

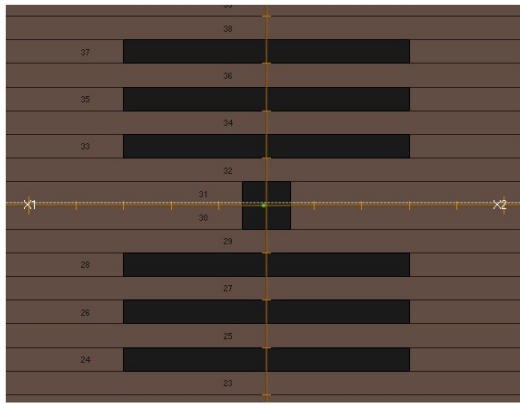
Investigating Dose Discrepancies between Raystation TPS and Mobius3D patient plan QA software

Purpose: To understand underlying differences in beam modeling leading to occasionally falling gamma analysis criteria.

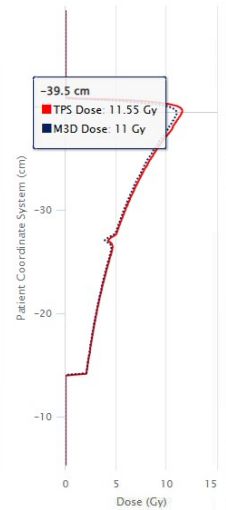
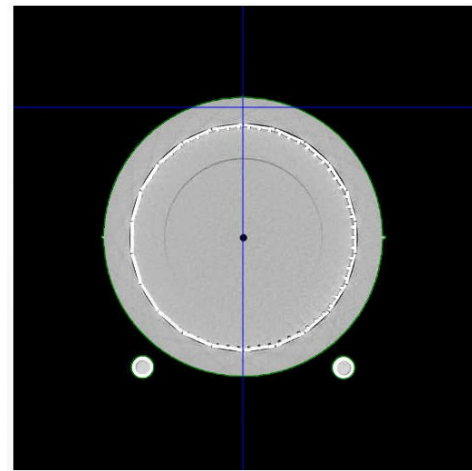
Material and Methods: M3D was commissioned using same beam data as the TPS and default DLG (Dynamic Leaf Gap) for Millenium-120 MLC is used. In about 10% of treatment plans, the gamma index criteria (3mm/3%) falls below 90%. In most of these plans, M3D predicts higher dose in the treated area. These cases have relatively high (> 4) modulation factor (= MU to prescription ratio). To investigate these discrepancies, test plans with (1) small MLC fields, and (2) Alternating open/closed MLC pairs were generated using TPS and compared with M3D.

Results: Good agreement is observed between TPS and M3D along the central axis even for small MLC field sizes (e.g. $1 \times 1 \text{ cm}^2$ in Fig1). ArcCheck and TPS are in good agreement for open MLC pairs. For all-MLC-closed fields, the dose through rounded MLC end is significantly underestimated by M3D ($\sim 60\%$, Fig.2) but these points represent a small fraction of dose points in gamma analysis, when not masked by jaws. For alternating MLC pairs (Fig.3), we can see that dose corresponding to mid-leaf position (See X dose profile at 1.2cm Y position), the agreement between TPS and M3D is still within a few percent. However, for Y off-axis position corresponding to a leaf edge (e.g. $Y = 1.5 \text{ cm}$), M3D values become significantly higher ($\sim 45\%$).

