Orthopedic Oncology

Case Examples

Medical Devices provided in Days, not Weeks

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Rapid provision of **FDA approved Personalized Virtual Surgical Planning, Surgical Guides** and **Models, Designed** and **Delivered** within a **Week** *

Manufactured in our **Texas Medical Center Cleanroom** facility.

"The fact that Insight can design and rapidly make guides within in a week is a big deal….and also get through surgery without extensive blood loss or other complications"

Dr Herrick Siegel

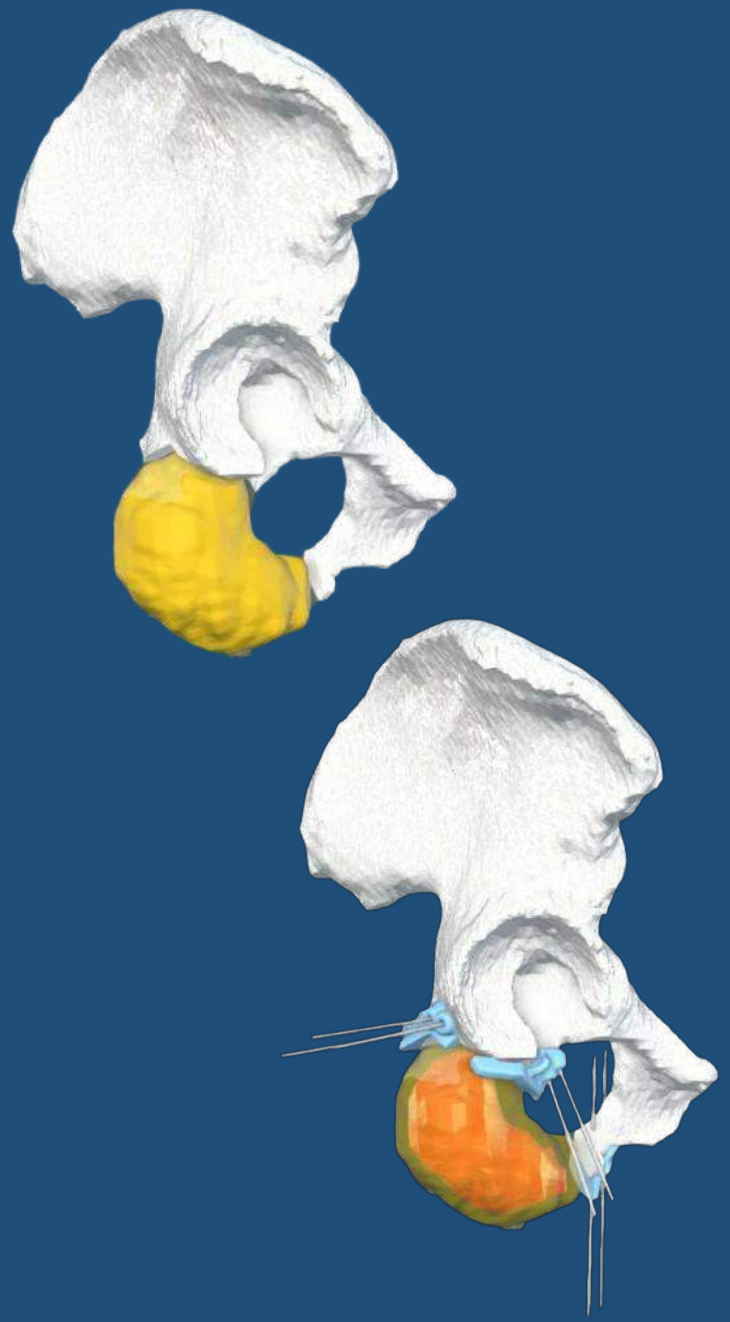
Specialist, Adult Reconstruction and Orthopedic Oncology. University of Alabama Birmingham Medicine

SPECIALITIES (ADULT & PEDIATRIC)

- **Upper limb**
- **Lower limb**
- **Pelvis**
- **VSP with Partner Implants**
- **Surgical Guides**
- **Allograft guides**

https://www.insightsurgery.com/oncology-solutions/

* Subject to complexity of surgical case and responsiveness of the clinician for review & approvals



CASE STUDY:

Giant Cell Tumor Guided Resection

SUMMARY

This patient presented with a giant cell tumor of the right ischium in need of resection. Due to the tumor's close proximity to the acetabulum, care would be needed in margin and osteotomy planning, in order to preserve as much bone as possible.

