AbstractID: 11055 Title: Motion Management for a Novel Ophthalmic Stereotactic Radiosurgical Device

Purpose:
Teletherapy of an unconstrained eye poses risks because of the likelihood of substantial eye motion. A new 100kVp tabletop stereotactic radiosurgical unit has recently been developed to deliver highly-collimated beams of x-rays to the retina. Here we evaluate the efficacy of a hardware and software motion-management solution designed for that system.

Method and Materials:
To minimize the effects of motion during therapy, an eye fixation device (the "I-Guide") was developed. It consists of a contact-lens, a central post, and a fixed, horizontal stabilizer bar. The contact lens is held to the eye with suction and attached to the central post. The post is mounted to stabilizer bar via a ball-joint. The I-Guide steadies the eye and incorporates reflective fiducials that are used by an imaging system to monitor the position and gaze-angle of the eye. During treatment, software continuously evaluates the deviation of the eye from nominal position. When necessary, the beam is automatically gated off by an algorithm that incorporates time as well as displacement, allowing brief excursions while still maintaining effective targeting.

Results:
The motion-management system was evaluated in a clinical trial of 40 patients. With the I-Guide in place, rapid eye motion was damped considerably. Because of the time component, the gating algorithm permitted brief, random excursions while stopping the beam when excess drift was apparent. With a 3-second x-ray source ramp-up, this flexibility was important for efficient treatment flow. Although patients' heads were immobilized, head mobility was found to be the dominant source of motion. However, the automatic gating-off of the beam followed by repositioning kept the average motion error under 0.4mm in all cases.

Conclusion:
The combination of I-Guide fixation, fiducial tracking, and automated beam gating enables precise targeting and dose conformality for ophthalmic radiotherapy.

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