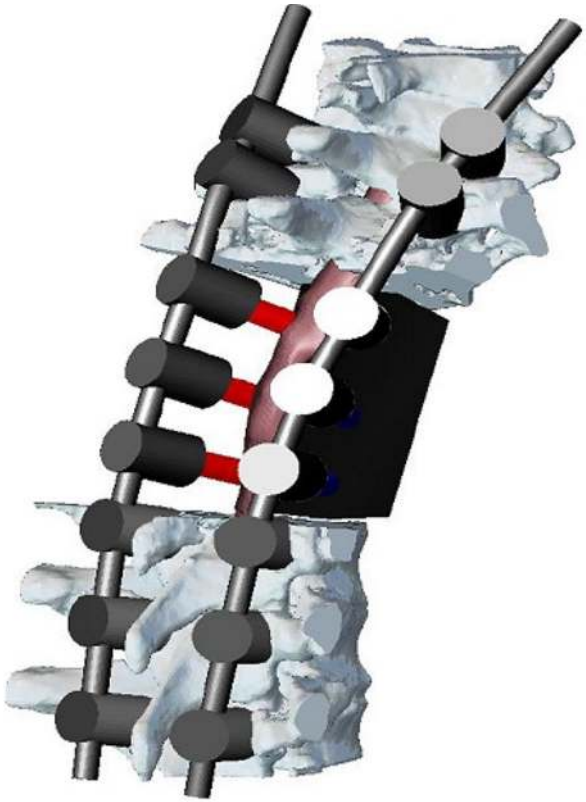
In surgery, the aggressive nature of the tumour became clear, having grown an additional 1.5cm in the interim month between virtual surgery and live theatre.

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.

3D LIFEPRINTS
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 3D LifePrints' 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 3DLP 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.

Case Summary

Surgeons were faced with a complex tumour located deep in the centre of a patient's liver. For surgery to be successful, an accurate estimation of the resection was necessary.

A 3D printed model was requested so that the correct lobe to be removed during the partial hepatectomy could be define and the tumour resection planned in detail.

Description

In this composite pre-surgical assessment 3D printed model, the patient's liver, hepatic artery, portal vein, IVC and tumour thrombus were segmented from CT scan data.

Each structure was assigned a bold colour to aid visualization and discussion. This model was produced through multi-colour advanced 3D printing.

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CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING

SPECIALITY ONCOLOGY
PROCEDURE COMPLEX TUMOUR EXCISION VIA PARTIAL HEPATECTOMY
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

The primary benefit of this model was the successful completion of the planned removal of the tumour from the patient's liver.

A secondary benefit has been its contribution to the university's surgical skill education programme, demonstrating 3D printing's ability to provide departments with tactile, ultra-specific pathological models that can act as adjuncts to traditional cadaveric and lecture-based learning. This model was the first in a series of 3D printed models for the university's surgical skills unit.

Case Summary

Surgeons requested a patient-specific anatomical model of a patient's thyroid tumour in order plan a Partial Laryngectomy for a patient presenting with laryngeal cancer.

The procedure would require surgical removal of both the tumour and a portion of the surrounding larynx.

The surgical team needed an exact, patient-specific 3D model to help calculate the resection of the tumour and the ideal margin of healthy laryngeal tissue to be taken with it, so that as much of the larynx as possible would be kept intact.

Description

3D LifePrints printed the thyroid cartilage (Purple), cricoid cartilage (Blue), hyoid bone (Yellow), tumour (Pink), and trachea (Brown) in a rigid material.

A window was included in the printing of the cartilage to allow the surgeons visual access to the tumour to plan the resection under realistic conditions.

3D LIFEPRINTS
CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING AND REFERENCE

SPECIALITY ONCOLOGY
PROCEDURE PARTIAL LARYNGECTOMY
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

The provision of a 3D printed patient-specific anatomical model, in multiple colours provided the surgeons with the ability to plan the surgery more accurately, being able to clearly differentiate tissue from bone, and reduce overall time the patient spent in surgery during the resection procedure.

Case Summary

Surgeons approached 3D LifePrints 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

3D LifePrints 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.