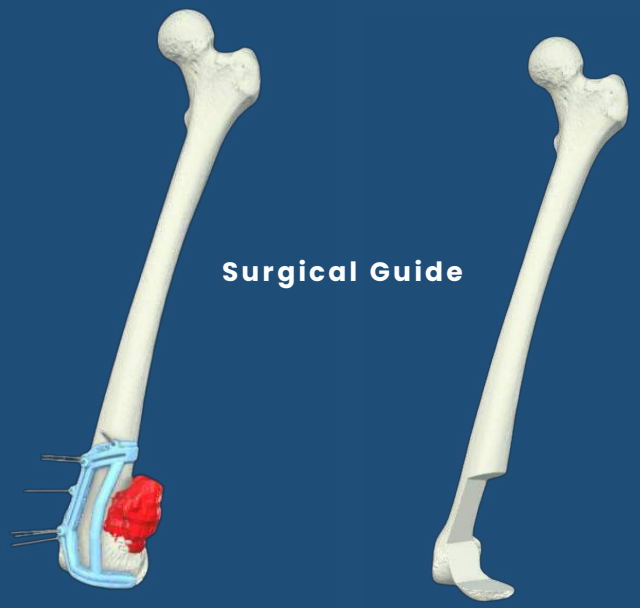
DESCRIPTION

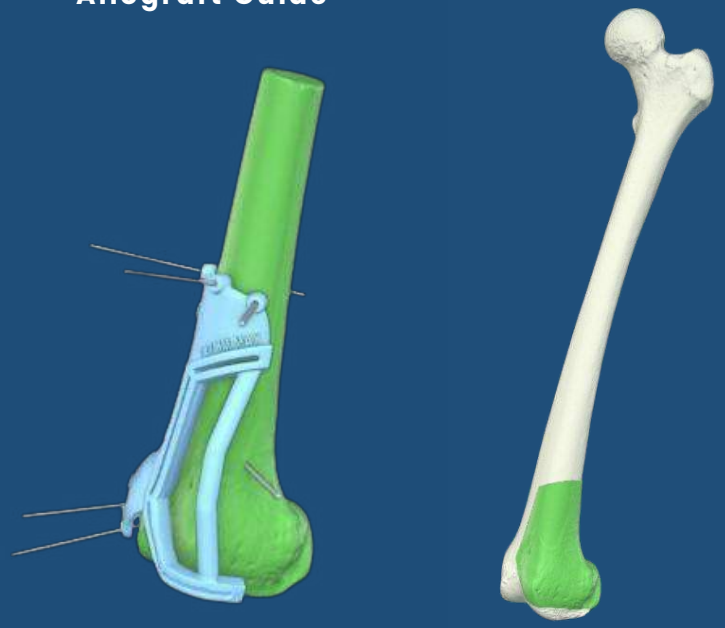
The patient's anatomy was segmented and 3D modelled from the combination of CT and MRI scans. The surgeon then worked with Insight Surgery in calculating their desired margins for bone preservation. With the whole region hard to access, the surgeon would use a high lithotomy approach for increased surgical access to be able to use guides

Three guides were designed in total. One to resect the tumor along the inferior pubic ramus. The anterosuperior and the posterosuperior ischial guides resected around the acetabulum in order to preserve joint anatomy and function. Design emphasized small guide footprints and open flanges due to limited surgical access and the smaller margins.

OUTCOME / BENEFITS

The surgery went well, with the guides proving useful for the surgeon given how close the tumor was to the acetabulum, with the anterosuperior guide being of particular importance in marking the cutting for that area of bone.





CASE STUDY:

Distal Femoral Osteosarcoma Resection & Allograft Guides

SUMMARY

This patient required a resection of a distal femoral osteosarcoma and a subsequent allograft reconstruction. The osteosarcoma was particularly invasive meaning the surgeon would have to remove a significant section distally. Additionally, it was important to keep as much of the articular surface of the lateral epicondyle intact to help maintain function at the knee joint for the patient. The surgeon also wanted to reconstruct the defect with an allograft that came with lateral collateral ligament for a better outcome.

DESCRIPTION

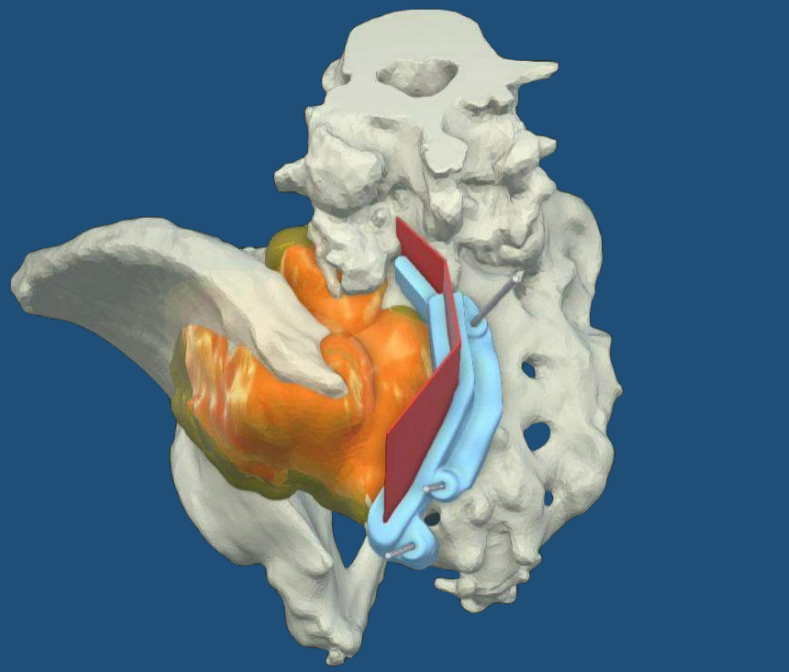
Following the 3D model generation from CT and MRI scans, Insight Surgery worked with the surgeon to establish the varying margins that would be needed for a successful resection; 10mm for the inferior/superior margins, and 12 mm medially.

