Patient Case Study:
Lymphoma Requiring 3D Printed Leg Wrap Bolus

SAINT LUKE'S RADIATION ONCOLOGY NETWORK
Department of Medical Physics
Dublin, Ireland

Overview

Adaptiiv Medical Technologies Inc. (Adaptiiv) provides cancer centers with regulatory cleared software to design patient-specific radiotherapy accessories that can be 3D printed.

The following case demonstrates the application of Adaptiiv's 3D printing software solution in clinical radiation oncology by creating a conformal and flexible full-leg wrap bolus. Saint Luke's Radiation Oncology Network (SLRON) effectively used Adaptiiv's solution to create a bolus that can be placed efficiently and consistently between fractions.

Saint Luke's
Radiation Oncology Network

ADAPTIIV

Patient History

The patient presented with multiple palpable lesions on the right lower leg, which were found via biopsy to be cutaneous T-cell non-Hodgkin's lymphoma. Due to the superficial nature of the lesions, the clinical team opted to bolus the entire lower leg with a 5 mm simple bolus.

Description

Due to the complexities of using wrap bolus on extremities, fabrication and treatment setup times are typically long and laborious. Additionally, the extreme curvature of the leg can cause difficulties in achieving an accurate and reproducible fit, resulting in inconsistent coverage and large air gaps. For these reasons, a 3D printed bolus was chosen for treatment. The bolus model was designed to include a slit, added through contouring tools available in Varian's Eclipse TPS. Due to the flexible nature of the 3D printed material, the slit width could be adjusted using Leucoplast tape if a tighter or looser fit was required. The ability to adapt ensured that the bolus could be easily fitted throughout treatment and adjusted to account for any edema or surface structure changes.

Fabrication and Treatment

Once the clinical team approved the plan, the bolus was imported to Adaptiiv's 3D Bolus software, cropped, smoothed, and converted to a file format compatible with 3D printing. The bolus was printed using an AirWolf Axiom 20 3D printer with WolfBend, a thermoplastic polyurethane (TPU) filament. The bolus was printed using a 0.5 mm nozzle with 100% infill. The printer speed was set at 30 mm/s, which resulted in a print time of approximately 23 hours to print the entire leg wrap. The final bolus could be adjusted to fit around the leg and, once placed, return to its original shape (Figure 1). Tape was used to secure the bolus onto the patient. The entire leg and bolus were immobilized using a thermoplastic immobilization device.

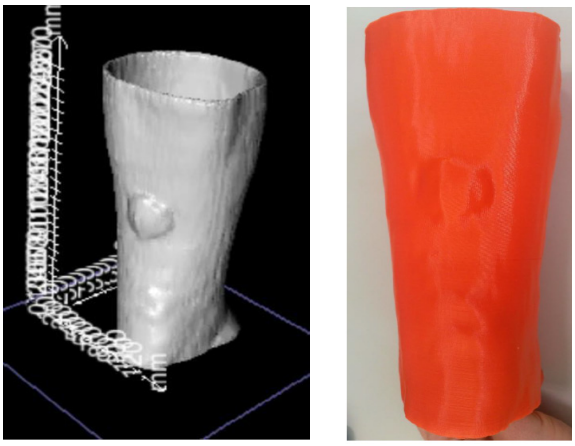

Figure 2. Planning CT scan of 3D printed bolus in the treatment position. Bottom: CBCT image verification showing consistent setup during treatment.

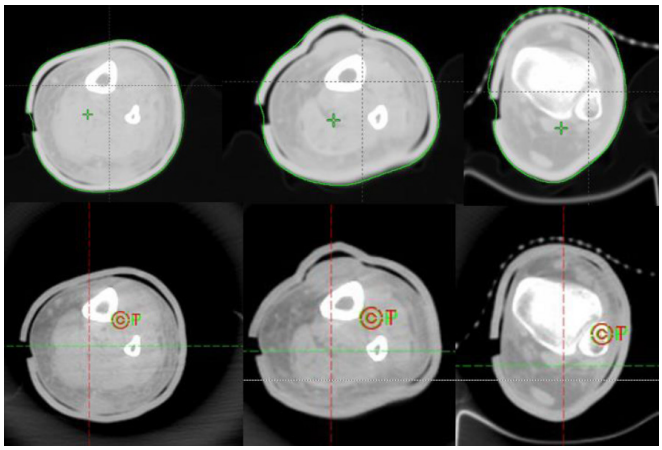

Figure 1. Left: 3D render in Adaptiiv's 3D Bolus software. Right: 3D printed bolus ready to use in patient treatment.

Results

The bolus conformed to the skin surface well at all levels and ensured a consistent and efficient placement for each treatment fraction (Figure 2). This approach was vastly superior to vinyl sheet bolus from both a conformity and efficiency perspective.

Summary

1. The 3D printed leg wrap bolus successfully conformed to the curvature of the leg.
2. The flexibility of TPU allowed the clinic to add a slit that could be used to loosen or tighten the bolus's fit in case the patient's anatomy changes during treatment.
3. The conformal nature of a personalized 3D printed bolus allowed for the easy and reproducible placement of the bolus, improving setup efficiency and accuracy.
4. Saint Luke's Radiation Oncology Network now uses a 3D printed approach for all extremities requiring bolus.

ADAPTIIV

Adaptiiv Medical Technologies Inc.
1969 Upper Water Street, Suite 906
Halifax, NS B3J 3R7

info@adaptiiv.com
adaptiiv.com