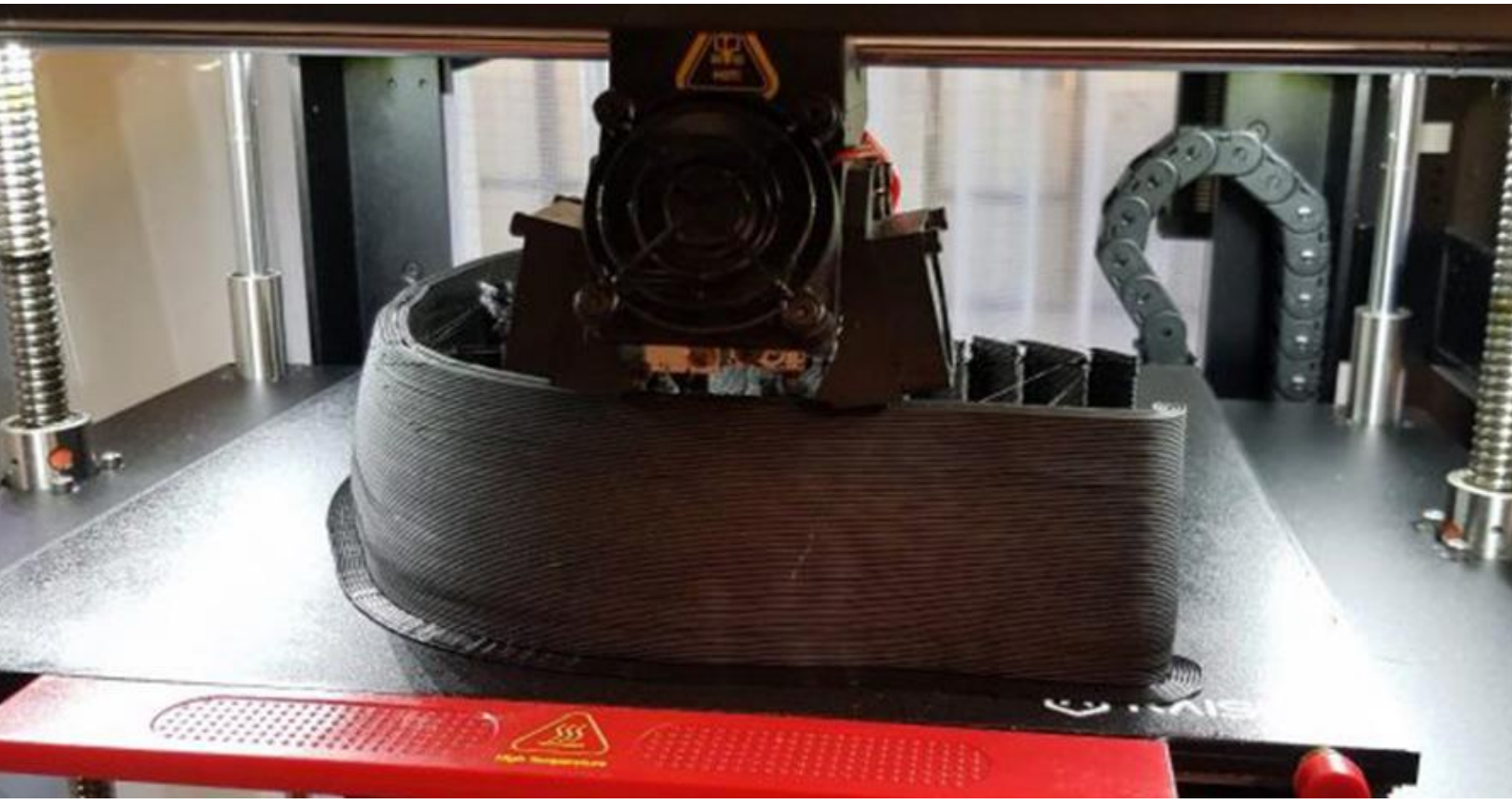
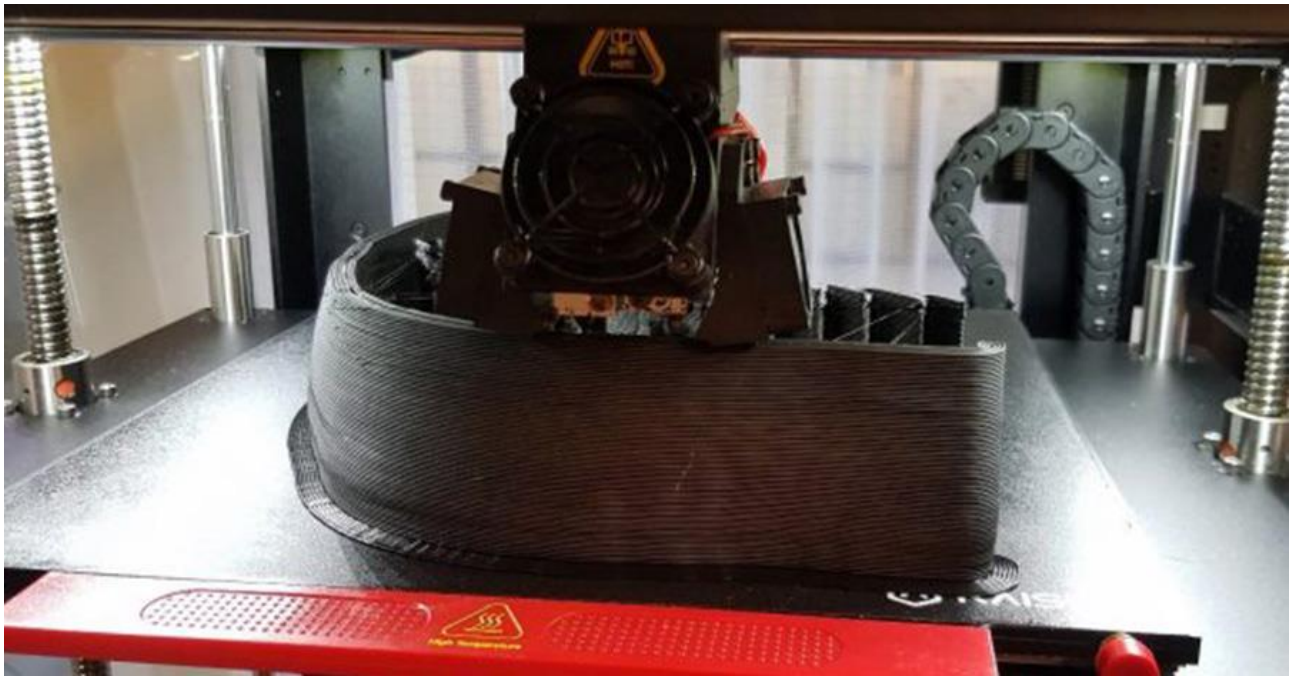
Medical 3D Printing in Radiotherapy



