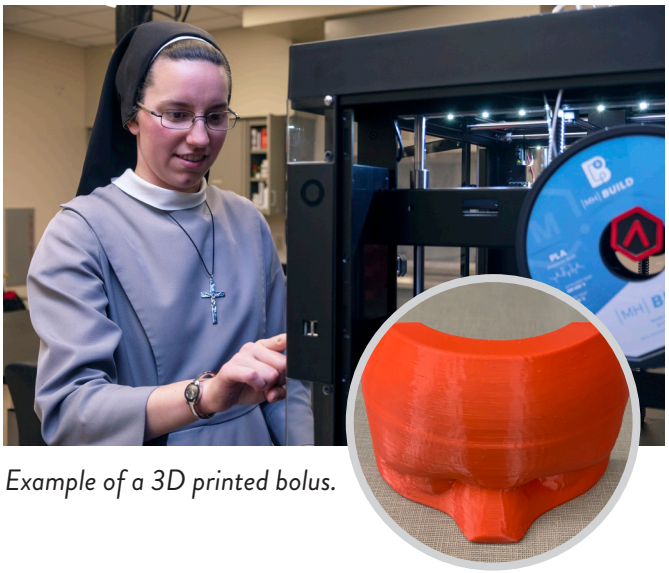
Patient-specific devices for radiation delivery

a Jump Simulation Case Study

THE OPPORTUNITY

Radiation can be used to treat cancers that are just beneath the surface of the skin, such as skin cancers and certain breast cancers. However, some of these cancers require enhanced dosage or are located on uneven surfaces, making it difficult to administer a uniform and accurate amount of radiotherapy. In these instances, radiation oncologists handcraft accessories called boluses to provide a more localized, effective treatment. But the materials used to make these tools are difficult to conform to the patient's anatomy and can result in air gaps that reduce the radiation dose at the targeted site.



Example of a 3D printed bolus.

THE SOLUTION

Radiation Oncology at OSF HealthCare Saint Francis Medical Center and Jump Simulation engineers are using an innovative process to design, fabricate and rapidly 3D print patient-specific bolus models that can be used throughout a patient's treatment. The goal is to improve radiation delivery, patient experience and patient outcomes.

THE IMPACT

Jump engineers have printed about a handful of bolus models for the Radiation Therapy team at OSF Saint Francis. This increases confidence that radiotherapists are treating tumor tissue with the prescribed radiation dose while reducing the amount to surrounding normal tissue. The models are easily reproducible, eliminating the need for patients to get re-fitted for each radiation treatment. And news of the 3D printed boluses is quickly spreading across the Ministry.

"We weren't always 100% certain we were achieving reproducible density and thickness in our homemade boluses. Using 3D printed, patient-specific models gives us a higher degree of confidence without any significant delays in getting a patient's treatments started."

– GREGG DEVANNA, MD, CHIEF MEDICAL PHYSICIST AT OSF SAINT FRANCIS MEDICAL CENTER

OSF HEALTHCARE

OSF HealthCare is an integrated health system owned and operated by The Sisters of the Third Order of St. Francis, headquartered in Peoria, Illinois. OSF HealthCare employs nearly 24,000 Mission Partners in 150 locations, including 15 hospitals throughout Illinois and Michigan. The OSF HealthCare physician network employs more than 1,500 primary care, specialists and advanced practice providers.

JUMP SIMULATION

Jump Simulation, a part of OSF Innovation, is one of the world's largest simulation and innovation centers with the vision of improving outcomes and reducing costs through excellent training. For more information, visit **jumpsimulation.org**.

To learn more, visit **osfinnovation.org/CaseStudies**

PERSONALIZING RADIATION TREATMENT FOR CERTAIN CANCERS

When treating shallow cancers, such as skin cancer, radiation oncologists may fabricate a treatment accessory called a bolus to help optimize the radiation dose to the targeted cancer while minimizing contact with surrounding anatomy. This can be done using everything from wet washcloths to soft commercial material.

However, these models can be unadaptable and difficult to conform to the patient, especially for cancers that need enhanced dosage or are located on uneven surfaces. This can result in air gaps that reduce the radiation dose at the targeted site and increase the risk of radiation hitting surrounding healthy tissue.

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HOW PATIENT-SPECIFIC BOLUSES CAN IMPROVE RADIATION TREATMENT

Radiation Oncology at OSF Saint Francis is using a software called Adaptiiv that combines patient CT scans with computer-generated radiation planning data to produce custom-made bolus models. Those models are sent to Jump engineers for 3D printing.

"This method eliminates the need for patients to come into their oncologist's office to get fitted for a bolus, leading to a better patient experience," said Tate Ralph, simulation engineer for Jump Simulation. "Once the Radiation Therapy team sends me a print from a CT scan, I can have a bolus printed and delivered in as little as two hours. As far as customized devices go, this is a very rapid turnaround."

After receiving the print, Radiation Therapy verifies the bolus fit and radiation dosage before a patient undergoes their first radiation treatment. This increases confidence in the accuracy of radiation dosing and reduces negative consequences that can result with radiation.

"We've recently seen a few cases where individuals had cancers on the tip of the nose, ears or cheek," said Gregg Devanna, MD, chief medical physicist at OSF Saint Francis. "The geometry of those anatomies makes it difficult to handcraft boluses that will accurately fit those areas. The 3D printed boluses uniformly conform to the patient's anatomy, reducing the chance for air gaps."

Because the models can't be reshaped, the bolus is easily applied to the patient, eliminating the need for patients to get re-fitted for each radiation treatment.

SPREADING THE GOOD NEWS

As Jump engineers and radiotherapists at OSF Saint Francis continue to 3D print boluses to treat certain types of cancer, news of this methodology is spreading.

"It's certainly on the radar of our physicians," Dr. Devanna said. "We've sent boluses to OSF sister sites in Danville, Ottawa and Pekin. Two centers here in Peoria have also used it, so it's gaining wide acceptance within the OSF Ministry."

Beyond that, this effort demonstrates the benefit of bringing engineering and clinical care together to deliver more precision medicine offerings, an overall OSF goal.

"I think the future is bright, especially when we have the new OSF HealthCare Cancer Institute coming and the resources associated with that to really be on the cutting edge of what we can do for our patients in the future," Ralph said.

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