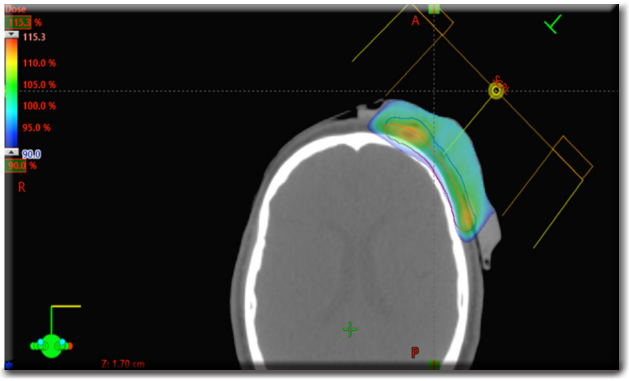


Standard electron field with Adaptiiv's MEB shows sparing of underlying healthy tissue and significant reduction of hotspots.

ADAPTIIV

nova scotia health

Patient Case Study: Clinical Application of Modulated Electron Bolus

Nova Scotia Health, Halifax, Nova Scotia, Canada

Overview

Adaptiiv Medical Technologies Inc. (Adaptiiv) provides cancer centers with the hardware, software, and materials to develop low cost, high performing medical tools that supersede existing conventional technologies. The modulated electron bolus (MEB) module in Adaptiiv's software demonstrates superior sparing of distal organs-at-risk (OARs) and underlying healthy tissue compared to photon IMRT delivery (e.g. VMAT) while also reducing the presence of hotspots. The following case is an example of how the Nova Scotia Health Authority (NSHA) was able to use Adaptiiv's MEB module to create, modify, and optimize a custom-fit bolus based on patient CT data to treat complex anatomies such as the scalp.

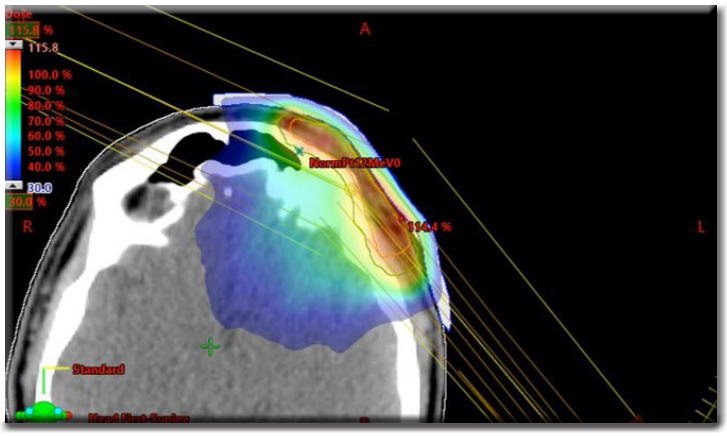
Description of Study

This case examines an adult patient with mycosis fungoides of the scalp. Three potential options are evaluated to determine the most optimal treatment plan:

1) Volumetric Modulated Arc Therapy (VMAT), Simple Bolus
2) Electron Therapy, Simple Bolus
3) Electron Therapy, Modulated Electron Bolus

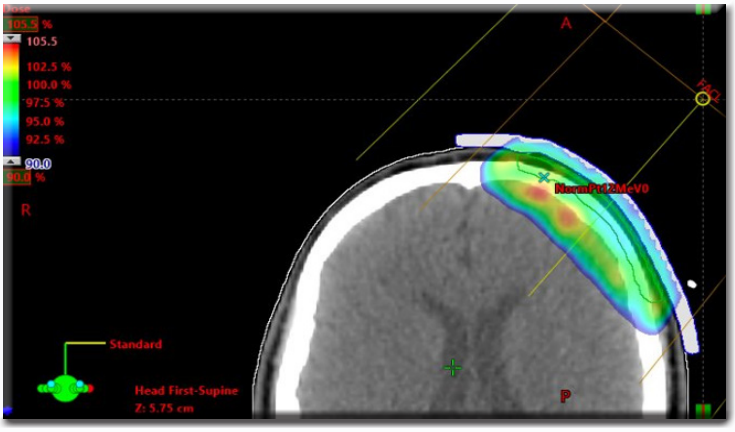
1) Volumetric Modulated Arc Therapy, Simple Bolus