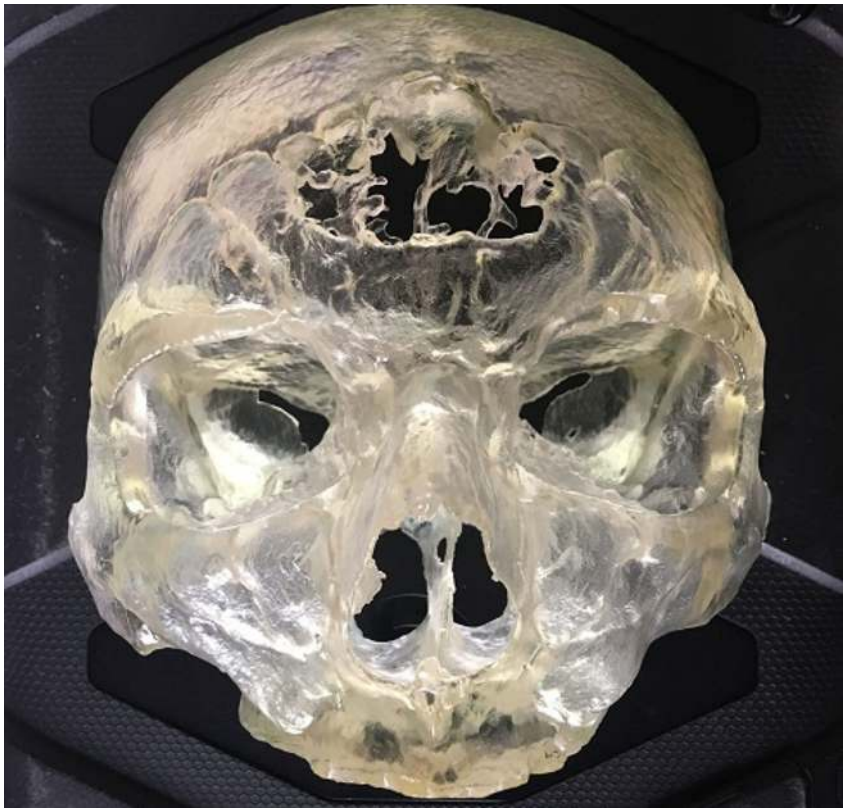
Full-scale replicas of the patient's 6th and 7th ribs, as well as the left scapula, were also printed. These models were used to help the surgeons evaluate how best to reconstruct the frontal bone. These were printed in, a bone like material, for a more realistic haptic feel.

3D LIFEPRINTS

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 on 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 an acetabular tumour required timely surgery to remove it from the bone. The surgical team were presented with the challenge of resecting the tumour with a safe enough margin of healthy bone which would be necessary to secure a custom implant in the reconstruction following removal.

A request was made for an anatomical model to be used for pre-surgical planning and virtual surgical simulation ahead of the live procedure.

Description

3D LifePrints used segmentation software to develop a virtual model of the patient's hemi-pelvis and acetabular tumour. With the tumour identified, it was possible to digitally grow the tumour by a 2cm margin as required by the surgeon. This grown margin was then digitally engraved on the model to show the ideal cutting locations in the bone.

A miniature, operable model printed in bone-like material was also used for physical simulation and reference.

3D LIFEPRINTS

CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING AND VIRTUAL SURGICAL SIMULATION

SPECIALITY ONCOLOGY
PROCEDURE RESECTION OF ACETABULAR SARCOMA
DEVICE 3D SEGMENTATION AND VIRTUAL PATIENT SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

Using the model to pre-determine the safest cutting planes in theatre ensured a safe resection of the growth and secured a higher quality position for the implant to be inserted into. For the patient, this meant less time under anaesthetic, lower risk while in surgery, and a better outcome post-surgery derived from the personalised treatment.

The model will be used by the department to catalogue the patient's conditions in 3D detail, for fuller understanding of sarcomas and refinement of future treatments. It will also act as an advanced teaching aid for other oncology surgeons and clinicians at the centre.

Case Summary

A patient diagnosed with an Ewing's sarcoma in their left ilium 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 sacroiliac joint 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. A patient specific Surgical Cutting Guide was also required to ensure accuracy of resection.

Description

3D LifePrints used segmentation software to develop a virtual model of the patient's left ilium and the 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.

