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Evaluation of the Accuracy of the CyberKnife

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The use of stereotactic radiosurgical systems to treat intracranial and extracranial tumors and other lesions re-quires a high degree of accuracy in target identification and localization. CyberKnife can deliver, with a high degree of precision, a single or several fractions of radiation dose to a well-defined small intracranial or extracranial target. The accuracy of the output factor directly affects the accuracy of dose delivery in CyberKnife system. The purpose of this study was to evaluation the total system accuracy of the CyberKnife and also to estimate an output factor for CyberKnife using the several detectors. Accuracy of target localization was meas-ured in anthropomorphic head phantom containing a spherical target, fiducial markers, and two pieces of film. The accuracy measured is the displacement of the dose contours from the treatment plan to that measured in the exposed phantom. All measurements of the output factors for collimators were per-formed by six different detectors: diode detector, X-Omat V film, Gafchromic EBT film, 0.015, 0.125 and 0.6 cc ionization chamber. Each collimator normalized with respect to the out-put factor of the largest collimator. We performed the E2E test and the general film dosimetry for estimation target localiza-tion in CyberKnife. The targeting error of the skull tracking mode and fiducial tracking mode were 0.956 mm and 0.923 mm. We could confirm the accuracy of total system is less than the 1 mm. For larger collimators, the output factors from six detectors showed a good agreement. For the collimators less than 15 mm, there were substantial differences in the output factors among different detectors. That is, the value of output factor for the 5 mm collimator of a diode and Gafchromic film was each 0.656 and 0.777. The Gafchromic EBT film was con-sidered more accurate than the others detectors.

Keywords : CyberKnife, Accuracy, Target Localization