VMAT is a radiation therapy technique that continuously delivers the radiation dose as the treatment machine (linear accelerator) rotates. The goal with this technique is to accurately shape the radiation delivered to the tumor while minimizing dose to the organs surrounding the target area. However, as seen below, this initial plan was rejected by the NSHA due to the volume of normal brain receiving an intermediate dose.



2) Electron Therapy, Simple Bolus

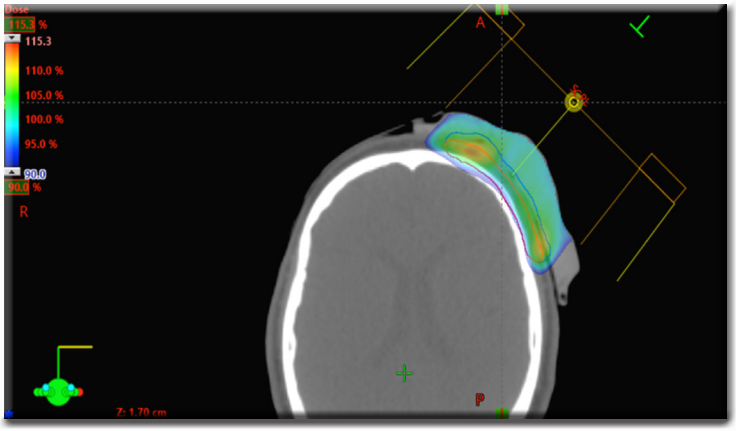
With the VMAT approach rejected, the next consideration was to use electron therapy (12 MeV electrons) and a simple bolus with uniform thickness. This plan was also rejected by the NSHA due to poor conformity of the 90% prescription isodose line and noticeable hotspots that would affect underlying healthy tissue.



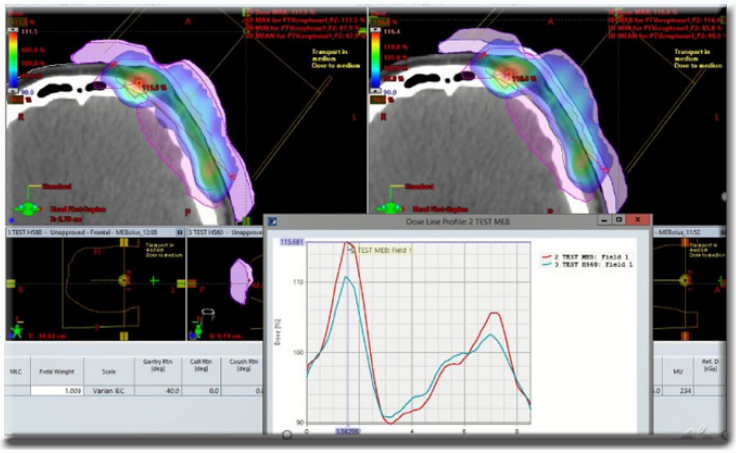
3) Electron Therapy, Modulated Electron Bolus

To achieve better isodose conformity and sparing of healthy tissues and OARs, the NSHA elected to design a modulated electron bolus in Adaptiiv's software to deliver modulated electron radiation therapy (MERT).

By importing each patient's treatment plan through Adaptiiv's software solution, the ray tracing algorithm in the MEB module evaluates the distance between the PTV and isodose line to create a custom-fit bolus that provides optimal dosimetry, as seen below.

