insight surgery

Digital Planning & Personalized Solutions

3D SOLUTIONS FOR ORTHOPEDIC SURGERY

3D PLANNING, PATIENT-SPECIFIC ANATOMICAL MODELS, AND SURGICAL GUIDES

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CASE SUMMARY

A patient had suffered a fracture of the wrist and forearm, requiring corrective surgery and the use of an implanted titanium plate to fix the bones in place for healing.

The surgical team requested assistance in the pre-surgical planning phase of the treatment pathway. In this case, it was important to be able to find the best positioning for a plate and subsequently make the correct plate choice for the fracture type and the patient's individual anatomy.

A patient-specific anatomical model of the wrist and forearm was commissioned.

DESCRIPTION

Insight Surgery segmented the patient's CT scan and created a model demonstrating the radius, ulna, carpus, the fracture site and the existing metal plate in situ.

The model was then printed in bone-like material, to imitate the realistic properties of the limb while allowing the templating of a range of implants and devices on it.

INSIGHT SURGERY
CASE STUDY

ORTHOPEDIC PRE-SURGICAL PLANNING

SPECIALITY: REVISION AND RECONSTRUCTION (UPPER LIMB)
PROCEDURE: WRIST FUSION AND FIXATION OF RADIAL NON-UNION
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

The model proved useful in comparing plate models and sizes and the surgeon was able to make the best selection for their patient ahead of surgery. The correction and implantation of the plate was successful, and the patient recovered well.

By selecting the correct plate in advance, the surgeon could confidently request only the required kit in theatre. This clarity avoids not only the need for those extra devices, but also the extra sterilisation required of them.

After repeat usage at this specialist hospital the use of this Guide is becoming standard practice for this procedure.

CASE SUMMARY

A patient required an acetabular reconstruction due to a peri-acetabular defect and surrounding bone loss. The surgeon needed to assess the extent of the defect and plan the reconstructive surgery. The key to the assessment was determining whether a buttress and augment were required to achieve stability of an acetabular cup. The surgical team requested a model of the patient's hemipelvis in order to help their pre-surgical planning and simulate different reconstruction options.

DESCRIPTION

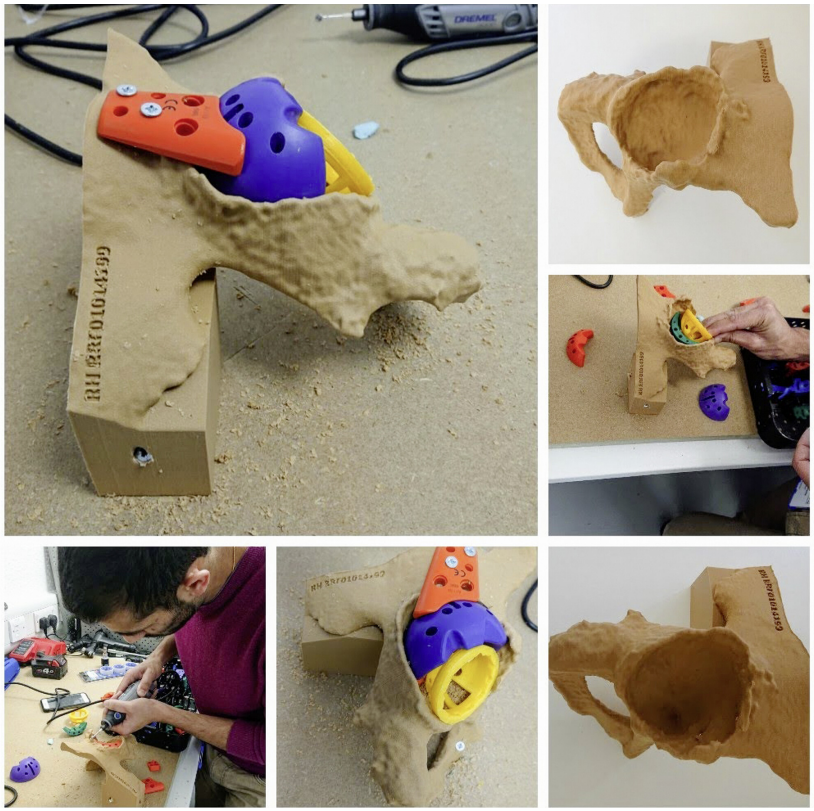
The patient-specific model containing the acetabular defect and compromised bone stock was provided for use in the on-site simulation laboratory. Printed in bone-like material, the acetabulum could be safely reamed to a recorded diameter, whilst maintaining suitable anterior cup coverage - avoiding post-surgical issues with psoas impingement.

