In Search of a One-Plan Solution to VMAT Chest-wall: Skin Dose

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Introduction

Chest wall radiotherapy following mastectomy can present significant planning challenges. VMAT treatment techniques, although not recommended for all cases, can become a viable option when traditional techniques have been exhausted. The planner, however, can be left with questions about various aspects of the optimization process, including selection of the appropriate cropping distance of the target volumes from the skin, use of bolus, thickness of bolus, and creation of flash. Comprehensive studies focused on one-plan solutions for 3D conformal planning on chest wall exist. Our primary aim is to answer questions regarding the topics mentioned above. The secondary aim is to investigate the feasibility of a one-plan solution for VMAT chest wall planning.

Materials and Methods

A representative chest wall phantom was fabricated using 3D printing (Fig 1). Target and OAR volumes as per departmental guidelines were drawn on the 3D printed phantom dataset to permit creation of VMAT plans. OSLDs and a PTW microDiamond detector were used to measure skin dose (Fig. 1) Due to detector buildup, the reported skin doses here are for roughly 1 mm depth.

The following NO BOLUS plans were created (Eclipse 13.6, AAA).

1. Tangents (for comparison)
2. VMAT with 0 mm cropping from skin
3. VMAT with 3 mm cropping from skin
4. VMAT with 5 mm cropping from skin
The following plans were created with 1 cm synthetic BOLUS.

5. VMAT with 0 mm cropping from skin
6. VMAT with 3 mm cropping from skin
7. VMAT with 5 mm expansion into the bolus

Optimization constraints are shown in Table 1. The target coverage was set with a higher priority than OAR constraints when it was deemed that compromises must be made.

![Fig 1](image1.png)

![Fig 2](image2.png)

![Fig 3](image3.png)

![Fig 4](image4.png)

![Fig 5](image5.png)

Discussion

Implications for one plan solution

- Cropping of target volumes is useful for VMAT optimizations but has a minor effect on skin dose (increased cropping distance, decreased skin dose).
- Skin dose with no bolus is ~70% regardless of cropping (up to 5 mm).
- Skin dose enhancement with bolus does not depend strongly on thickness.
- Brass mesh enhancement is slightly lower than tissue equivalent bolus in VMAT plans.
- Use of 5 mm and 10 mm bolus requires 2 plan solution due to separation difference between bolus on / bolus off.
- Our clinical experience suggests skin dose of ~90% of prescription dose gives good clinical results (based on tangents) (5 mm bolus on, 50% of fractions).
- To achieve similar results with VMAT and a single plan, data suggest use of 3 mm bolus or brass mesh:
  - Brass mesh: 80% of fractions
  - 3 mm bolus: 70 – 80% of fractions.
- 3 mm and brass mesh have minimal perturbation on dose distribution at depth and can be used in a one plan solution.
- Similar to a breast study, we found that without bolus more skin sparing is achieved with VMAT compared with 3D CRT tangents.

References

1. C. Ordonez-Sanz et al., “A single plan solution to chest wall radiotherapy with bolus?”, Br J Radiol., 87 (1037), 2014

Table 1: Dosimetric Criteria for VMAT Chest wall irradiation.