Raise3D Case Study
Mar 19, 2020

3D printing, also referred to as additive manufacturing, has ignited a revolution in several industries thanks to the quick and cost-effective production of 3D objects from digital models. With the rapid advancement of flexible manufacturing and innovations in Biomedical fields, 3D printing is now widely implemented for medical purposes, such as: implant designs, surgical planning and training, and prosthetics.

You can 3D print with thermoplastics like Polycarbonate, semi-flexible plastics, ABS, which is strong and weather resistant or PLA (Polylactic Acid), which will biodegrade over time, even inside a human body!



In the field of radiotherapy, 3D printing is used to create custom devices for beam range modulation, 3D Conformal Radiation Therapy (3D CRT), or Brachytherapy application.

Radiation therapy is now one of the frontline treatments in Oncology, along with chemotherapy, surgery, or medications for immunotherapy. If cancer can be treated with radiation, patients are referred to a Radiation Oncologist — a doctor who specializes in treating patients with radiation therapy- a common form of cancer treatment that uses high dose radiation to shrink tumors by destroying cancer cells.

Recent breakthroughs in radiation technology, like intensity-modulated radiation therapy, have helped to reduce toxicity. But these methods tend to be complex, requiring extensive planning and safety checks before treatment can begin. 3D printing is an excellent tool for providing personalized cancer treatment.

3D Printed Shields and Bolus:

One significant application of 3D printing in the medical field is the production of **customized bolus and shields used during radiotherapy**. A bolus fabricated from a material that has properties similar to human tissue when irradiated is widely used to reduce or alter dosage for targeted radiation. It is placed over the treatment area to modify a dose both at the skin surface and sub-dermally with a 3D printed shield that protects healthy tissues and organs from unwanted radiation.

3D printing technology is a great asset to design customized boluses and shields that fit a patient's unique anatomy perfectly. This is most commonly accomplished by creating thermoplastic masks.

