Patient Case Study:
Clinical Application of Modulated Electron Bolus (MEB)

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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 is an example of how Nova Scotia Health (NSH) used Adaptiiv's MEB module to design a custom-fit bolus to adhere to the complex surface anatomy of the scalp for treatment. The MEB was shown to offer superior sparing of distal organs-at-risk (OARs) and a significant reduction of hot spots compared to photon IMRT delivery (e.g. VMAT) and the standard bolus.

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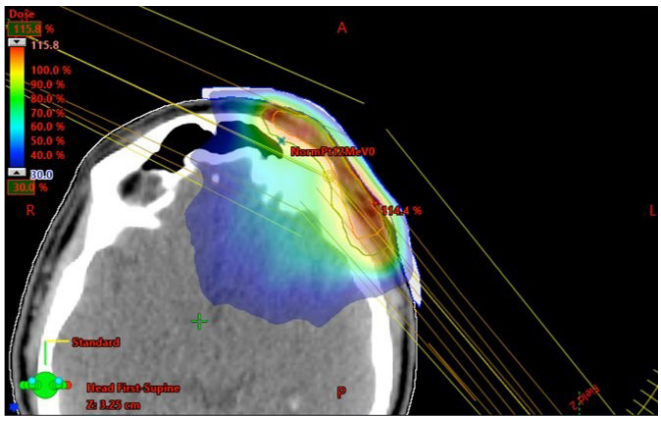
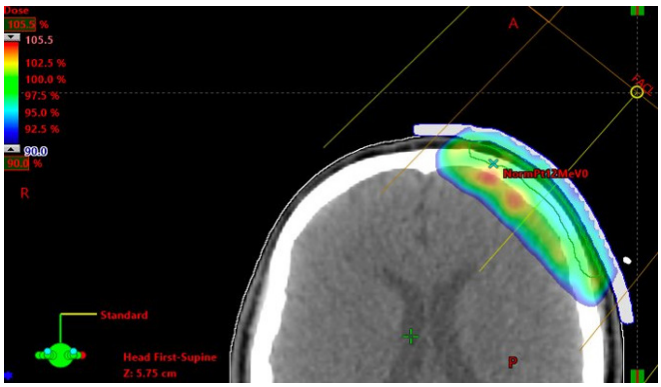
Description

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



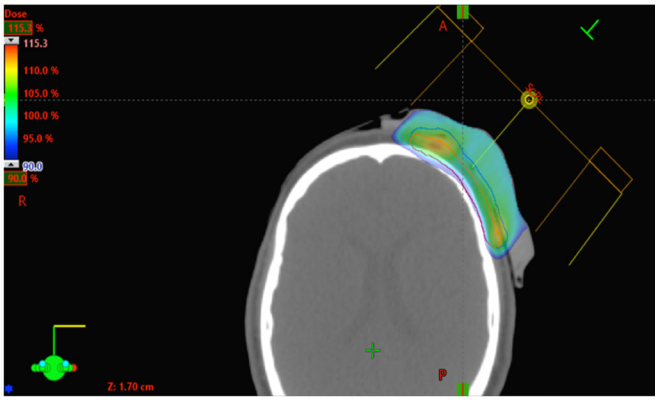
1) Volumetric Modulated Arc Therapy, Simple Bolus

VMAT is a radiation therapy technique that continuously delivers radiation as the treatment machine (linear accelerator) rotates. This technique accurately shapes the radiation delivered to the tumour while minimizing the dose to the organs surrounding the target area. This method was rejected from the original treatment plan due to the volume of healthy brain tissue receiving an intermediate dose.



2) Electron Therapy, Simple Bolus

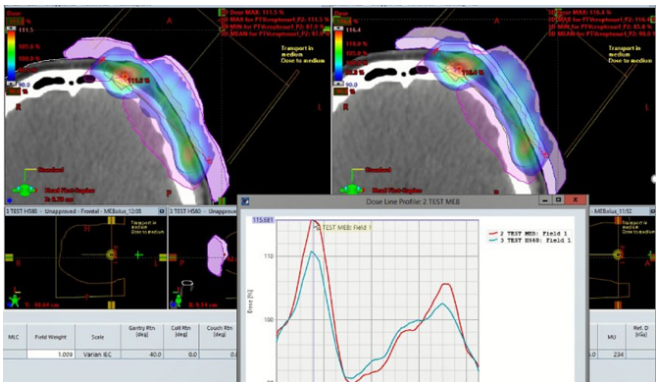
With the VMAT approach rejected, the next consideration was to use electron therapy (12 MeV electrons) and a simple bolus with uniform thickness. This method was rejected for treatment due to poor conformity of the 90% prescription isodose line and noticeable hot spots.



3) Electron Therapy, Modulated Electron Bolus

The NSH designed a modulated electron bolus to deliver modulated electron radiation therapy (MERT) using Adaptiiv's MEB software module.

