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Dosimetric Verification of Dynamic Conformal Arc Radiotherapy using the Optimization Algorithm

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The purpose of this study is to develop the optimization method for adjusting the shift of film isocenter and to suggest the quantitative criteria for film dosimetry after optimization in the dynamic conformal arc radiation therapy (DCAR).

The DCAR planning was performed in 10 patients with brain metastasis. Both absolute dosimetry with ion chamber and relative film dosimetry were performed throughout the DACR using BrainLab's micro-multileaf collimator. An optimization method for obtaining the global minimum was used to adjust the error due to the shift of film isocenter, which consists of the largest part of systematic errors.

The average of point dose difference between measured value using ion chamber and calculated value acquired from planning system was 0.56±0.36% and maximum reached 1.14% with absolute dosimetry. These results were well matched with the AAPM criteria showing much less than 5%. The translational values for film isocenter shift after optimization were within ±1 ㎜ in all patients. The mean of average dose difference before and after optimization was 1.79±0.34% and 1.44±0.33%, respectively and the average of percentage showing over 5% dose difference were 5.61±3.69% and 0.32±0.51%, respectively. After optimization, the dose differences decreased dramatically and the percentage showing over 5% dose difference and average dose difference was less than 2%.

Our results show that this optimization method is effective in adjusting the error in isocenter and the quantitative criteria is accurate and useful in clinical application of dosimetric verification using film dosimetry. The quantitative criteria suggests that the film isocenter shift after optimization should be within ±1 ㎜, and a ratio over 5% dose difference and average dose difference should be less than 2%. The 3D dose-verification scheme with an optimization algorithm for DCAR determines the setup errors in the measuring device by minimizing the average dose difference between the calculated and measured doses.

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