The surgical team were then able to trial implants with the model; augments (blue and green), buttress (orange), cup (yellow).

INSIGHT SURGERY
CASE STUDY

ORTHOPEDIC PRE-SURGICAL PLANNING AND SIMULATION

SPECIALITY: REVISION AND RECONSTRUCTION (LOWER LIMB)
PROCEDURE: ACETABULAR RECONSTRUCTION AND PROXIMAL FEMORAL REPLACEMENT
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODELS



OUTCOME / BENEFITS

Using the model, the surgical team could fully assess the defect and find the most effective implants for the reconstruction ahead of live theatre. This preoperative planning saved substantial intra-operative decision making time while the patient was under anaesthetic and resulted in a stable and bespoke solution.

The planning also confirmed the surgeons' belief that an optimal solution could be achieved without the need for an expensive bespoke implant.

CASE SUMMARY

Conventional cement removal techniques for femoral stem revision can result in complications or prolonged surgical procedures. After removing a previously implanted femoral stem, it is necessary to clear the cement to achieve good fixation of a new stem. Proximally, this is achieved with an osteotome by breaking the cement into the space created by the removed implant; the cement found distally to the implant is released by drilling and inserting a drill tap that is reverse-hammered using a slap-hammer. Problems arise when the drill diverts from the cement, breaching the femoral cortex. The surgical team approached Insight Surgery to plan and print a sterile guide that controlled the drilling direction and depth and reduced the risk of perforation of the patient's femur.

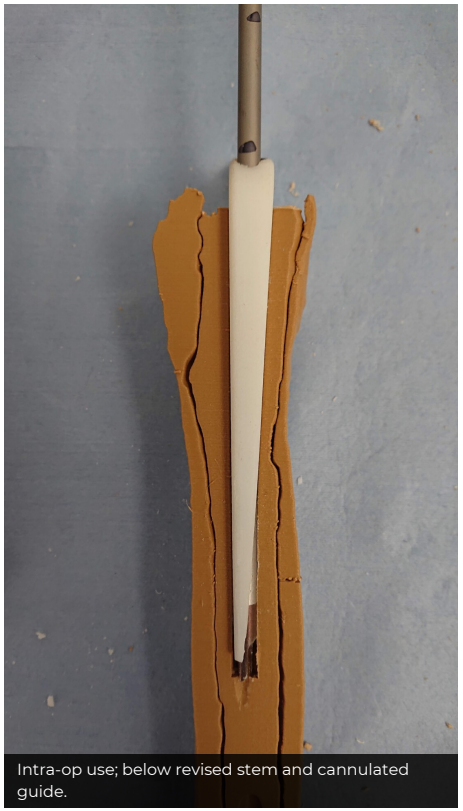
DESCRIPTION

Insight Surgery designed and 3D printed a novel drilling guide, in sterilisable material, using the geometry of the removed femoral stem and introducing a cannulation directed along a predetermined axis. The axis is orientated in virtual space directly into the centre of the cement tail and removed from the implanted mesh to create the specified cannulation. Insight Surgery's simulation lab gave the surgeon the opportunity to 'test-run' the guide with a 3D printed model of the patient's femur. The bone and cement were segmented out from the patient's scans and printed in an operable 3D material for simulation.

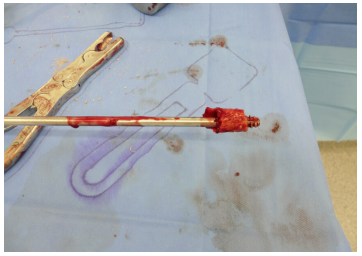
INSIGHT SURGERY
CASE STUDY

ORTHOPEDIC PRE-SURGICAL PLANNING, SIMULATION AND SURGICAL GUIDE

SPECIALITY: REVISION AND RECONSTRUCTION (LOWER LIMB)
PROCEDURE: INTRA-OPERATIVE REMOVAL OF DISTAL CEMENT PLUG DURING FEMORAL STEM REVISION
DEVICE: 3D PRINTED PATIENT-SPECIFIC CEMENT REMOVAL DRILLING GUIDE


Intra-op use; below revised stem and cannulated guide.