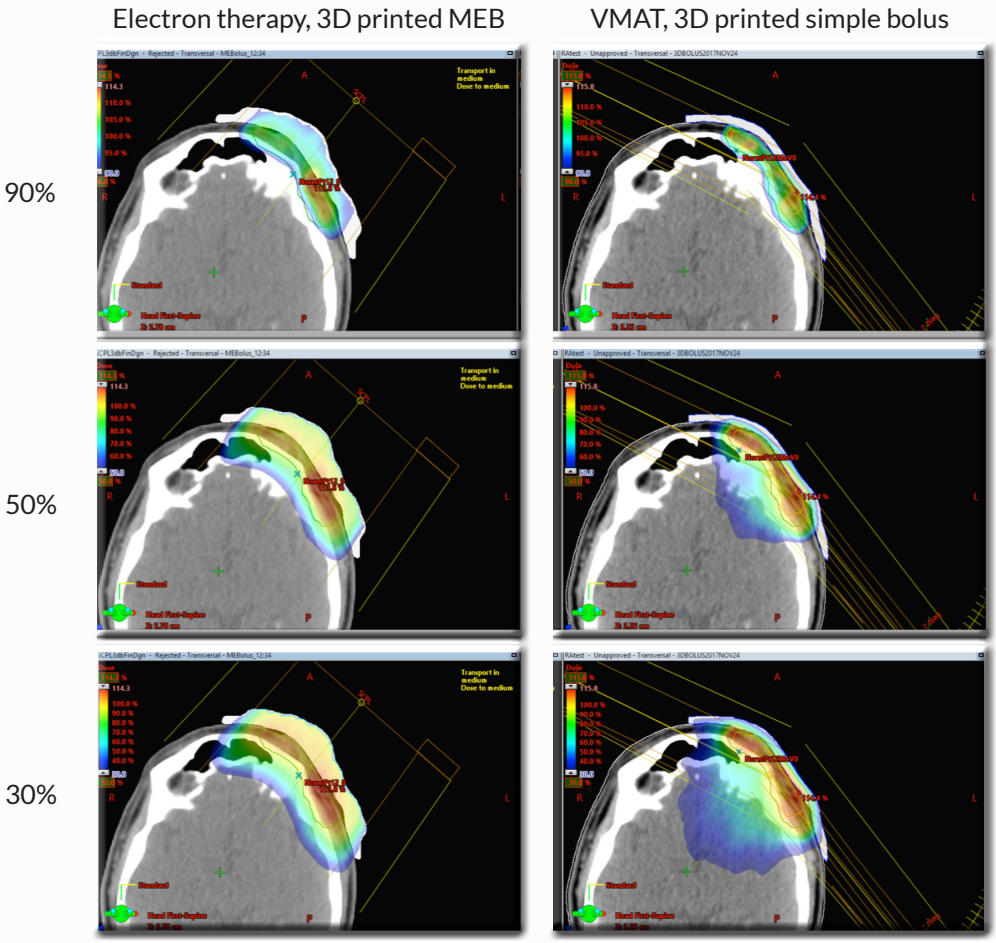


The images below show the comparison of a hotspot corrected plan (left) with the original MEB (right). **Dose conformity to the target volume was maintained while lowering the hotspots (maximum dose was lowered by 5%, from 116.4% to 111.5%)**.

