

Evaluation of Out-of-Treatment Field Doses for Prostate Treatment in a Robotic Radiosurgery System

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Abstract

Objective: The aim of this study is to measure and evaluate the peripheral dose delivered to patients receiving CyberKnife prostate treatment using OSL dosimeter, to compare the contribution of treatments with fixed collimator and MLC to peripheral dose.

Methods: On CT images of the Alderson Rando phantom, a hypothetical prostate tumor, bladder, and rectum were plotted. Using the FIX collimator and MLC, plans were created for the two collimators with the VOLO treatment planning system, provided the prescribed dose remained the same. A total of 24 OSL dosimeters were placed on the slices we determined by moving away from the edge of the treatment area, 3 in each section starting from 2 cm to 62 cm distance. The contributions of the MLC and fixed collimator to the peripheral dose were compared by comparing the measurements taken for the OSL detectors placed in the same slices of the phantom for both treatment plans.

Results: The contribution of the plans made with the fixed collimator to the peripheral dose (in cGy) ranged from 0.37% to 0.028% of the total number of monitor units (MU) given at distances between 2-62 cm from the field edge. For MLC, it is between 0.57% and 0.037%.

The percentage of the doses measured at the farthest and closest distances obtained with the fixed collimator to the prescribed dose was calculated as 0.24% and 3.17%, respectively. These values were found between 0.18% and 2.84% for MLC.

Conclusion: Peripheral doses per MU were lower in treatment with a fixed collimator compared to MLC. On the other hand, when the percentages were evaluated according to the prescribed dose, we found that the peripheral dose was higher in plans made with a fixed collimator. These results showed us that the peripheral dose per MU is higher in the plans made with MLC, but the contribution to the peripheral dose is higher in the plans made with the fixed collimator, since more MU number is needed to achieve the targets. Considering the concerns of secondary cancer risk for the treatment of early stage prostate cancer, our results show that plans with MLC may be preferred because of the less contribution to the peripheral dose and the shorter duration of treatment.