3D4MED

3D PRINTING FOR SURGERY

A *new* technology for an effective and customized surgery!

The Idea

We transform medical images (MRI & CT) into a 3D printed object to hold in your hands!

Why?

To help surgeons **planning** and **performing** the surgery, and to facilitate doctor-patient **communication**.

Surgeon Testimonials

"To hold in my hands the 3D printed patient's anatomy, to visualize it and study it from different perspectives, has given me the appropriate tools to analyse cleary the specific anatomical region to operate and plan the best procedure."

*Prof. **Andrea Pietrabissa**, Director of **General Surgery** II, IRCCS Policlinico San Matteo, Pavia*

"The 3D printed model allows us to plan the resection and speed up the surgical process, thus reducing the time for general anesthesia and allowing a more precise and symmetrical result to be obtained."

*Prof. **Marco Benazzo**, Chief of **Otolaryngology**, IRCCS Policlinico San Matteo, Pavia*

"The use of a 3D printed model is very important when choosing the surgical technique and the prosthesis, as it allows a less invasive surgery and the choice of not carrying out the surgery under unfavourable circumstances."

*Prof. **Enrico Maria Marone**, **Vascular Surgeon**, IRCCS Policlinico San Matteo, Pavia*

We make three-dimensional replicas of each patient's **unique patient's anatomy**, showing all the surgical relevant structures accurately. Through the combination of engineering and medical skills, we can provide a truly integrated service tool for surgical planning.

Our 3D printed models are made for **any medical specialties**. We have several years' experience in the following areas, to date:

- Abdominal surgery
- Otolaryngology & Maxillofacial surgery
- Orthopedics
- Vascular surgery

...but it is possible to reproduce **many other anatomical structures**!

Technologies

Our 3D printers allow us to choose the most suitable technology according to the application field and to specific surgery requirements: we can print and combine different colors and materials, even deformable and transparent, with very high resolution of detail.

Deformable models can be used for realistic simulations of the surgical procedure, while **transparent** ones are useful for planning the endoprostheses placement. We can produce **interlocking models**, to assess structures or tumors otherwise inaccessible, and **models with high chromatic resolution**, to identify the relevant anatomical structures more easly.

By exploiting each material's different physical features, we can make models with mechanical properties very close to reality, i.e. deformable models for vessels or chalk powder ones for bone structures.

ObJet260 Connex3

Polyjet printer with photopolymer resins crosslinking with UV light.

FORM2

Small stereolithography printer with photopolymer resins crosslinking with UV laser light.

ProJet 460 Plus

Plaster printer, with a chromatic resolution of over 2.8 million colors.

Abdominal Surgery

Our 3D printed models are used at Policlinico San Matteo in **50%** of the cases of **surgical planning in pancreatic surgery** and in **100%** of the cases of **spleen** and **kidney surgery**.

We have printed **more than 40 models** to date, for spleen resection, kidney, liver, spleen and pancreas tumor resection, for splenic artery aneurysm bypass and for living-donor kidney transplant.

Unlike simple virtual models, our 3D models allow the surgeon to assess the anatomical distances easily and to evaluate the most suitable access points, as they ensure a full overview of the surrounding anatomical structures. The 3D models are also particularly useful for atypical clinical cases, with complex morphological abnormalities in vessel conformation.

Multichrome plaster model for robotic kidney tumor resection. This model can be used for surgical planning and intra-operative guide.

Multichrome resin model for splenic artery bypass. This technology allows to combine various levels of transparency and deformability in the same model, to be used also for surgical procedure simulation.

Otolaryngology & Maxillofacial Surgery

We have printed 3D models of **temporal bones** and **jaws** used for planning facial bone surgeries.

Temporal bone models are used by surgeons to plan the placement of hearing aids and prosthesis.

Mandibular models are useful in surgical planning of both the demolishing and reconstructive phases that follow the removal of mandibular tumors.
Our 3D models have also been used during the pre-operative phase for modelling metal plates for reconstruction, thus allowing a reduction of operating and anesthesiological times.

