## Treating ocular melanoma with a modified pencil-beam-scanning system: a dosimetric study

Addition of a dedicated eyeline to a multi-room proton therapy center is often cost-prohibitive: the number of patients does not justify creating a treatment room for eye treatments only. Modification of a general-purpose pencil-beam-scanning (PBS) nozzle to enable ocular treatments would allow centers to add ocular-melanoma patients to the daily treatment mix in their gantry rooms.

The Ocular Option (OO) is a –for now conceptual– add-on to the Varian ProBeam PBS nozzle. It consists of a 3.5-cm range shifter located just downstream of the ionization chambers and a snout with a field-specific aperture positioned 7 cm from isocenter. No changes to the scanning system or beam phase space are made. Initial feasibility studies have shown that such a system has a lateral penumbra of ~2 mm and a distal fall-off of ~3 mm.

We implemented a 3D contouring and treatment-planning process in RayStation to optimize robust treatment plans for this system. An MRI scanning protocol using a 70-mm loop coil was developed to maximize tumor contrast. The MRI images were combined with CT, optometric measurements, and fundus photographs in the RayOcular module to create an eye model and delineate the tumor. OO plans were inversely optimized on patient CTs minimizing dose to both ocular and extra-ocular OARs. Robust optimization ensured target coverage under 1mm displacement and 8% range uncertainties.

Treatment plans were developed for 13 patients treated with a plaque at our institution. Three of these patients had MRI imaging, the other ten only CT. The OO plan quality was evaluated against the plan for dedicated proton eyeline.

The OO plan quality is reasonable and, in most cases, comparable to the eyeline plan quality. The increased flexibility of the OO inverse plan optimization allows for a more deliberate balancing of dosimetric trade-offs and often results in a better compromise between competing dose constraints.

In the continuation of this project, we plan to evaluate the use of multiple gazes per plan, to include eye rotation in the robust optimization of the plans, and to compare the OO plans and OAR doses to those of our I-125 Brachy treatments. Additionally we plan to develop patient immobilization and gaze fixation for the OO that is compatible with CT, MRI, as well as in-room IGRT and treatment.