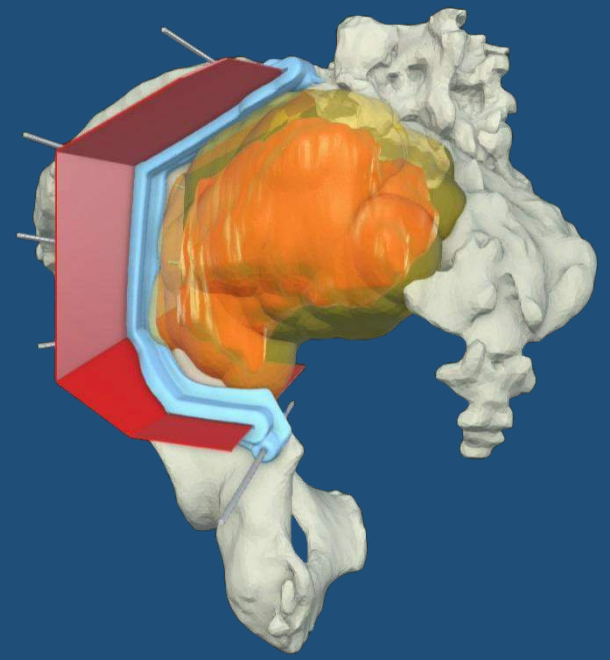
The guides for the tumor also kept the lateral/articular surface intact to a sufficient degree.

Matching guides were then designed and manufactured for the allograft so the defect could be reconstructed. It also accounted for LCL tissue reconstruction.

OUTCOME / BENEFITS

The surgery went well with clear margins achieved and a successfully transferred allograft which fit well with the patient's anatomy.





CASE STUDY:

Sacral & Iliac Tumor Resection

SUMMARY

This patient presented with an aggressive tumor invading both the ilium and sacrum where the growth had begun to compromize a number of sacral roots.

The surgeon planned to resect the tumor with safe margins while attempting to preserve as much bone and neurovascular structures as possible, for optimum recovery and function post-operation.

DESCRIPTION

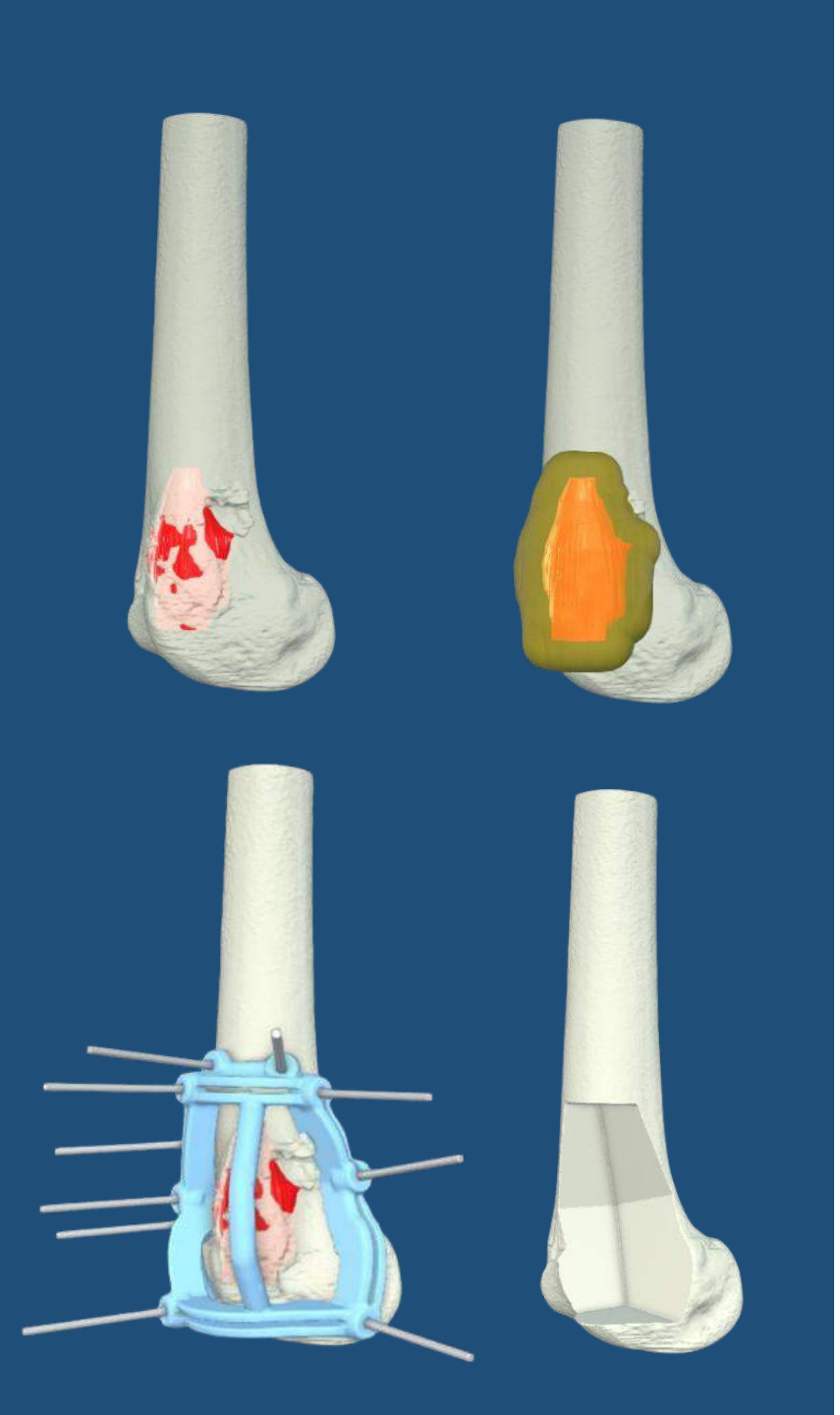
Following the creation of a 3D anatomical model from the CT and MRI scans, three guides were proposed. Two for the sacrum - one anterior guide and one posterior guide. This allowed for maximum bone and nerve conservation whilst also ensuring adequate margins. These two guides would join up distally to allow for the complete resection of the affected region of the sacrum.