Plaster model for jaw tumor resection both pre-(sx) and post-operative (dx).
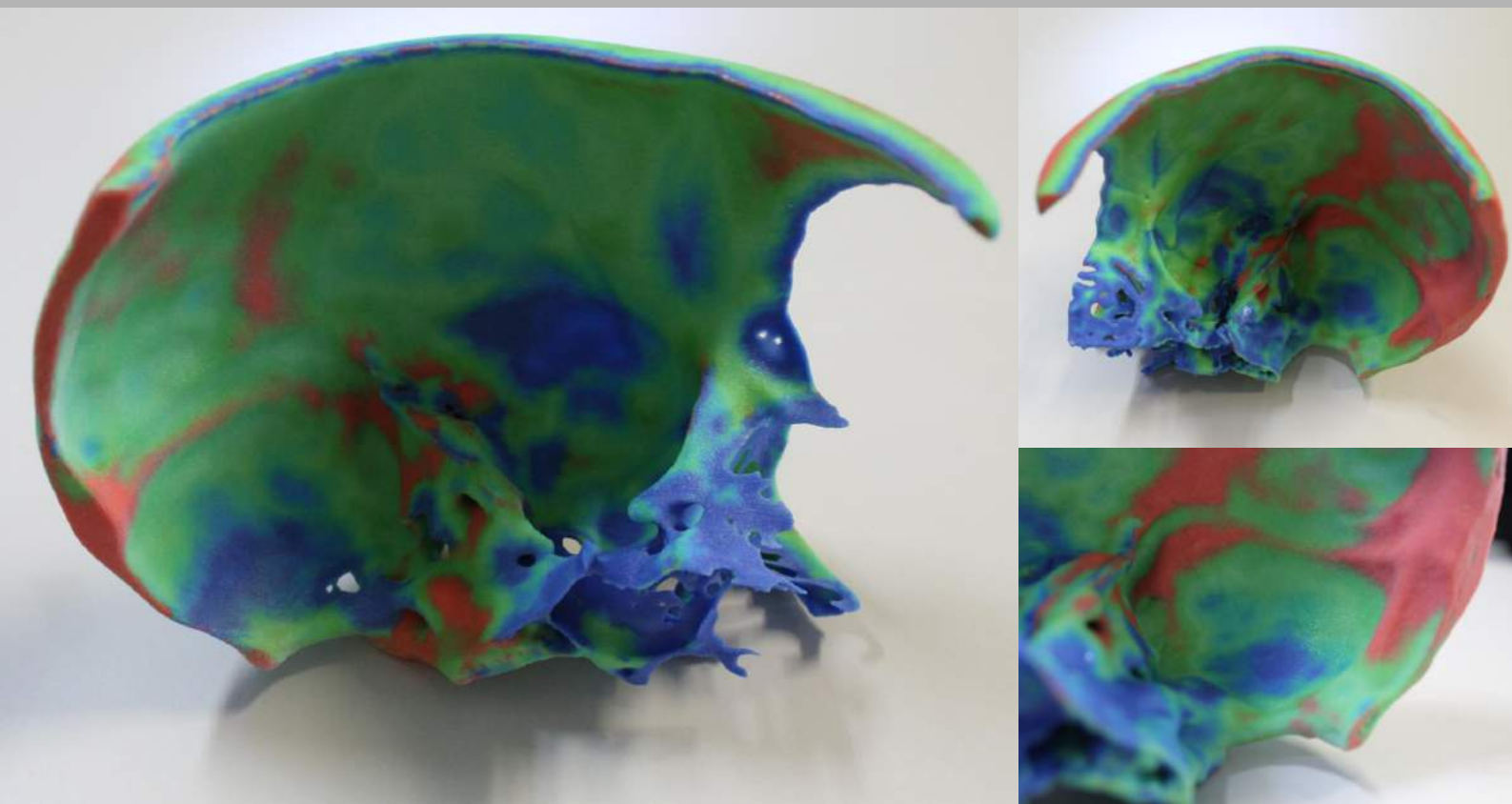
Temporal bones thickness map for planning hearing prosthesis placement.

*Temporal bone model for surgical planning.*

Ortophedics

Our 3D models reproduce injuries due to fractures (**pelvis** or **heel** fractures and **spine** trauma) and cancer.

Since 3D models for traumatic injuries are required with considerable urgercy, we are able to produce them **within 12 hours**, depending on the bone district.

Our 3D models can also be used to test and choose the best surgical instruments and devices (metal bars, screws, plates, templates, etc.) for every single patient.

Interlocking model for spine tumor resection: improvement of the tumor visibility, located in a hardly accessible point.
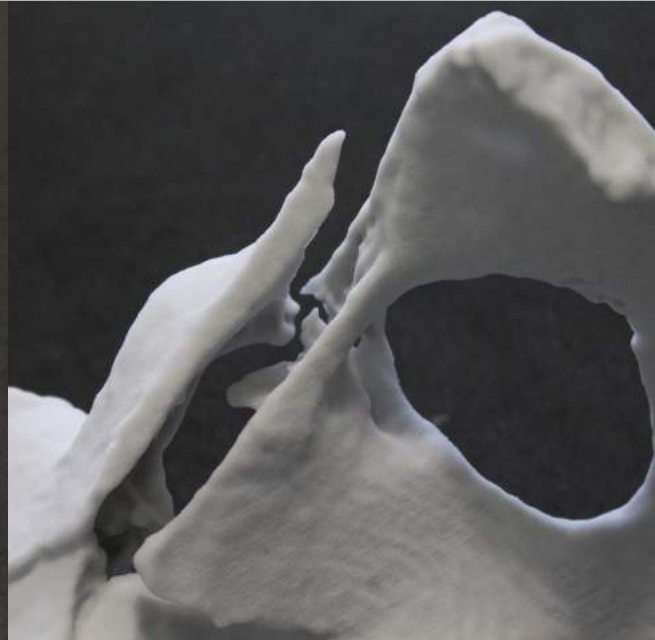
Pelvis fracture model.

