Patient Case Study: Lymphoma Requiring Full Leg Wrap Bolus

Department of Medical Physics
Saint Luke's Radiation Oncology Network, Dublin, Ireland

Overview

Adaptiiv Medical Technologies Inc. (Adaptiiv) provides cancer centres with the hardware, software, and materials to develop low cost, high performing medical tools that supersede existing conventional technologies. The following case demonstrates the application of Adaptiiv's 3D printing software solution used in clinical radiation oncology through the creation of a conformal, flexible full leg wrap bolus. This case is a great example of how Saint Luke's Radiation Oncology Network (SLRON) was able to effectively use Adaptiiv's solution to create bolus that can be placed quickly and consistently on a daily basis.

Description

Due to the complexities of bolusing extremities, treatment setup times are typically long and laborious, potentially resulting in inconsistent coverage with large air gaps. For these reasons, a 3D printed bolus approach was undertaken. The 3D printed bolus was generated with a slit using 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 when a tighter fit was required. This ensured that the bolus could be easily fitted on a day-to-day basis and was able to adapt to account for any edema that occurred during treatment.

Patient History

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 0.5cm bolus.

Fabrication & Treatment

Once the clinical team approved the plan, the bolus was exported to Adaptiiv's 3D Bolus software where it was cropped, smoothed, and converted to a format suitable for 3D printing. The bolus was printed using an AirWolf Axiom 20 3D printer with WolfBend, which is a thermoplastic polyurethane (TPU) filament. Printing was undertaken using a 0.5mm nozzle with 100% infill selected. The printer speed was set at 30mm/s, which resulted in a print time of approximately 23 hours to print the entire leg wrap. The final bolus could simply be pulled open to fit around the leg and naturally returned to its original position once the leg was in place (Figure 1). Tape was used to secure the bolus closed and the entire leg and bolus were immobilized using a thermoplastic immobilization device.

Results & Findings

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 using sheets of standard bolus from both a conformity and efficiency perspective.

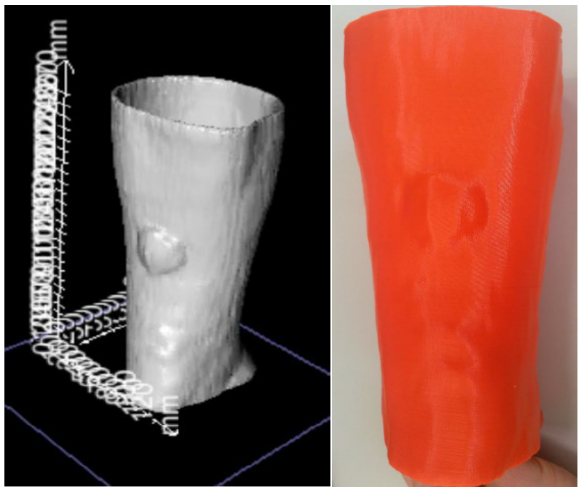

Figure 1.
Left: 3D render in Adaptiiv's 3D Bolus software.
Right: Final 3D printed bolus ready to use for patient's treatment.

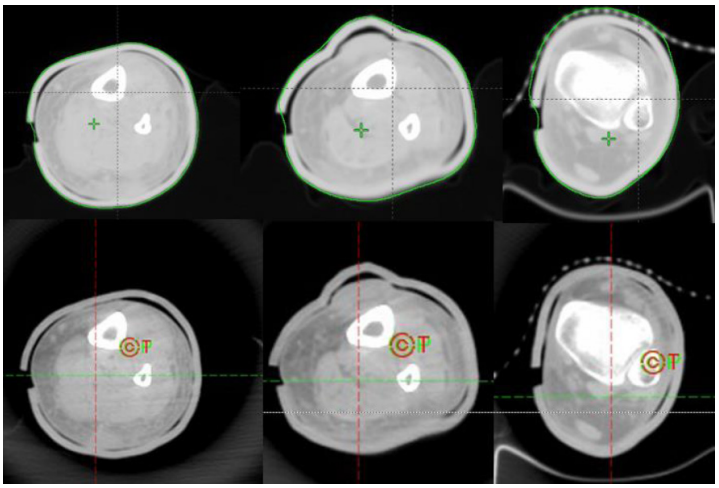

Figure 2.
Top: Planning CT scan of 3D printed bolus in the treatment position.
Bottom: CBCT image verification showing consistent setup during treatment.

Summary

1. SLRON's experience using the Adaptiiv solution for 3D printed bolus has improved their ability to bolus extremity regions.
2. By using the Adaptiiv solution instead of standard sheet bolus, SLRON was able to save setup time and improve treatment accuracy through the reduction of air gaps that occur when treating extremities.
3. SLRON now uses a 3D printed approach for all extremities requiring bolus.