The third guide allowed for resection of the tumor affecting the hemipelvis and used wider margins to those used for the sacrum..

OUTCOME / BENEFITS

Due to soft tissue obstruction the guides were used to define the initial location and angles of the cutting planes, after which the surgeon completed the cuts freehand.

Negative margins were successfully achieved, and intra-operative efficiency was enhanced for both surgeon and patient.



CASE STUDY:

Distal Femoral Tumor Resection & Allograft Guides

SUMMARY

In this case, the surgeon needed to resect a distal femoral tumor with multiple considerations applying to the procedure. Given the tumor size and location, a complex geometric cut that maximized bone conservation was desired. It was therefore important to maintain the posterior aspect of the distal femur, and also preserve as much of the articular surface of the lateral epicondyle as they could. Preserving the ACL insertion point on the distal femur was the final requirement. Insight Surgery helped the surgeon plan margins to achieve all three directives.

DESCRIPTION

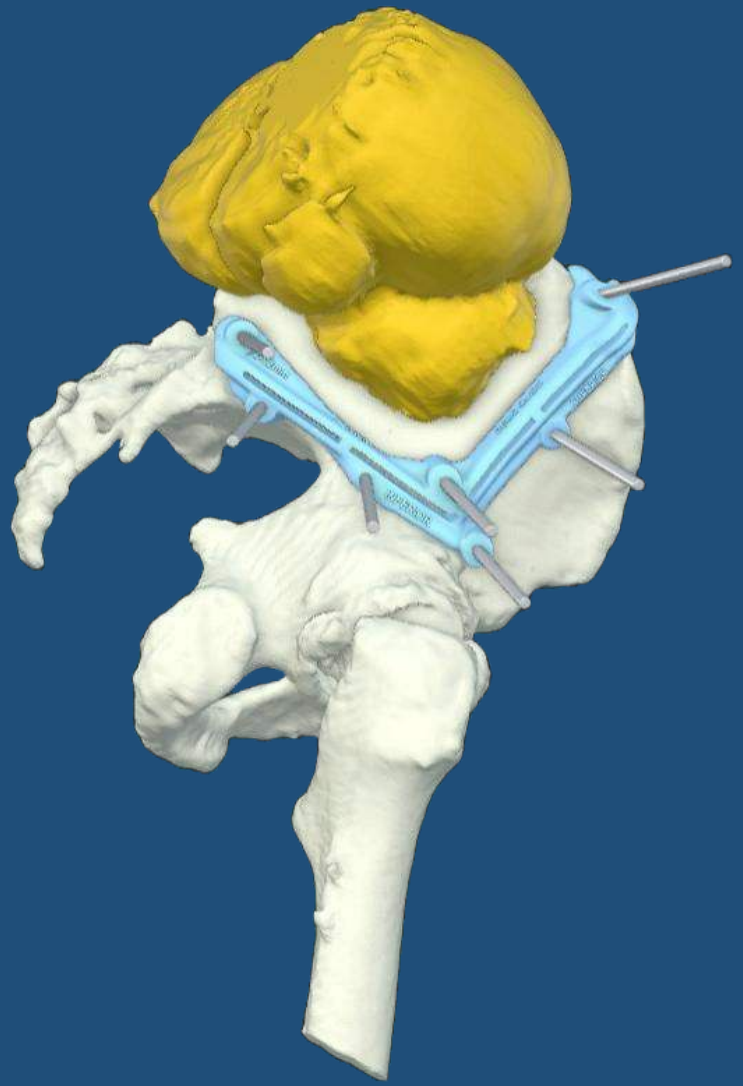
Combining CT and MRI scans, a 3D model of the patient's anatomy was segmented and virtually reconstructed.

Two guides were designed and manufactured, replicating the planned cutting planes with margins for the geometric cut; one for the resection and one for the matching allograft so that the segment for the reconstruction could accurately slot into the resulting defect.

OUTCOME / BENEFITS

The surgeon was happy they were able to preserve the patient's ACL and not have to reconstruct with an allograft for that also.

"I really wanted to thank you all for the amazing work you did on putting this together, especially with such a compressed timeline. The case could not have gone more smoothly and the result was incredible ... and easy with your guides and guidance."



CASE STUDY:

Pelvic Squamous Cell Carcinoma Resection

SUMMARY

This patient had already undergone both chemotherapy and radiotherapy to treat the squamous cell carcinoma developing in their iliac wing.

