AbstractID: 4331 Title: Intermediate Energy X-Ray Photons (0.2 - 1.0 MeV) for Radiosurgery: Producing a beam and measurement of radiological penumbra

Purpose: The main advantage of stereotactic radiosurgery is the steep dose gradient associated with the intracranial dose distribution. We are examining the effects of x-ray energy on penumbra and dose gradient. Specifically, we are exploring the reduction in radiological penumbra for intermediate energy x-ray photons (0.2-1.0 MeV) or so called IEP's. The purpose of this work is two-fold: 1.) to produce an IEP beam using a medical linear accelerator and 2.) to examine the radiological penumbra associated with this beam.

Method and Materials: A Siemens medical linear accelerator was adapted to produce IEP's. PDD measurements versus depth (SSD=100cm,FS=2x2cm^2) were done in solid water using a Markus parallel plate ionization chamber (PTW Freiburg). These were compared with Monte Carlo computer simulations (MCNP-4C). Monte Carlo involved generating x-ray spectra that impinged upon a SW phantom. A penumbra measurement device (consisting of a half-beam block) was constructed to examine radiation beam edge profiles using film (Gafchromic EBT) at SSD=100cm,FS=1.1cm^2 and depth=2cm. In a separate experiment, film irradiations were done collimating a 3x3mm^2 beam using a 10cm thick brass block flush with the SW surface. In all cases, the geometric penumbra (due to the finite source size) was made negligible by having the collimation very close to the phantom. A high-resolution digital microscope (Axiomat) was used to acquire film profiles.

Results: Measured PDD values were 55.4%(surface), 62.6%(5cm), and 34.7%(10cm). Monte Carlo PDD's compared with measurement suggest a nominal 800kV x-ray beam. For the half-beam block, the 80%-20% film edge profiles were 0.345mm (IEP) and 2.10mm (6MV). For the 3x3mm^2 field, there was a 5-fold reduction in radiological penumbra (IEP vs. 6MV).

Conclusions: A novel intermediate energy photon beam (of nominal energy 800kV) has been produced using a conventional linear accelerator. There is a substantial reduction in radiological penumbra when using IEP's with small fields.