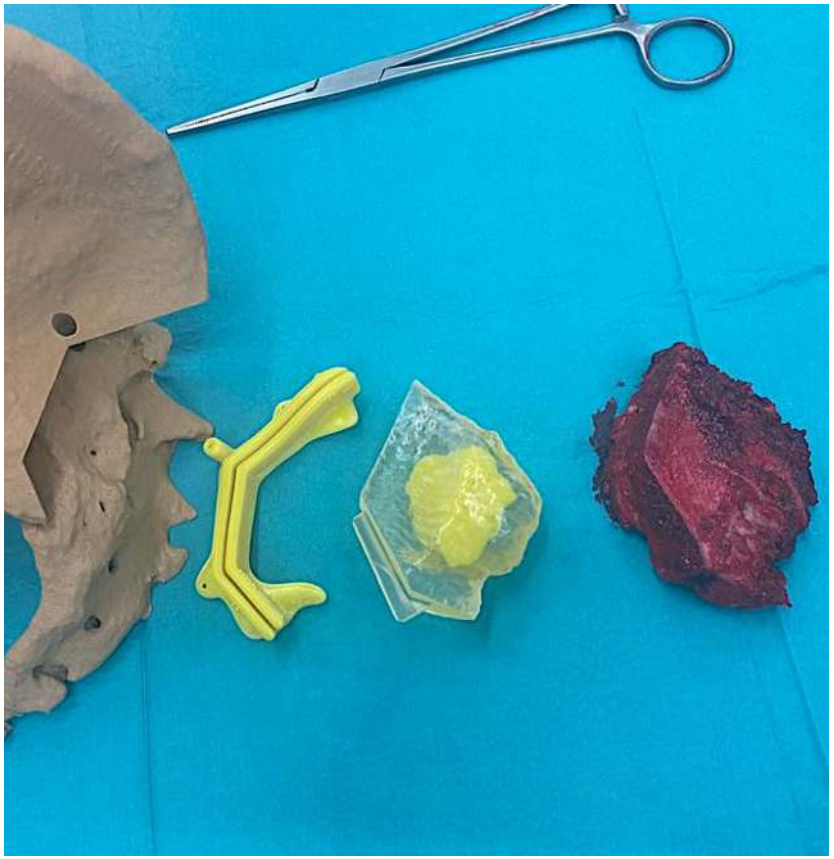
The tumour was then digitally grown by a 1cm margin as requested by the surgeon. This grown margin was then digitally engraved on the model, providing a guide to show the ideal cutting locations on the bone. This allowed for the creation of a 3D printed surgical cutting guide to show the ideal cutting planes on the left ilium. It was printed in sterilisable polyamide.

3D LIFEPRINTS

CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDE

HOSPITAL NUFFIELD ORTHOPAEDIC CENTRE
PROCEDURE RESECTION OF EWING'S SARCOMA AT THE ILIUM
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODEL AND SURGICAL GUIDE (POLYAMIDE)



OUTCOME / BENEFITS

Using the surgical cutting guide in theatre ensured a safe resection of the growth and secured a higher portion of healthy bone being left untouched. For the patient, this meant less time under anaesthetic, lower risk while in surgery, and a better outcome post-surgery derived from the personalised treatment.

The model will be used by the department to catalogue the patient's conditions in 3D detail, for fuller understanding of sarcomas and refinement of future treatments. It will also act as an advanced teaching aid for other oncology surgeons and clinicians at the centre.

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.

A request was made for an anatomical model to be used for pre-surgical planning and virtual surgical simulation ahead of the live procedureation of a surgical cutting guide to be used in theatre.

Description

3D LifePrints used segmentation software to develop a virtual model of the patient's distal radius and the tumour. The tumour was then digitally grown by a 1cm margin as required by the surgeon. This grown margin was then sectioned on the model, which allowed the creation of a patient-specific cutting guide, showing the ideal cutting planes on the radius. The model was then 3D printed in multicolour to vividly show tumour boundaries

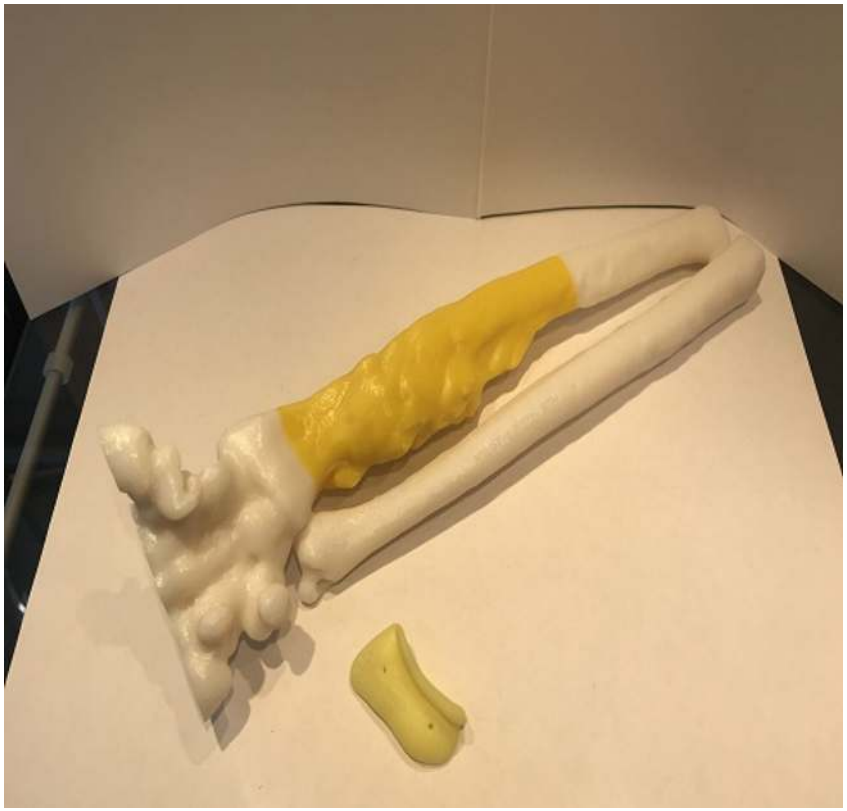
The surgical guide was 3D printed in sterilisable Polyamide for the surgery.