However, the mass continued to enlarge and resection was proposed by the surgeon.

DESCRIPTION

CT and MRI scans were used to construct the virtual 3D model of the patient's pelvis. The tumor was grown with a 10mm allowance to allow for negative margins.

Discussions with the surgeon to plan the cuts resulted in the design of one 'mega' guide which would allow for complete resection. With consideration, Insight Surgery also designed and provided an alternative for the surgeon in the form of two individual guides which would allow the same resection in two stages if placement complications occurred. These two guides shared common K-wire placements for uniform fit.

OUTCOME / BENEFITS

The surgery *"was successful and negative margins were achieved."*

The surgeon appreciated the provision of guide options.

Patient Anatomy

Patient Guide

Allograft Guide

Final Result

CASE STUDY:

Osteosarcoma of the Distal Femur

SUMMARY

This young female patient presented with an unusual cartilage lesion, resembling chondrosarcoma in her posterior femur that required resection. Pre-surgical imaging showed her intra- & extra-osseous components needed to be removed, with a 5mm margin.

DESCRIPTION

The surgeon placed a request with Insight Surgery for the provision of surgical guides and a patient-matched allograft solution. A complex 6-planar osteotomy was required to remove the entire tumor, whilst preserving the continuity of the anterior, medial, and lateral cortices.

Surgical guides were designed and manufactured for the required osteotomies on both the patient and allograft. These enabled the surgeon to accurately restore a more natural anatomy for the patient.

OUTCOME / BENEFITS

The main aim of this surgical procedure was to replace the affected segment of the right distal femur with an allograft bone implant. The surgical guides allowed the surgeon to make the appropriate cuts with a higher degree of accuracy than making these osteotomies freehand and increasing the likelihood of stable fixation and osteointegration.

Using the Virtual Surgical Plan that was created prior to the surgery, it was possible for the surgeon to effectively determine the size and positioning of the required cuts. Overall, this meant less time was spent in the surgery for the procedure due to enhanced pre-surgical plans defined by the surgical team.

CASE STUDY:

Pediatric Femoral Osteosarcoma Resection

SUMMARY

In this case, surgeons were presented with a pediatric patient with a femoral osteosarcoma requiring resection and allograft reconstruction. However, additional complications in planning arose from the femur having fractured as a result of the cancerous growth. Careful consideration was needed for the resection and reconstruction to proper length and configuration.

DESCRIPTION

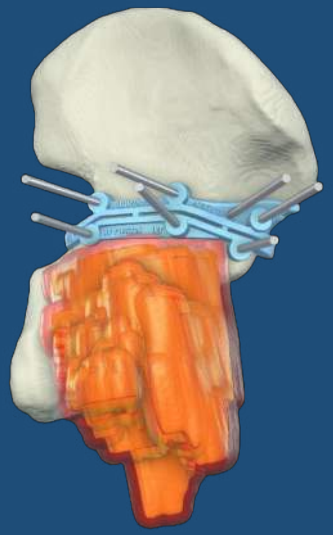
Insight Surgery used a combination of CT and MRI scans to develop the anatomical model. The tumor was grown 5mm distally and 10mm proximally in order to plan cutting planes with safe margins. Four cutting guides were designed; two for the patient resection and two to facilitate the subsequent allograft reconstruction.

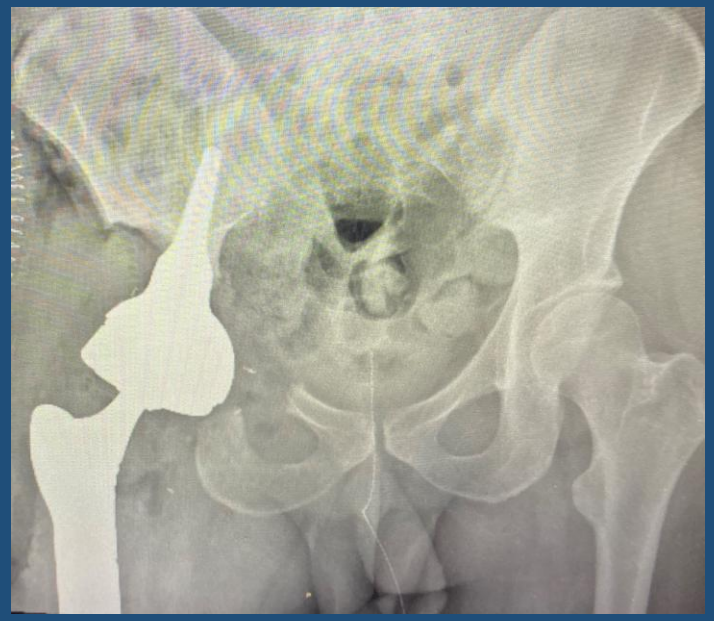
A virtual model of the patient's contralateral healthy femur was also constructed from CT. This was used to plan the correct femoral length needed for reconstruction. Cutting guides were designed and manufactured to accurately resect the patient anatomy and then reconstruct to correct length and ensure optimal fit with the allograft.

OUTCOME / BENEFITS

Planning in this case proved useful for surgeons facing a growth that had significant implications for this young patient and resulted in informed treatment decisions.

