

# Hybrid Conformal-VMAT Treatment Planning and Quality Assurance for Stereotactic Radiotherapy of Multiple Brain Metastases

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## Abstract

**Objectives:** Dosimetry of VMAT treatments for multiple brain metastases presents challenge for patient-specific QA with higher percentage of the plans not meeting 1.25mm/3% criteria that we observe for single target treatments. Discrepancies have been attributed to inaccuracy of modeling lateral geometry of HD MLC leaf. Objective for this project was to modify SRT plans to reduce leaf surface exposed to the radiation while producing highly conformal plans that would also meet our QA criteria.

**Methods:** Single isocentre VMAT plans use two coplanar arcs and the dose is calculated with 1.25mm resolution. Conformal MLC-shaped fields are produced as the starting point for VMAT optimization, and "level 1" of multi-resolution optimization is then omitted. We call this a hybrid conformal-VMAT technique. If PTVs are separated in superior-inferior direction arcs may be designed to treat superior PTVs with one arc and inferior ones with the other. This permits individualized selection of collimator angles to reduce mutual "shadowing" of PTVs that produce unnecessary irradiation of the normal brain between metastases. Patient specific QA includes Monte Carlo calculation on patient CT dataset and EPID-based dose reconstruction in a virtual cylindrical phantom.

**Results:** Twenty-five patients with multiple metastases were treated in our department since November 2015 with nine of these patients planned and treated using hybrid technique. In six out of treated sixteen VMAT plans the dose to one of the distant (with isocentre to the PTV distance of over 4cm) off axis PTVs the was different to the reconstructed dose by over 4% (mean difference for these cases was 5.7%, standard deviation 2.2%). For the nine plans calculated with hybrid technique the difference between calculated and reconstructed dose reduced to less than 2.5% (mean difference for these cases was 1.1%, standard deviation 1.4%). In addition "hybrid" plans required on average 45% less monitor units than VMAT. Conformity indices were marginally higher for hybrid plans as compared to VMAT but the difference was not statistically significant. There was no statistically significant difference in gradient measure.

**Conclusions:** The dose calculated in hybrid conformal-VMAT planning technique produced clinically acceptable plans with conformity and gradient indices comparable to VMAT. Hybrid technique improved agreement of calculated dose with QA measurements to within 2-3%. In addition hybrid conformal-VMAT plans required on average 45% less monitor units than VMAT

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resulting in faster treatment delivery.