Foot fracture model.

Vascular Surgery
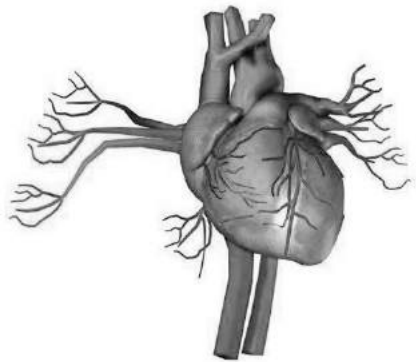
3D printing makes a real contribution to the planning of **aneurysms** and **aortic dissections** surgeries.

Our 3D printed models are also used to assess the placement of **vascular endoprosthesis**, when choosing type and geometry of the most suitable prosthesis for the specific clinical case.

Aorta models for surgical planning: the transparent one can be used for planning vascular endoprosthesis placement; multichrome plaster models allow to the identification of the anatomical structures of interest.

Cardiac emicavity for surgical access evaluation.

Team

Young researchers, experienced academics and renowned surgeons: our engineering and medical knowledge in the service of cutting edge surgery.

Ferdinando Auricchio
Professor, University of Pavia

Andrea Pietrabissa
Director of General Surgery II, IRCCS Policlinico San Matteo of Pavia

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Researcher, University of Pavia

3D@UniPV
Virtual Modeling and Additive Manufacturing for Advanced Materials

We have been working for long with renowned national and international health and scientific institutes for research, hospitalisation and health care, among them:

IRCCS Policlinico San Matteo, Pavia, Italy

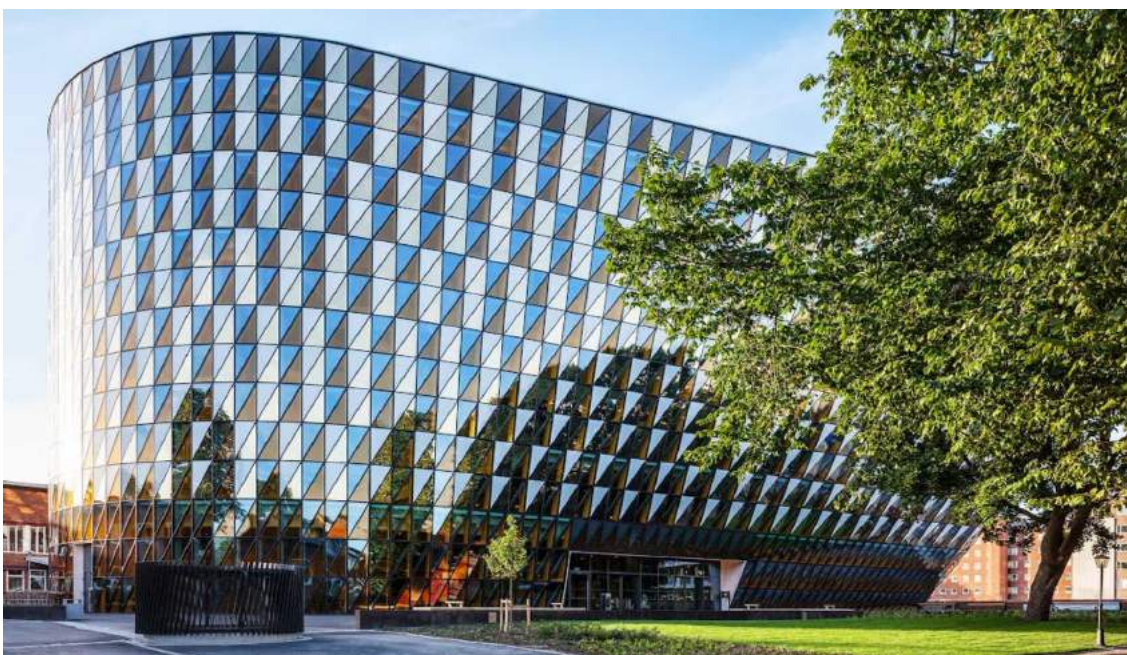*IRCCS Policlinico San Donato, Milan, Italy*

Karolinska Institutet, Stockholm, Sweden

Crowdfunding

The crowdfunding compaign "*3D Printing for Surgery*" promoted by **Universitiamo by UniPV** has also supported our project.

🌐 *www.universitiamo.eu/campaigns/stampa-3d-per-chirurgia*

And it is still possible to support us through **bank transfer**:

Holder: *Università di Pavia*

IBAN: *IT 20 J 03111 11300 000000059256*

Payment description: *UNIVERSITIAMO – La stampa 3D aiuta il tuo chirurgo*

All donations are fully deductible.
(For more details visit the Tax Benefits Website).

3D4MED

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The Project is part of the University's Strategic Plan **3D@UniPV**