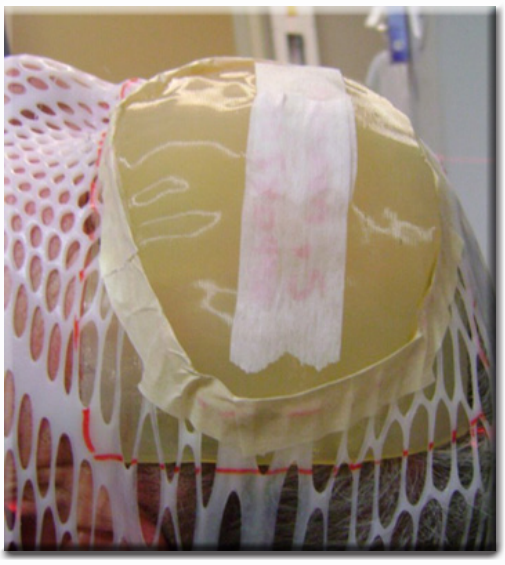


Results / Findings

In comparison to the VMAT plan, the MEB plan illustrates significant sparing of healthy tissue at various isodose levels. The images below show this at 90%, 50%, and 30% prescription isodose levels - the left column shows electron therapy with 3D printed MEB; the right column shows VMAT with 3D printed simple bolus.

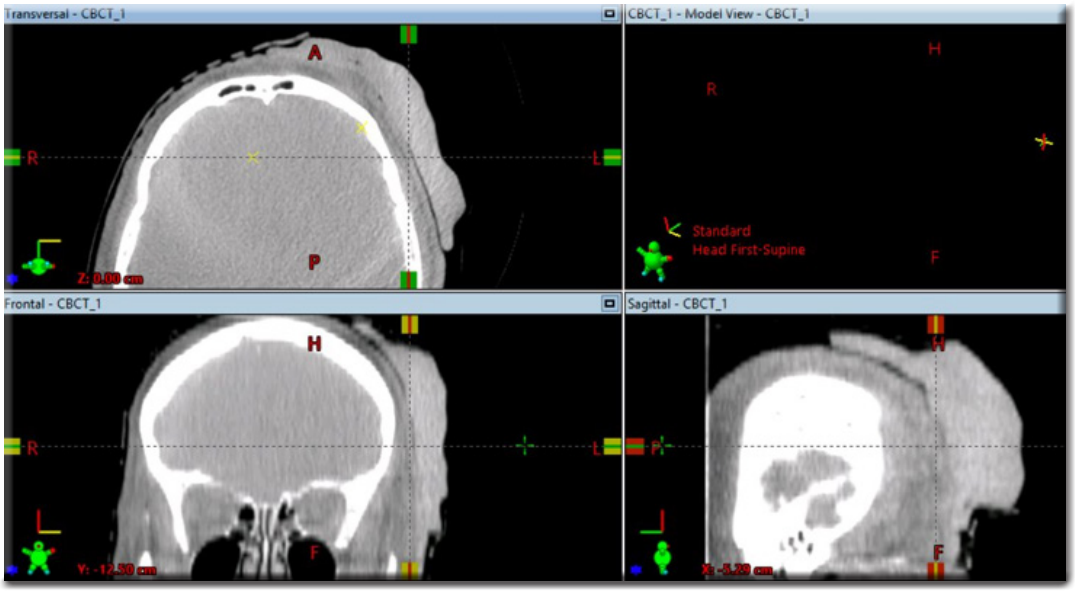


Upon plan completion, the optimal MEB object was imported into the planning system with the correct radiological properties for final dose calculation. The MEB was then 3D printed and integrated into the immobilization mask (as seen below) for the patient without requiring an additional planning CT. A cone beam computed tomography (CBCT) image guidance was then performed for quality assurance of placement and fit.



Results / Findings (continued)

Custom-fit, modulated thickness bolus designed and fabricated with Adaptiiv's MEB solution allows MERT dose distributions that provide superior sparing of distal OARs and reduce hotspots compared to electron treatment plans using simple bolus. The CBCT verification images shown below illustrate the superior fit and minimal air gaps.



Summary

1. Adaptiiv's modulated electron bolus (MEB) significantly reduces air gaps and achieves excellent dosimetry by tailoring the 90% isodose to follow the exact contours of the PTV, while sparing critical OARs.

2. Comparisons of the isodose levels of the MEB plan with the VMAT plan illustrate the significant skin sparing effect at various prescription isodose levels, as well as a significant decrease in dose to underlying healthy tissue.