AbstractID: 7066 Title: A Generalized Biologically Equivalent Dose (gBED) Model and its Application for Radiosurgery and Hypofractionated Body Radiotherapy

Purpose: Vastly different dose fractionation and dose prescription schemes exist for radiosurgery and body radiotherapy of intracranial and extracranial tumors. A generalized biological equivalent dose (gBED) model has been developed to account for variations in dose fractionations and non-uniform dose distributions for both targets and critical structures of such treatments.

Method and Materials: Assuming cell survival fraction (S) can be expressed as $S = e^{-\alpha\, gBED}$, we derived $gBED = \sum_i w_i BED_i$ where $w_i = v_i S(d_i) / \sum_i S(d_i)$, $BED_i = nd_i [1+d_i/(\alpha/\beta)]$ of the linear-quadratic model, and v_i is the i^{th} voxel receiving the dose of d_i as in the calculation of the dose volume histogram. In the above *gBED* formula, w_i is the probability-weighted volume unit which is analogous to the voxel mass (density×volume). As a result, we derived a new histogram by plotting accumulative BED_i versus accumulative w_i and we called it Dose Unit Histogram (DUH). To study DUH model, analyses were applied to a group of >20 radiosurgery and body radiotherapy cases of varying fractionations and dose volume histograms. The dependence of gBED on α/β values (ranging from 2-20) and other physical dose parameters were also investigated.

Results: The normalized DUH fell consistently below the normalized DVH curves regardless of α/β values. This indicates a decreased effect to target and increased tolerance of the normal structure. For high α/β values such as 20, gBED approached to the conventional BED calculated from the mean dose of a volume. For low values of α/β such as 2, gBED was significantly different, particularly for non-uniform target dose distributions.

Conclusion: A generalized BED formula was developed and used for radiosurgery and body radiotherapy planning analysis. The formula yielded different histogram plots from conventional DVH by accounting for the variations in dose fractionation and non-uniformity of the dose distributions.