3D LIFEPRINTS

CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDE

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



OUTCOME / BENEFITS

Using the custom surgical guide to pre-determine the safest cutting planes in theatre ensured a safe resection of the growth and secured a higher portion of healthy bone being left untouched. For the patient, this meant less time under anaesthetic, lower risk while in surgery, and a better outcome post-surgery derived from the personalised treatment.

The model will be used by the department to catalogue the patient's conditions in 3D detail, for fuller understanding of sarcomas and refinement of future treatments. It will also act as an advanced teaching aid for other oncology surgeons and clinicians at the centre.

Case Summary

This patient presented with a non-symptomatic Grade 1 chondrosarcoma that had been picked up in a routine scan for a separate investigation. The tumour was small and localised in their left ilium, and the surgeon planned to do a targeted, bone-conserving resection that preserved the integrity of the ilium whilst maintaining safe margins.

3D LifePrints was asked to design and deliver a novel sterilisable surgical drill guide that allowed for this.

Description

A 1mm slice CT of the left ilium was performed that 3D LifePrints used to create a virtual anatomical model. The tumour was grown by 10mm to create a safe surgical margin and highlighted for better visualsation.

The consultant determined their ideal path for resection and 3D LifePrints' biomedical engineer devised a patient-specific, circular drilling channel guide for use in theatre. The surgical guide was then printed in biocompatible, sterilisable material and delivered to the surgical team alongside a 3D printed anatomical model for intra-operative reference. The guide was printed in 3D LifePrints' controlled environment facilities, located within its Nuffield Orthopaedic Centre hub.

Drill - 2mm bit

Blade - 0.89mm Uni Knee Blade

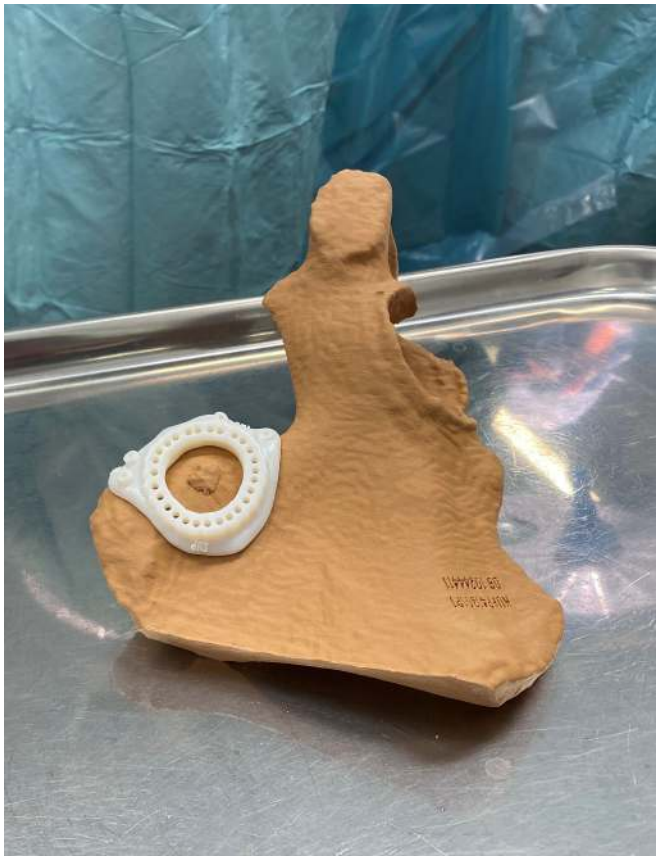
Fixation - 1.6mm K-wires

3D LIFEPRINTS

CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDE

HOSPITAL NUFFIELD ORTHOPAEDIC CENTRE
PROCEDURE TARGETED RESECTION OF ILIUM
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODEL AND SURGICAL GUIDE



OUTCOME / BENEFITS

The surgery was extremely straightforward and completed within an hour. The guide fitted well and once the drill holes were made the surgeon was able to easily complete the osteotomy with a uni sawblade. The surgical team appreciated the level of precision the guides enabled and were able to salvage all of the sacroiliac joint, whilst also avoiding disturbance of any neurovascular structure. Sectioning of the tumour showed good margins.