Tap used to remove large piece of distal cement.



OUTCOME / BENEFITS

Using the patient-specific drilling guide allowed the surgeons to more effectively and efficiently remove the cement from the patient's femur.

Damage to the femur was kept to a minimum and no splitting occurred, which had been serious consideration prior to surgery.

Surgery was completed more quickly than anticipated, directly benefiting the patient and hospital.

Access to the simulation lab allowed the surgeon to consider the appropriate access, including any fouling of the greater trochanter, ensuring the guide could be used effectively on the day of surgery.

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 the tumour due to its proximity to the spinal cord and subsequent effect on 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

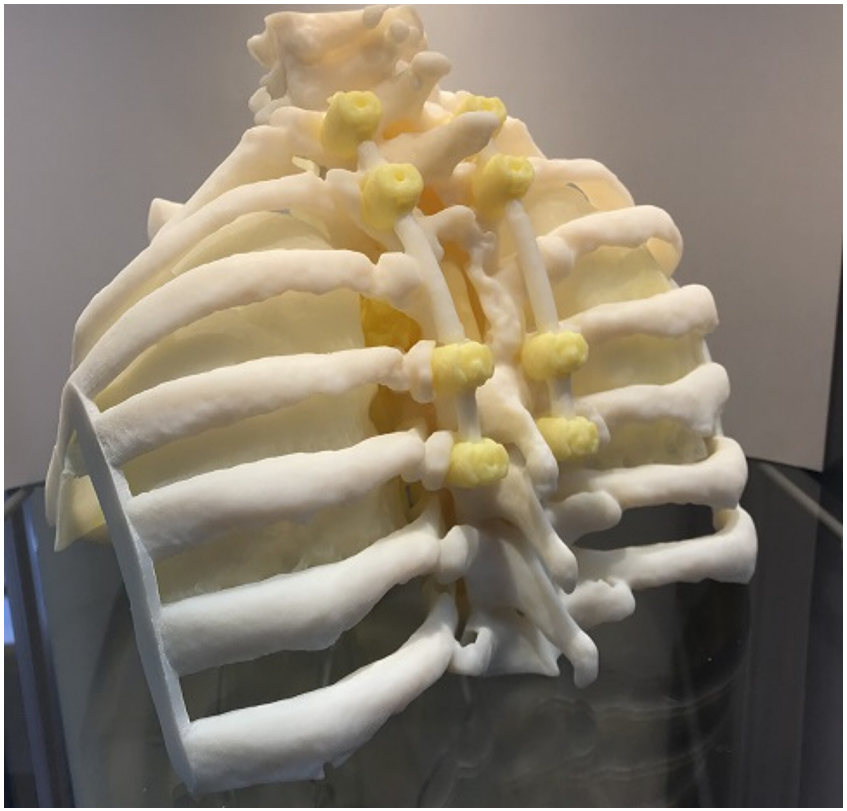
Insight Surgery used segmentation software to develop a virtual model of the patient's spine, spinal cord, oesophagus, airway, blood volume and tumour.

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.

Case Summary

To manage the onset of osteomyelitis, this patient had undergone debridement of the distal femur. As a result, a large cavity was left for the surgeon to navigate in a subsequent ligament repair.

The surgeon requested a 3D model to gain a full appreciation of the cavity in preparation for a tunnelling procedure. The nature of the cavity meant drilling a tunnel that travelled through all three planes, which added to the complexity of the surgery.

Description

Insight Surgery segmented the patient's CT scan data to produce a virtual model of the femur and an accurate visualisation of the cavity.

This model was then 3D printed as two halves in bone-like material. Connectors were made so that the model could slot together in the correct orientation, without obstructing the surgeon's drilling trajectory.

INSIGHT SURGERY
CASE STUDY

ORTHOPEDIC PRE-SURGICAL PLANNING

SPECIALITY: ORTHOPEDIC
PROCEDURE: DISTAL FEMUR WITH PREVIOUS OSTEOMYELITIS
DEVICE: 3D PRINTED PATIENT-SPECIFIC ANATOMICAL MODEL

OUTCOME / BENEFITS

The model allowed the surgeon to measure and trial various angles and locations of entry before getting into theatre.

The surgeon was left confident after simulating that he could successfully drill a suitable tunnel without breaching the cavity.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