Patient Anatomy
& Surgical Guide





Postoperative X-Ray

CASE STUDY:

Acetabular Osteosarcoma

SUMMARY

In this exemplar case, the patient presented with an osteosarcoma that had invaded the acetabulum. Insight Surgery provided personalized surgical guides to safely resect the compromised bone whilst maximising bone conservation.

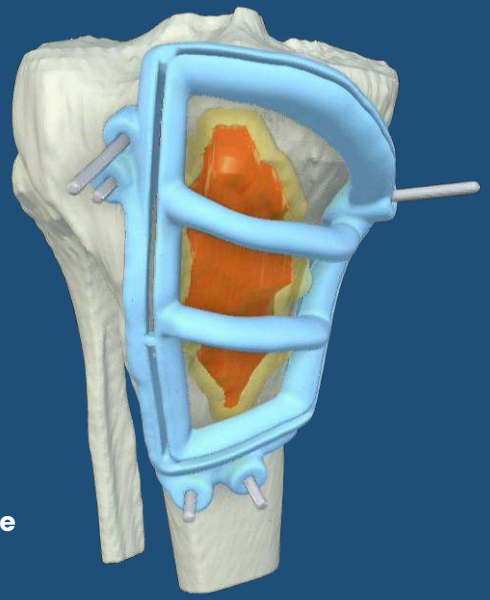
DESCRIPTION

Within 5 days of receiving the surgeon's instruction, Insight Surgery was able to rapidly design and manufacture multiple medical devices; patient-specific anatomical models for pre-surgical planning and surgical guides for optimizing the resections.

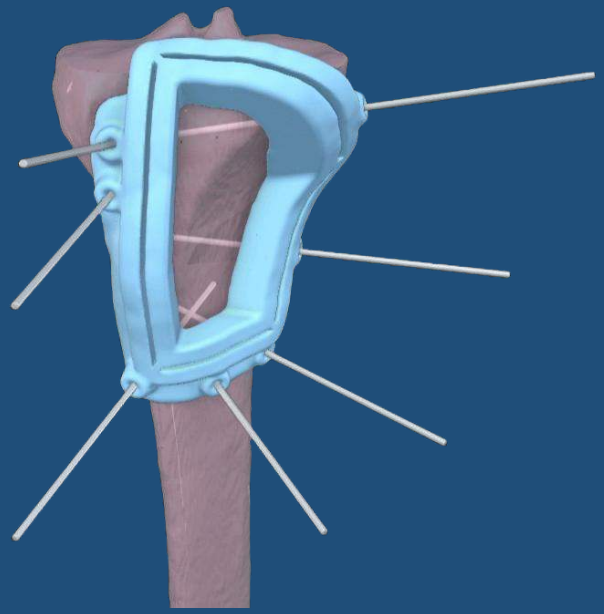
OUTCOME / BENEFITS

The surgeon commented:

"The patient had an unfortunate and significant progression of disease despite chemotherapy that necessitated a change of surgical plans with a tight window. With the expert help and a true collaborative effort from the teams at Insight and ImplantCast, we were able to implement a precise and patient-specific plan for the patient that made our surgery more efficient and optimized the outcome for the patient. I am thankful for the support and the efficiency with which this was delivered."



Surgical Guide



Allograft Guide

CASE STUDY:

Tibial Osteosarcoma Resection & Allograft Reconstruction

SUMMARY

This patient presented with a low-grade osteosarcoma of the right proximal tibia. The surgeon elected to resect the tumor and follow up with an allograft reconstruction

DESCRIPTION

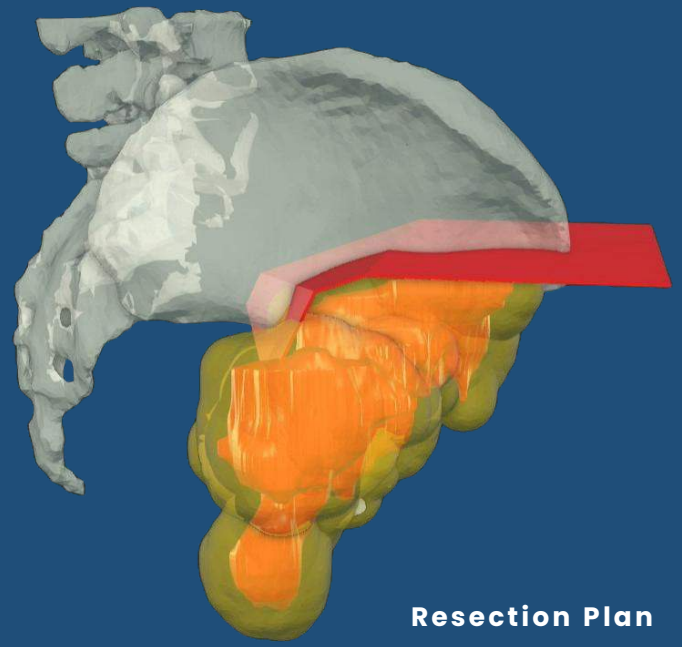
After building the anatomical model Insight Surgery worked closely with the surgeon to develop guides that would allow for negative margins in resection while allowing variable tolerances throughout the footprint to account for soft tissue in different locations. A support bridge in the guide was used to help achieve this low profile.

