Investigating the Potential use of Photon MLC for Electron Beam Shaping

Arpita Agarwal[#] N. Rastogi*
K.J. Maria Das S. Kumar**
S. A. Yoganathan***

ABSTRACT

The purpose of this study was to analyze the dosimetric characteristics of an existing photon multi leaf collimator (pMLC) for field shaping and intensity modulation of electron beams. Also, two different techniques (photon boost technique and short SSD technique) were explored to improve the dosimetric characteristics of electron beams collimated by pMLC.

In this study Millennium 120 MLC equipped with Clinac 2100CD was used to shape the beam portals and modulate the intensity of electron beams of energies 4, 6, 9, 12 and 16 MeV. The MLC was programmed to define the field sizes of 5x5, 10x10, 15x15 and 20x20 cm2 within the applicators of 10x10, 15x15, 20x20 & 25x25 cm2 respectively. Perspex slab phantom and EDR-2 film was used to measure the profiles of pMLC-collimated electron beams at 100cm SSD. From these profiles, the penumbra was analyzed. The MLC leakage for all electron energies was also measured using PTW parallel plate ionization chamber within perspex slab phantom. Next two different techniques (photon boost technique and short SSD technique) were explored to improve the dosimetric characteristics of electron beams collimated by pMLC. In photon IMRT boost technique, the degraded pMLC profile was boosted by 6 MV photon beam IMRT. In next method, short SSD technique was used and the electron beam characteristics were measured at SSD 70 cm.

The measured penumbra for various field sizes was in the range of 2.5-6.5 cm for 4 Mev, 3-4.5 cm for 6 Mev, 2.5-3 cm for 9 & 12 Mev and 2-2.5 cm for 16 Mev electron beams. The magnitude of penumbra increases with decreasing beam energy and increasing field size. The MLC transmission values were negligible (<0.1%) for all electron energies. When analyzing the electron intensity modulated profiles, we found that the sharp dose gradient was averaged out due to the scatter of electron beams and this was even worst for low energy electron beams.

Keywords: *Dose rate, intensity modulated radiotheraphy, MLC leaf velocity, Dynamic IMRT*

**Department of Physics, IFTM University, Moradabad, India*
***Department of Radiotherapy, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India*
****Post doctoral Researcher, Physics and Astronomy, Louisiana State University, Baton Rouge, Louisiana, USA.*
[#]Corresponding Author: arpitagrwl@gmail.com