Dependence of Dose Output on the Switch Rate of an Intensity Modulated Radiation Therapy (IMRT) Collimator

Jen-San Tsai, and Mark J. Engler

Tufts-New England Medical Center

Department of Radiation Oncology

Boston, Massachusetts

Multi-vane intensity modulated collimator (MIMiC) of NOMOS features its tomotherapy, beam intensity modulation and shaping conformal to target, and inverse planning. The MIMiC has 40 vanes switching back and forth independently to define the required field shape and control vane's beamlet intensity to the tumor and simultaneously off the critical structures. However, the switchings of these vanes incur momentary dampings and induce additional transient boundaries to their well defined field edges depending on their switching rates. As a result, actual clinical profiles and output factors of the vane beamlets are slightly different from the ones extracted during their stationary openings. In this study, dose outputs of 7 standard vane patterns were measured with an ionization chamber at different switching periods. Profiles of the vane patterns at various switching periods were measured with film. Furthermore, the dose outputs for 6 IMRT patient treatment plans were measured at different gantry speeds using the same ionization chamber embedded in a cylindrical tissue-equivalent phantom. These results indicate the switching vane profiles and their outputs are dependent on the switching rate. A theoretical model of vane opening status is provided to interpret the measured profiles and the dose outputs relative to the switching rate. In summary, the dose output and profile of a vane pattern are a function of the switching rate.