One of the priorities for resection was preserving tibial tuberosity to maintain function of the knee extensor mechanism. This objective extended to the choice of allograft; finding a good match for the tuberosity. Surgical guides were designed and manufactured for the allograft cuts to attempt good global fit around the tumor resection borders.

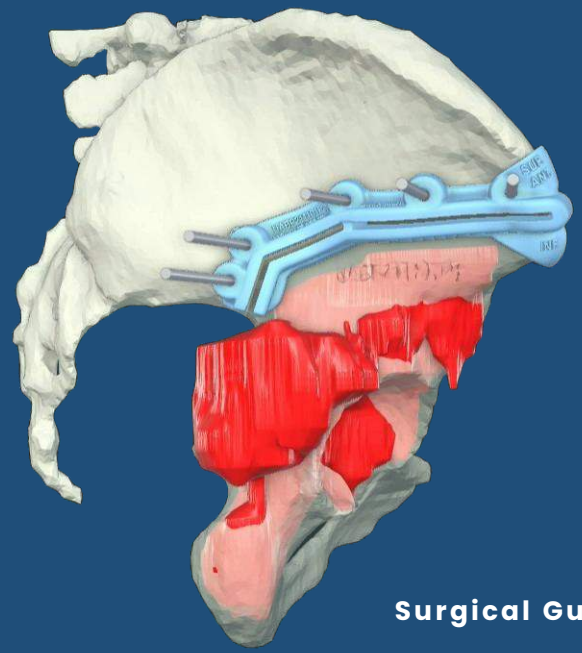
OUTCOME / BENEFITS

The surgeon particularly appreciated the angled cut running underneath the tibial plateau. If attempted freehand it likely would have ran horizontally, as it had in the surgeon's last case which resulted in the structure collapsing post-op.

The cut provided by this guide allowed the tibial platform more structural integrity and strength, reducing the risk of collapse and further surgery for the patient.



Resection Plan



Surgical Guide

CASE STUDY:

Osteosarcoma Resection & Hemipelvectomy

SUMMARY

This patient's osteosarcoma was fast growing and the surgeon had particular concerns about the growth compromising important anatomical structures at and around the sciatic notch, including the sciatic nerve.

A hemipelvectomy was planned to entirely remove the affected part of the hemipelvis, whilst safely preserving as much as bone as possible to allow for subsequent reconstruction with an implant.

DESCRIPTION

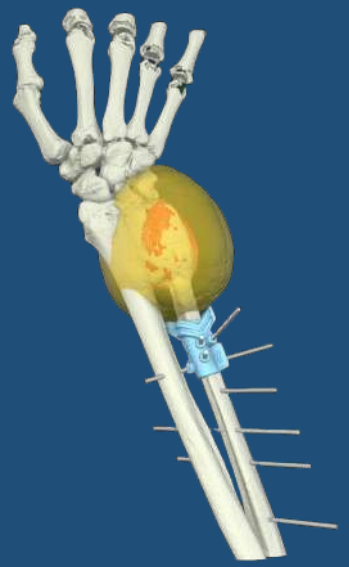
A 3D model was built through a combination of CT and MRI. Two different tumor margins, wider anteriorly and narrower posteriorly, were agreed upon with the surgeon and used to set the resection plane locations and angles. Using the narrower margin posteriorly helped the surgeon to avoid critical neurovascular structures at the sciatic notch and preserve as much bone as possible for reconstruction.

Notably, this case demonstrated Insight Surgery's capability for extremely quick turnaround. Owing to the urgency of the growth, it took less than five days from receiving the scans to delivery of the guides for sterilization prior to use in theater.

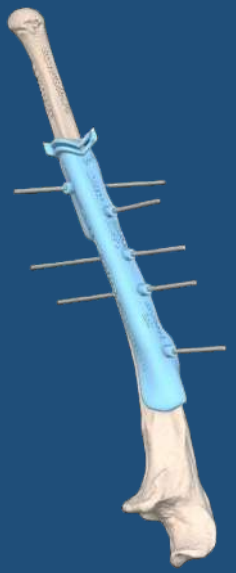
OUTCOME / BENEFITS

Virtual planning and intra-operative surgical guide use resulted in a successful hemipelvectomy procedure in 90 minutes. This meant less time in theater for both patient and surgeons compared to a procedure without.

Negative margins were achieved and this resection formed the basis on which the surgeon would reconstruct the joint with a custom implant.



Surgical Guide



Allograft Guide

Final Result with Allograft

CASE STUDY:

Distal Ulna Resection & Allograft Reconstruction

SUMMARY

This patient presented with a post denosumab giant cell tumor of their distal right ulna bone. The treatment plan included an allograft transplant and reconstruction of the distal ulna. Insight Surgery were instructed to provide a Virtual Surgical Plan, patient-specific anatomical models and sterilizable guides for cuts on both the patient bone and allograft.

DESCRIPTION

Insight Surgery's engineer utilized the contralateral scan and the healthy anatomy as a foundation for the creation of a Virtual Surgical Plan for the reconstruction of the affected ulna area.

The boundary of the tumor was extended by 2cm to produce a cutting edge for the design of the guides. Patient-specific guides were produced for dorsal and palmar approaches of the ulna resection. As well as a freehand and fixed option for the allograft.

Along with the sterilizable guides, models and demo guides were printed to allow pre-surgical planning and familiarization with the devices ahead of the operation.