Post-operatively, the patient experienced a quick rehabilitation period and was able to return home after 48 hours.

Case Summary

This pediatric patient required a partial pelvic resection, including the distal part of the iliac bone and superior part of the periacetabular bone, to remove metastatic thyroid carcinoma.

Description

3D LifePrints first created a virtual model of the patient's pelvis, including the tumour. The model was then printed in bone-like material.

Three surgical cutting guides were then designed following the completion of virtual surgery by the surgeon, in which the optimum cutting planes were determined.

The first guide provided the cutting plane to resect the inferior ilium, with the aim to retain continuity between the Ischium and Ilium and the greater sciatic notch. The second guide provided trans-acetabular cutting planes to connect the ilium resection to pubic resection. The third provided resection through the superior pubic ramus.

The surgical guides were printed in sterilisable material and delivered for surgery.

Blade – 1mm (20mm) (Misonix Bonescalpel)

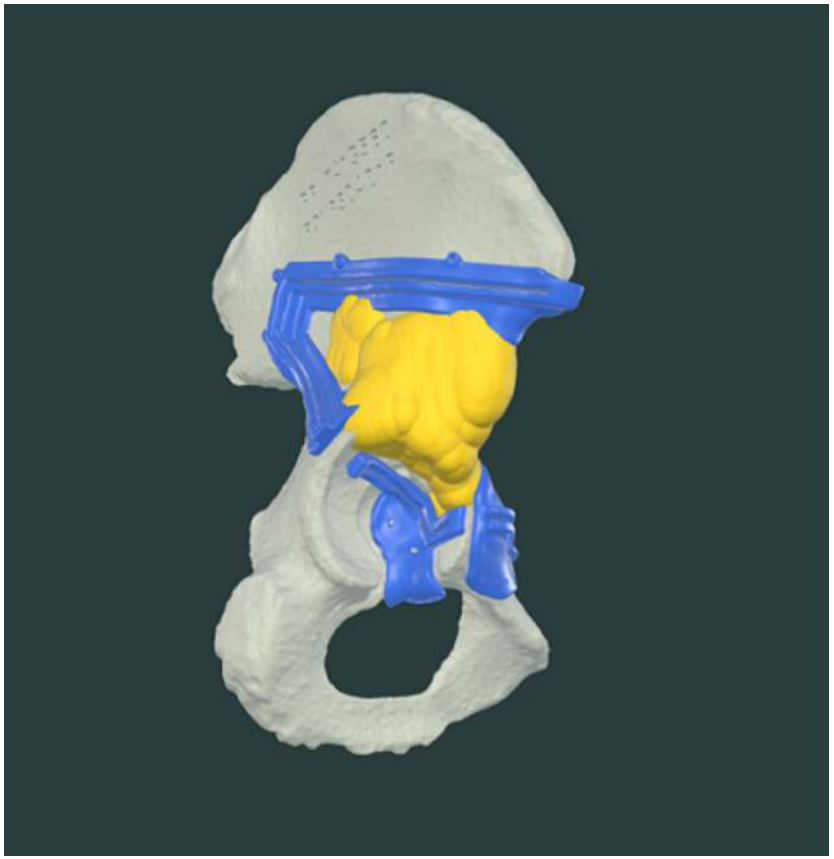
Fixation – 1.6mm K Wire

3D LIFEPRINTS

CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDES

HOSPITAL ROYAL NATIONAL ORTHOPAEDIC
PROCEDURE PI & PII HEMIPELVECTOMY
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODEL AND SURGICAL GUIDES (POLYAMIDE)



OUTCOME / BENEFITS

3D LifePrints were able to combine the CT and MRI scans provided to create a detailed model and patient-specific guides that translated careful pre-operative planning into navigated osteotomies with accurate and clear margins. The printed anatomical model allowed for the surgical guides to be assessed before the operation, was helpful prior to surgery when discussing across disciplines, and was referred to throughout the complex resection.

