Abstract ID: 16059 Title: Impact of Machine Output Rate on Effective Dose Rate and Biologically Equivalent Fraction Size in Total Body Irradiation (TBI)

Purpose: Examine the feasibility and biological significance of increasing machine output rates in extended-distance Total Body Irradiation (TBI).

Methods: Biologically equivalent doses for TBI are derived from the LQ cell survival model. Effective dose rates and corrected fraction size for a mini-TBI (i.e., 1 fraction x 2 Gy to patient mid-line) delivered using 4 and 8 beams are computed as a function of machine output rate. The number of beams used for a TBI tends to increase with increasing patient size because of the clinical constraint of no more than 1000 MU per beam. All of the reported results include a 1 minute gap between beams and a (conservative) 5 minute gap for patient repositioning.

Results: For a 4 beam treatment, increasing the machine output rate from 200 to 400 MU/minute reduced the fraction delivery time by 36% (28 to 18 minutes), and only increased the effective dose rate from 7 to 11 cGy/minute. For 8 beams, the fraction delivery times for 200 and 400 MU/min are 52 minutes (3.85 cGy/min) to 20 minutes (6.16 cGy/min), respectively. Increasing the machine output rate from 200 to 400 MU/min is unlikely to require more than 2-5% reduction in fraction size (alpha/beta = 1 Gy). The size of the required correction decreases as alpha/beta increases.

Conclusions: Patient-specific planning to correct for differences in beam number (patient size) are unlikely to alter the determination of biologically equivalent fraction sizes by more than 5%, which is well within the 10% uniformity specified in many TBI protocols. A clinical trial to evaluate patient safety and treatment efficacy for machine output rates as high as 600-700 MU per minute are reasonable. Such a trial has the potential to substantially to increase patient comfort and reduce facility and labor costs without jeopardizing treatment effectiveness or safety.