Traditional methods of fabricating shields or masks involved casting of several molds, which were not only expensive but very time and labor-intensive. 3D printed shields from materials like Thermoplastic Urethane (TPU), or Silicone, can be easily and cost-effectively created from existing CT/MR images with no inconvenience to a patient.

Customized Irradiation at AMC:

At the radiotherapy department in the AMC (Academic Medical Center – Amsterdam), the treatment goal is to remove the tumor as effectively as possible without affecting healthy cells. The Pro2 Series 3D printer from Raise3D plays an important role in this. Clinical physician and frequent user of the printer, Atilla Erogluer, explains how that works.

'We chose a Raise3D printer because it is reliable, has a large construction area, and can print quickly."

Custom Fabrication of Malleable 3D Printed Bolus using Raise3D Pro2

A customized, 3D printed bolus is produced for physicians to apply to irregular surfaces which helps prevent unwanted irradiation. Erogluer successfully fabricates boluses using a 3D scanner and evaluates its efficacy and develops a customized radiotherapy plan. A custom fabricated 3D bolus prevents air gaps and showed improved target coverage when compared with that without the bolus.

Raise3D Interview with Atilla Erogluer, Clinical Physician at AMC

Raise3D: You have been working with a Raise3D Pro2 since the beginning of 2019. What are you able to accomplish with the printer?

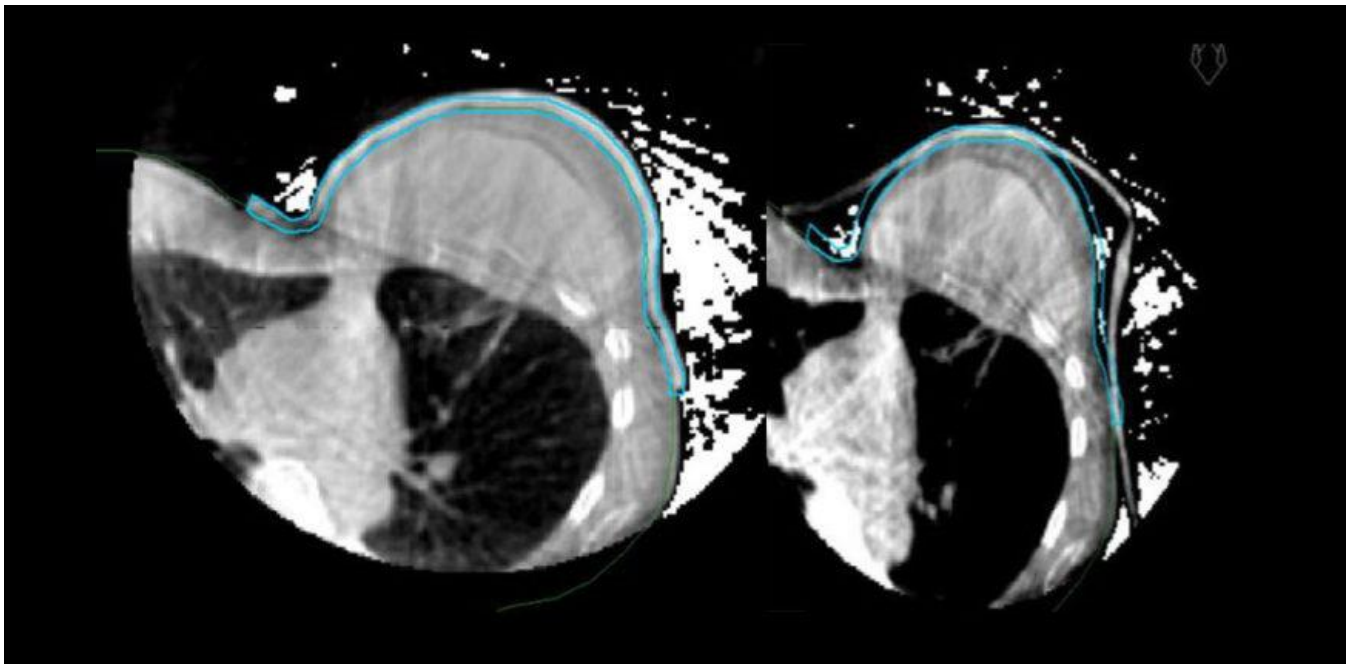
Erogluer: *"In our department, we try to remove tumor tissue in people with cancer through radiation. To be effective, the irradiation dose must be as high as possible. We achieve this by placing superficial tumors called 'bolus' on the patient's skin. This is a silicone flap that fits precisely to the skin so that the maximum radiation dose is just below the surface of the skin. With the PRO2 3D printer, we 3D print a custom mold for every patient who needs a bolus. We then pour silicone material into the mold that, once cured, acts as a bolus."*

Raise3D: How did you make the boluses before?