The completed resection was noted to be accurate and as expected. The surgeon stated "the advantage of using guides was that I could achieve clear but close margins that conserved bone and enabled ice cream cone reconstruction. It wouldn't have been possible if I'd free-handed the cuts".

Case Summary

A 36 year old male with a complex spindle cell sarcoma required a partial resection of the pelvis (right side) to remove the tumorous tissues.

The surgeon requested the design and manufacture of sterilisable surgical guides to aid in the hemipelvectomy from the right ilium (between the sciatic notch and the superior/inferior iliac spine) to the contralateral pubis.

Description

3D LifePrints segmented the patient's data, merging CT and MRI scans to capture both bony and soft tissue, to develop a virtual model of the pelvis and tumour. The model was printed in bone-like material and resin (Tumour) and used by the surgical team for intra-operative reference.

Four surgical cutting guides were created from the surgeon's virtual plan. The first guided a bilateral cut through the ilium from the lateral aspect. The second ensured the sacral cut travelled parallel to, and intersects the anterior aspect, of the sacroiliac joint. The third navigated a cut through the contralateral pubis, parallel to the pubis symphysis; this was provided in two iterations that could be decided in surgery depending on soft tissue.

All four guides were printed in sterilisable material in 3D LifePrints' controlled envrionment.

Blade – 1mm (20mm) (Misonix Bonescalpel)

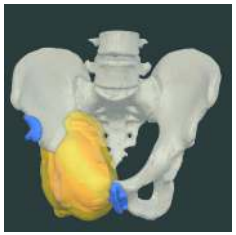
Fixation – 1.6mm K Wire

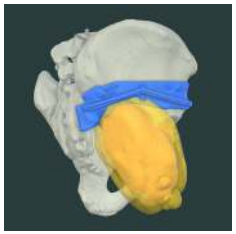
3D LIFEPRINTS

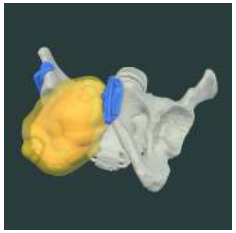
CASE STUDY

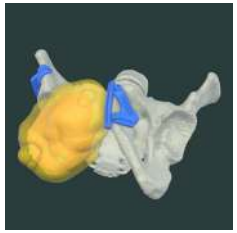
ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDES

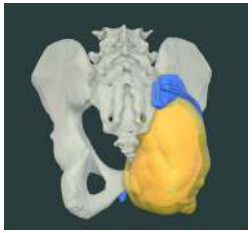
HOSPITAL ROYAL NATIONAL ORTHOPAEDIC
PROCEDURE PI & P3 HEMIPELVECTOMY
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODEL AND SURGICAL GUIDES (CLEAR POLYAMIDE)











OUTCOME / BENEFITS

Use of the guides enabled the surgical team to carry out the pre-determined cuts as planned with clear margins. Less need to refer to digital scans was observed with the model providing adequate reference.

The surgeon also positively noted 3D LifePrints' decision to manufacture the guides in an ISO certified, 3D print biocompatible, transparent material, stating it was an improvement on previous opaque materials as it allowed visibility of the blades in relation to the bone when being used. The inclusion of the silhouettes (Guides) and the cutting planes on the model was also noted as valuable.

As 3D LifePrints engineers work more closely with the individual surgeon and a good relationship develops, surgical guides and models become more and more suited to the surgeon's preferences, The surgeon in this case confirmed the devices were "getting better every case".

Case Summary

This patient presented with a chondrosarcoma and a last minute request was made to 3D Lifeprints to provide sterilisable surgical cutting guides to aid in a PII/PIII resection of the right hemipelvis. The scans were segmented, surgery planned, and model and guide approved, manufactured and sterilised inside 72 hours of receipt of the scans and instruction.

Description

Upon receiving the patient's PET CT scan, 3D LifePrints segmented the imagery to build the virtual model of the pelvis and tumour. The tumour boundary was grown by a 10mm margin, as instructed. The optimal cutting planes were then agreed upon by the surgeon and the biomedical engineer.

The first guide provided allowed for an accurate tri-planar cut through the acetabulum from the lateral aspect. The accuracy of the cuts allowed the surgeon to keep enough bone stock for an effective reconstruction. A second guide for the Pubic Symphysis was created but only used as a reference template for the osteotomy. The guides and models were designed and printed in 3D LifePrints' controlled environment facilities located within its Nuffield Orthopaedic Centre hub. Optimally, we would ask for 10-14 days to complete this service, having the facility onsite allows us to meet very tight turnarounds in emergency situations.