OUTCOME / BENEFITS

A chevron cut was used for both the patient anatomy and the allograft for several reasons. It has benefits when locating the allograft accurately and can give added multiplanar and torsional stability.

However, the primary benefit is that this configuration provides an increased contact surface area between the native anatomy and the allograft, promoting osseointegration post-operatively, leading to greater stability. This service from start to finish was completed within the patient's 28-day treatment window.

CASE STUDY:

Partial Radial Osteotomy

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 tumor with a safe margin in order to preserve as much of the distal radius and the radiocarpal joint as possible.

DESCRIPTION

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

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

OUTCOME / BENEFITS

The surgeon commented that it 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 tumor."*

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

FASTER RECOVERY

Less time in ICU, faster rehabilitation. On average patients stayed 3 less days overall and 1.5 days less in ICU.

FEWER MAJOR ISSUES

By the use of surgical guides in complex orthopedic oncology cases. an ~18% reduction in major complications during and after was observed.

FEWER POSITIVE MARGINS

In our study with the UK NHS over 26 real world cases, 13 of the cases that did not use guides had 3 positive margins as opposed to 0 positive margins where guides were used.

REDUCED THEATER TIME

Overall, between a 10% to 30% reduction in theater time was observed brought about by the use of digital planning and surgical guides.

INCREASED SURGICAL LISTS

Significant time savings in surgery by using digital planning and guides means more procedures can be added to future surgical lists.

REDUCED BLOOD LOSS

In our studies with the NHS,. an overall decrease of ~13% in blood loss was seen which improved the patient outcomes and lowered operational theater costs.

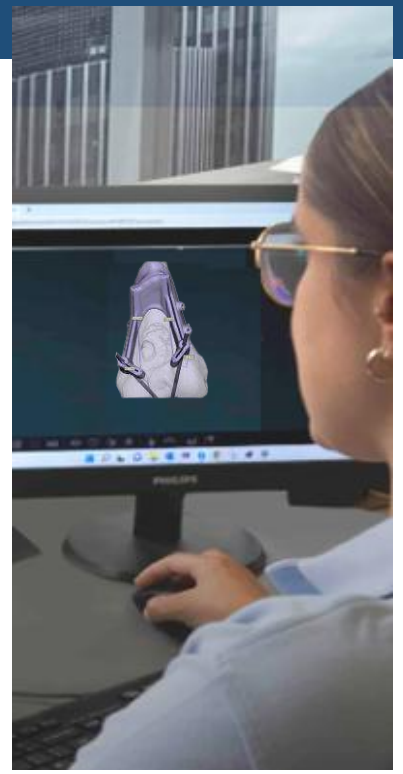
Benefits of Personalized Surgical Solutions

NHS
Royal National
Orthopaedic Hospital

insight
surgery

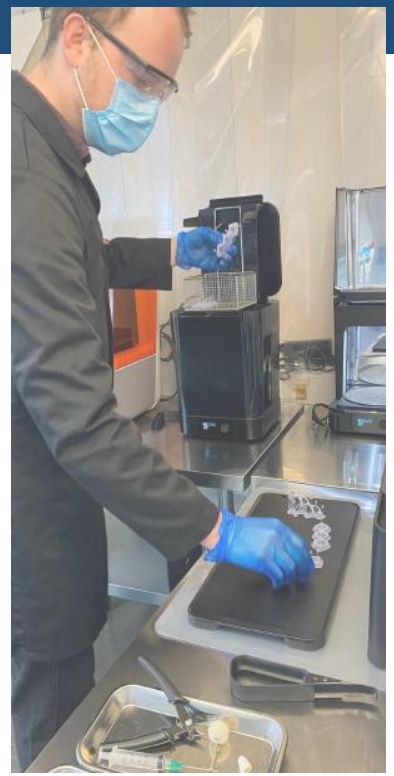
Workflow for Guided Orthopedic Oncology Resection

Patient scan & surgeon case instructions received

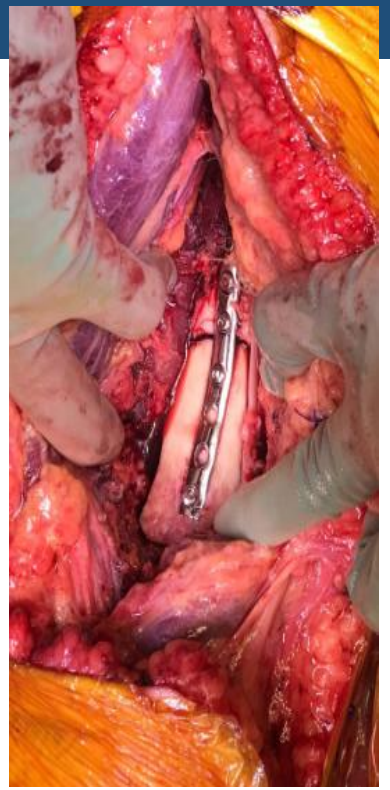


Virtual Surgical Plan (VSP) defined with 3D model and Surgical Guide

Final review & approval of VSP and devices by surgeon



3D printing of medical devices in our in-house cleanrooms



Surgery is performed

insight surgery

Digital Planning.
Personalized Solutions

Medical Devices provided in Days, not Weeks

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