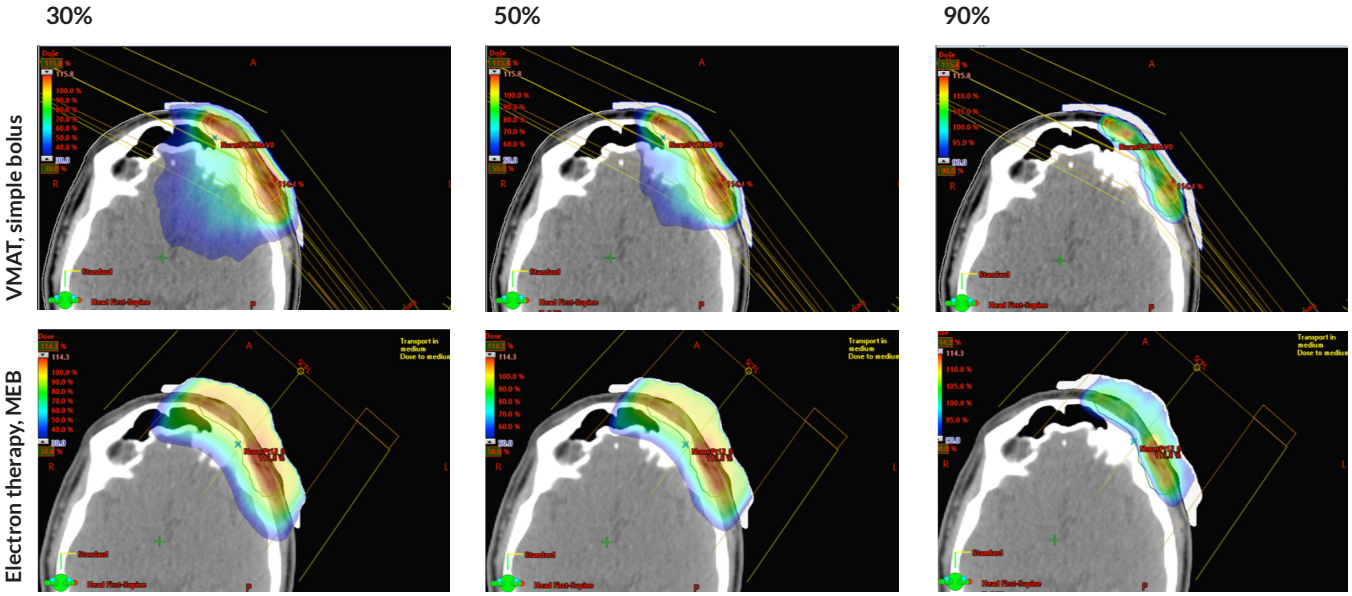
By importing the patient's treatment plan into Adaptiiv software, the ray tracing algorithm evaluates the distance between the PTV and isodose line and creates a custom-fit bolus that provides optimal dosimetry and significant reduction of hot spots.



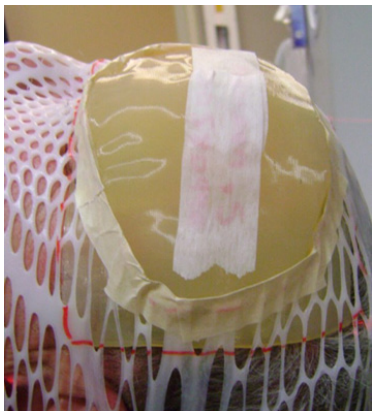
A comparison of a hot spot corrected plan (left) with the original MEB (right) shows that the dose conformity to the target volume was maintained while reducing hot spots; the maximum dose was lowered by 5%, from 116.4% to 111.5%.

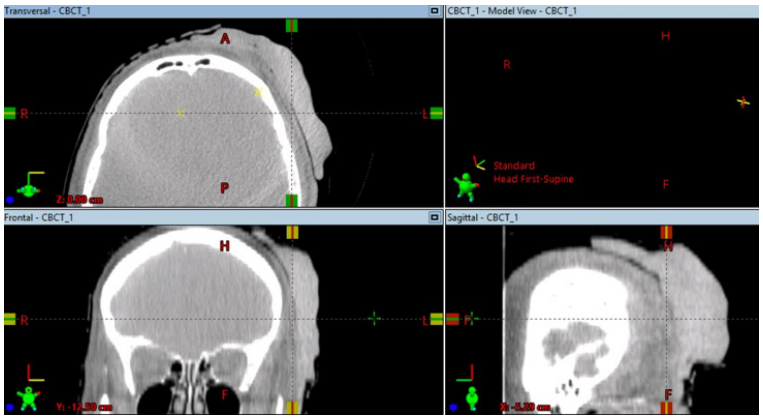
Results/Findings

The images below shows a comparison of 90%, 50%, and 30% prescription isodose levels for VMAT with 3D printed simple bolus to electron therapy with a 3D printed MEB.



Upon plan completion, the MEB 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. CBCT image guidance was then performed for quality assurance of placement and fit The CBCT images below illustrate the superior fit and minimal air gaps.





Summary

1. Adaptiiv's MEB significantly reduced air gaps and achieved excellent dosimetry by tailoring the 90% isodose to follow the exact contours of the PTV.
2. Comparisons of the MEB and VMAT plan at various isodose levels illustrate the significant skin-sparing effect and substantial dose decrease to underlying healthy tissue when using MEB.

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