Blade - 0.89mm

Fixation - 1.6mm K Wire

3D LIFEPRINTS

CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDE

HOSPITAL NUFFIELD ORTHOPAEDIC CENTRE
PROCEDURE PII/PIII HEMIPELVECTOMY
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODEL AND SURGICAL GUIDE (POLYAMIDE)

OUTCOME / BENEFITS

Use of the model in pre-surgical planning, and the surgical guide in theatre, meant the surgical approach could be limited to posterior extensile Kocker Langenbeck approach. Significant operative time was saved and bone stock was preserved, excluding use of augments to support the Lumic Cup (Implantcast).

Clear margins were confirmed in post operative tests, confirming complete removal of the tumour tissue.

Case Summary

A request was made to 3D LifePrints by the Nuffield Orthopaedic Centre to provide sterilisable surgical guides to assist in the partial removal of a patient's pelvis (left side) due to it being compromised by tumorous tissues.

A fast-track service was required to meet the urgent surgery date for the resection of the sarcoma.

Description

3D LifePrints used the patient's latest CT and MRI scans to segment and build a virtual model of the left hemipelvis. The sarcoma within was digitally grown by a 15mm margin and highlighted in order for the consultant to determine optimum surgical cutting planes.

The first guide allowed for a bilateral cut through the ilium for the lateral aspect. The second guide allowed for a single cut through the pubis. The third guide directed a single cut through the ischium.

All three guides were printed in clear, sterilisable material at 3D LifePrints' controlled environment facilities, housed within its Nuffield Orthopaedic Centre hub.

Blade - 0.89mm

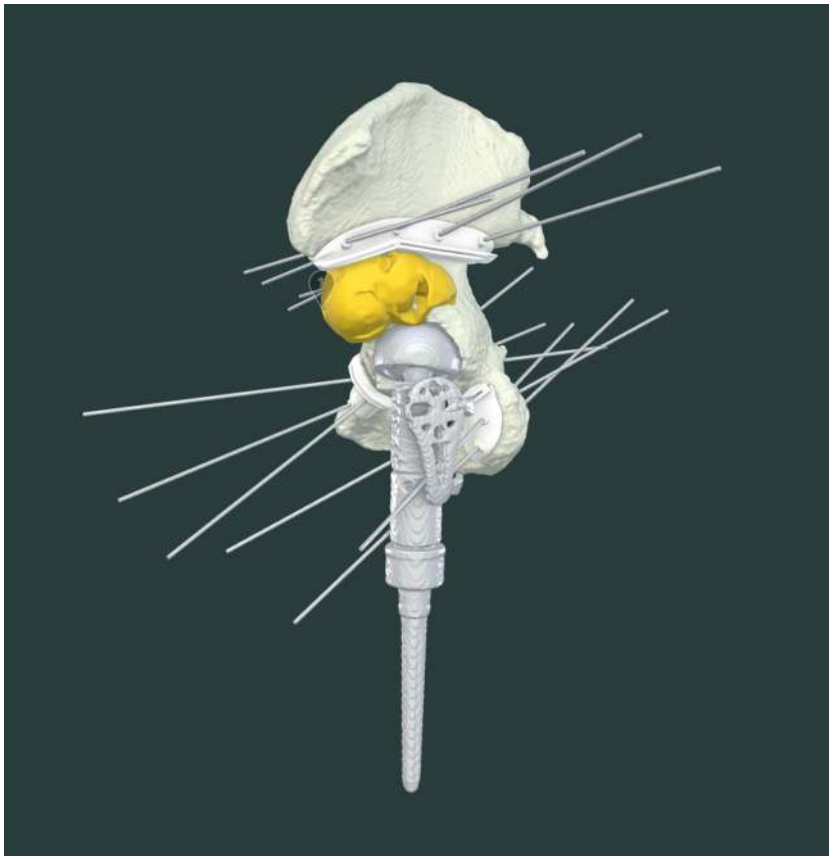
Fixation - 1.6mm K-wires

3D LIFEPRINTS

CASE STUDY

ONCOLOGICAL PRE-SURGICAL PLANNING, VIRTUAL SIMULATION, SURGICAL GUIDE

HOSPITAL NUFFIELD ORTHOPAEDIC CENTRE
PROCEDURE PI/II HEMIPELVECTOMY
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL MODEL AND SURGICAL GUIDES



OUTCOME / BENEFITS

- Rapid turnaround of the design and manufacture of the model and guides was achieved (within one week)
- Pre-operatively, the surgical team used the anatomical model and guides to engage the patient with thorough discussion regarding tumour re-recurrence and the metastasis of the tumour.
- Intra-operatively, the guides fitted optimally and allowed for a single posterior extensile approach to be used. Significant operative time was saved.

