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A New Index of the Dose Homogeneity for Treatment Planning

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The dose–volume histogram (DVH) can provide an adequate assessment of target homogeneity based on a homogeneity index (h-index) defined by the ratio of the maximum dose (Dmax) in the tumor volume to prescription dose (Dp) or the uniformity index (u-index) defined by the ratio of Dmax to the dose covering 95% of the target volume. The closer the h or u-index approaches one, the better the homogeneity in the target volume is. Although these indices, acquired by values of two points in DVH curve, are simple and easy to calculate, it seems that they are not sufficient to represent the homogeneity from the whole DVH curve. In this study, we examined the dose homogeneity for the treatment of brain tumor based on a statistical analysis of the DVH, and developed new index that provides objective scores of the dose homogeneity for the gross target volume (GTV) in a radiotherapy treatment plan. The newly defined homogeneity index for assessing dose homogeneity in a target volume, named the sigma-index (s-index), was developed using a normalized differential-DVH (dDVH) with statistical analysis. The s-index, determined as the standard deviation of the normalized dDVH, was found to vary from 0.80 to 3.15 for the DVHs of brain tumor at out institution. The results showed that the s-index gives a consistent method for quantifying the degree of homogeneity and has been demonstrated to be more accurate than the conventional methods in evaluating the dose homogeneity. A guide line of the treatment plan based on dose homogeneity is discussed with relation to equivalent uniform dose (EUD).

Keywords : Homogeneity Index, Equivalent Uniform Dose, Target-volume DVH