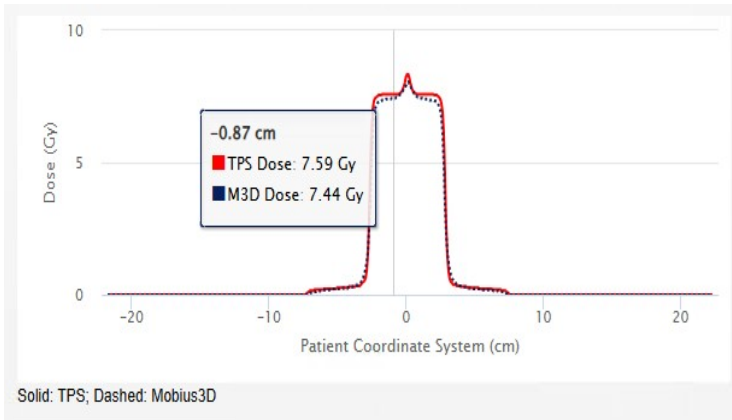
Conclusions: M3D is a very useful plan QA tool and matches our TPS predictions even for small field sizes. For plans with high modulation factors, an open leaf pair is often neighbored by closed leaves. Therefore, a significant fraction of beamlets delivering dose to the patient are very close to leaf edges and inaccurate modeling of tongue-and-groove effect leads to observed discrepancies. Film dosimetry providing higher spatial resolution is needed for further analysis.



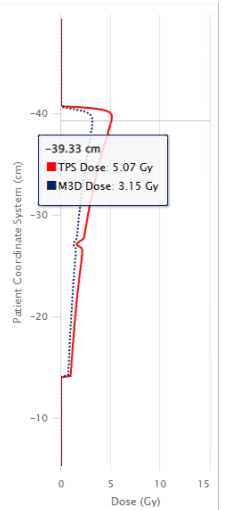
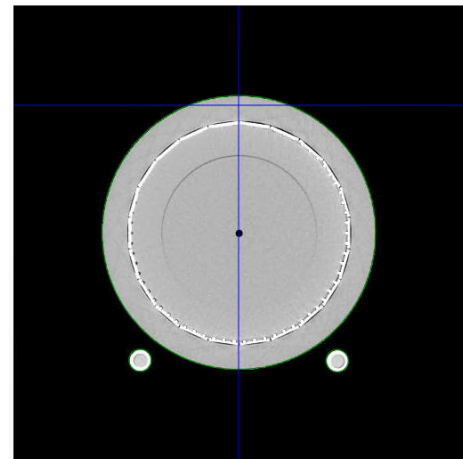
MLC Aperture to test M3D MLC model



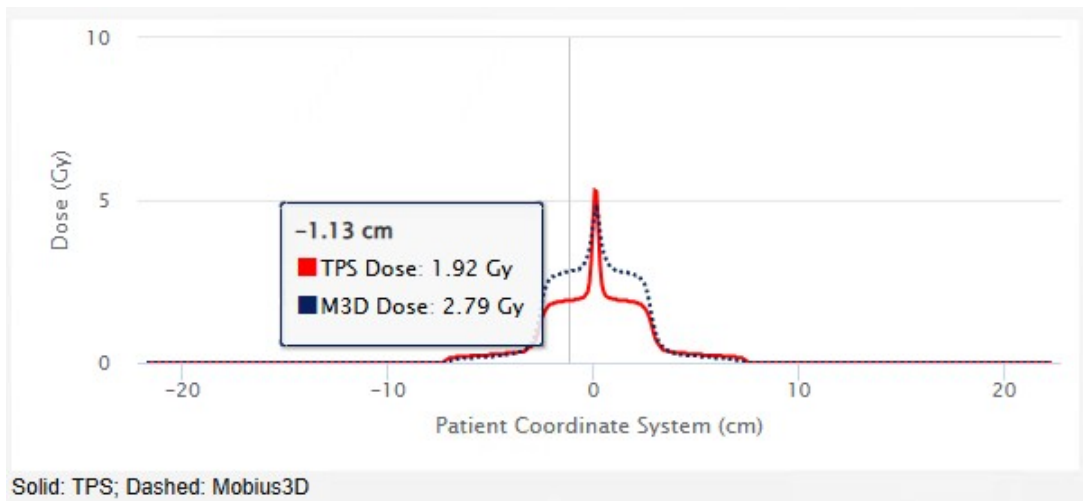
CAX depth dose profile for 1cmx1cm MLC field



X Profile at mid-leaf position (Y = 1.2cm) for 1 open MLC pair



Depth dose profile at 1.2cm Y off-axis distance for closed MLC leaves



X Profile at Inter-leaf position (Y = 1.5cm) for 1 open MLC pair