Erogluer: *"Before we had a 3D printer here, we cut out a loose flap of silicone material for each patient. The biggest disadvantage was that the bolus does not exactly fit the skin of the patient, creating air holes. This is is not great for dose distribution. Placing the bolus is also complicated. And cut-out boluses always have the same thickness. That is also not ideal. Fortunately, we are no longer affected by that."*

Raise3D: Are there any other benefits that the 3D printed boluses bring?

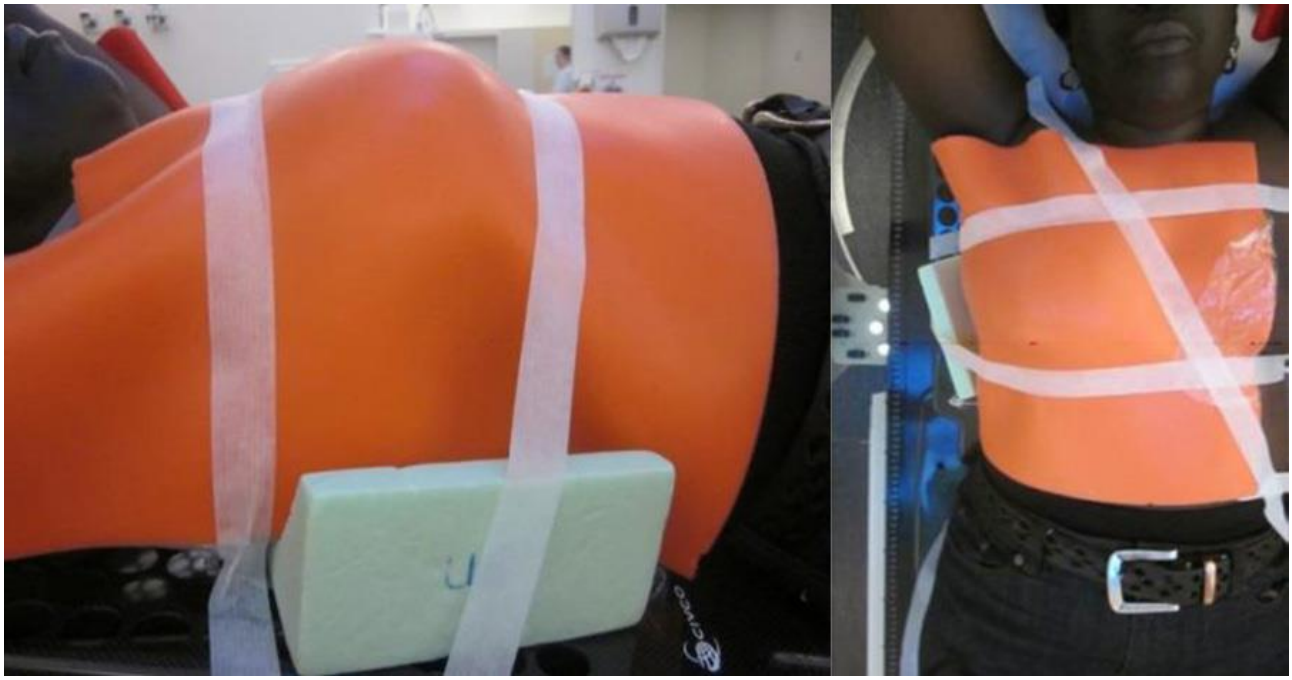
Erogluer: *"We can now also draw specific structures on the bolus, called cross-threads or ISOC location. That way, we can position the bolus even more accurately on the patient with the help of laser lines."* We can use our 3D printing technology to create custom applicators for each patient. This allows us to tailor each patient's treatment specifically to his or her unique anatomy.