Case Summary

A clinical scientist required a 3D printed liver phantom for two key reasons. Firstly, to validate radiotherapy simulations conducted in software, to be able to be able to see the size of tumours within a scan in order to give a more accurate dose of radiation. Using a physical model he would be able to verify his research beyond virtual simulation.

Secondly, moving forward, segmentation and modelling of patient's livers would provide accurate volume and locations of tumours within the organ, allowing more precise dosimetry in patients. For those receiving treatment, it would mean more optimised dose delivery and reduced radiation exposure in surrounding healthy tissue.

Description

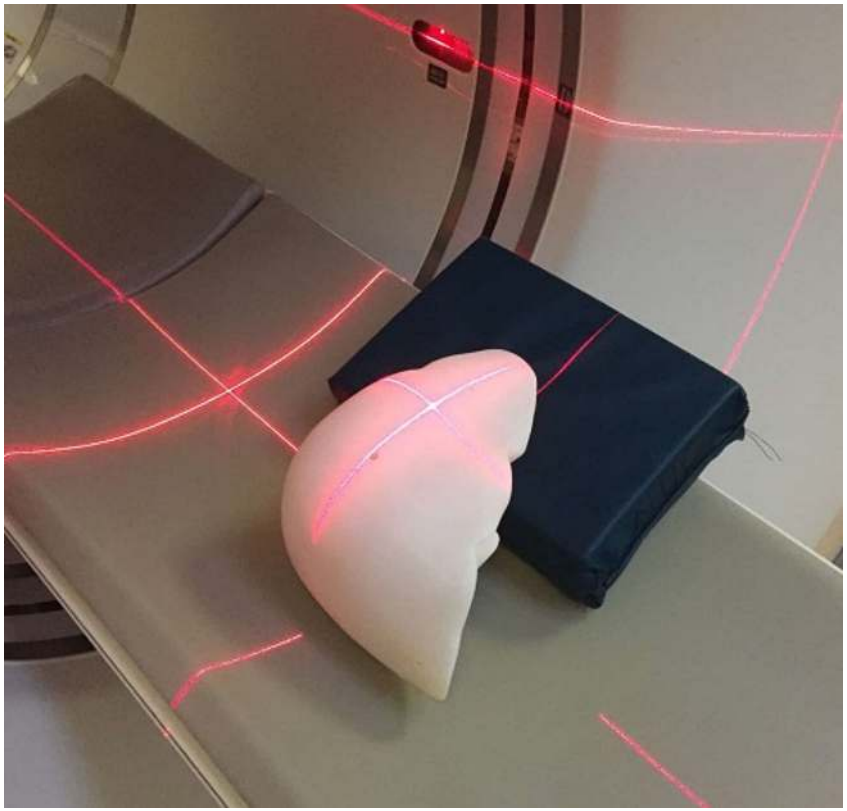
To aid in an accurate dosage measurement, an anatomically correct (ICRP) liver phantom was 3D printed with three chambers for holding radioisotopes. The three chambers varied in size, to mimic different sized tumours.

The phantom was then scanned (Phillips PET/CT) in the correct anatomical orientation. By using the measured dosage and known cavity volume, the surrounding exposure could be estimated.

3D LIFEPRINTS
CASE STUDY

ONCOLOGICAL NUCLEAR MEDICINE SIMULATION

SPECIALITY ONCOLOGY
PROCEDURE TARGETED RADIOTHERAPY FOR LIVER CANCER
DEVICE 3D PRINTED PATIENT SPECIFIC ANATOMICAL PHANTOMS



OUTCOME / BENEFITS

Using specialist medical segmentation software, 3D LifePrints provided patient specific 3D prints that identified the boundaries separating the liver and tumour – providing a more accurate and case-specific dosage of radiation. The 3D model helped the clinician understand the irregularities of a tumour before a treatment pathway is decided.

This results in several benefits including reduced risk of radiation exposure to surrounding tissues, reduced damaged to the kidneys in this case, and a better understanding of the shape and size of the tumour.

ONCOLOGY SOLUTIONS

3dlifeprints.com

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

EMAIL US

info@3dlifeprints.com

CALL US

+44 (0) 151 528 6830
(Liverpool / Manchester office)
+44 (0) 1865 52 2767
(Oxford office)
+44 (0) 207 193 5630
(London office)
+44 (0) 113 328 1487
(Leeds office)

FIND US

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