AbstractID: 5228 Title: A novel three-dimensional radiochromic film phantom for use with stereotactic radiosurgery units

Purpose: To create a three-dimensional (3D) film dosimeter capable of simultaneously measuring the entire relative dose distribution of the volume fields of an Elekta Gamma Knife (GK) unit.
Methods and Materials: A spherical head phantom was constructed out of Virtual Water™ (VW™). This phantom was constructed with a bored hole allowing the insertion of a stack of film 2.5cm in thickness and 5cm in diameter. The hole is fitted with two unique fiducial rods that prevent both rotation and inversion of the film. Radiochromic film with a thickness of 105 microns is used, allowing approximately 240 layers of film to be inserted into the phantom. One layer of film is assumed to be water/tissue equivalent; however, the water/tissue equivalency of a thick stack of film has not been determined. Monte Carlo MCNP5 methods were used to determine the water/tissue equivalency of a thick stack of radiochromic film.
Results: Using MCNP5 simulations, the water/tissue equivalency of a stack of film 2.5cm thick was determined. For a simplified model of the film phantom, the dose distribution in the active layer of the pieces of film was found to be within -1.7% of the dose distribution in similar layers of VW™, demonstrating that a stack of radiochromic film may be used as 3D dosimeter.
Conclusion: Using a stack of film as a 3D dosimeter limits the resolution of the determination of the relative dose distribution only by the resolution of the scanner and by the thickness of the film layers. This allows resolutions of 50x50x105 microns^3 to be achieved. Most 3D dosimeters require advanced imaging equipment to read out the data but a 3D film dosimeter allows any institution which has a flat bed scanner to obtain 3D dose distribution information.