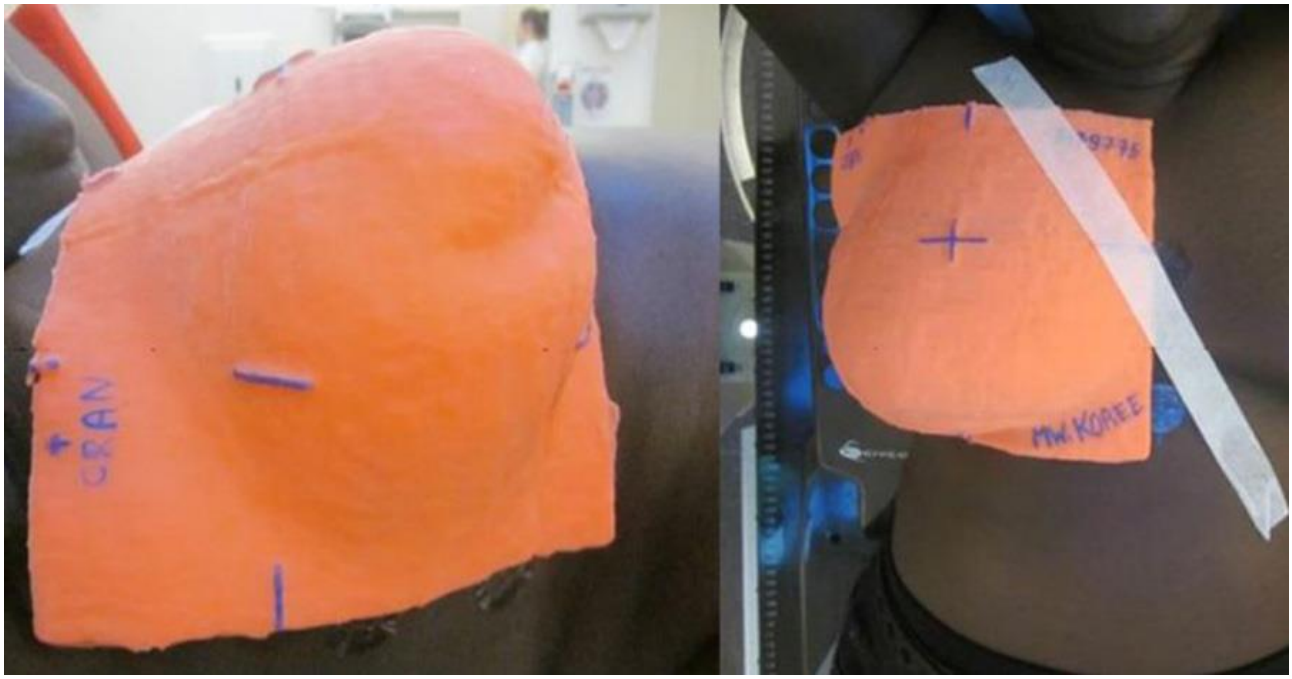


Choosing Raise3D Pro2 for Radiotherapy

Raise3D: Why did you choose a Raise3D printer?

Erogluer: *“Because it is reliable, has a large construction area and can print quickly. You don’t want patients to wait, so it is essential for us that we can always rely on the 3D printer. Besides, some boluses are quite large. For example, consider a chest. If you want to print a mold from it in one go, you need a lot of building space. And it is important for us that a printer prints quickly. We usually receive the necessary information two to three days before a patient starts treatment. We must then be able to print the correct template in a short period. It is also handy that the printer can be controlled remotely via the network and that you can follow the progress of the print via the webcam.”*





3D Printing for the Future

Raise3D: Is this the first time you worked with 3D printers?

Erogluer: *"No, our instrumental service already worked with it. Among other things, they print spare parts with it. "*

Raise3D: Judging from your enthusiasm, it's also not the last time?

Erogluer: "Absolutely not! Now we still print molds from our boluses; in the future, we will be happy to print the boluses directly. We have not succeeded yet because it requires very smooth and soft material, but we will continue to try. We could also use the 3D printer for brachytherapy, where irradiation takes place internally. The doctor places several thin tubes (catheters) on the patient's tissue so that small radioactive sources are placed in the right place. With a 3D printer, we can print a mold into which we insert different catheters. That is not yet the case, but who knows what will happen in the future. In any case, we have enough development plans that benefit both the patient and the hospital."

[Also known as internal radiation, brachytherapy involves placing radioactive material into a tumor or its surrounding tissue. Because the radiation sources are placed so close to the tumor, a radiation oncologist can deliver a large dose of radiation directly to the cancer cells.]

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Connect with Raise3D

Do you have a great 3D printing success story and think it would be cool to be featured on www.raise3d.com, we would love to learn more! Write to us at inquiry@raise3d.com

For more information about Raise3D printers and services, browse our website, or schedule a demo with one of our 3D printing experts.