The study of Surface Dose for Photon Beam with External Magnetic Field

1 Tieh-Chi chu
2 Yuan-Rong Chen
2 Jao-Perng Lin

1. Department of Nuclear Science, National Tsing Hua University, Hsinchu 300, Taiwan
2. Department of Radiation Oncology, Changhua Christian Hospital, Changhua 500, Taiwan

Body of Abstract: Clinically, the issue of surface dose is the major concern of radiation oncologists and medical physicists. The purpose of this study is to reduce cutaneous complications caused by the increased surface dose due to secondary electrons induced by parts of the head of linear accelerator, shielding blocks and trays. The basic principle is that the direction of the charged particles can be affected by Lorentz force of the magnetic field. The trajectory of secondary electrons can be manipulated resulting in reduced surface dose of the patients.

The measurement is performed using a Siemens MD-2 linear accelerator equipped with 6 MV and 10 MV photons. A pair of permanent magnets with 2,400 gauss (0.24 tesla) is mounted on the head of linear accelerator. We use several thermoluminescent dosimeters and a parallel plate ionization chamber to measure the surface dose. The study is performed in three successive stages. The first stage is to evaluate the influence of magnetic field upon the surface. The second stage is to evaluate the surface doses of wedged fields under the influence of magnetic field, and in the third stage we use Rando phantom to evaluate surface doses of a breast cancer patient treated with tangential technique with simultaneous magnetic field.

In the case of using magnetic field, the degree of electron contamination of surface dose increases from 1.998% to 8.771%. In the case without using block tray, the degree of electron contamination of surface dose increases with higher photon energy and larger field size. The percentage depth dose (PDD) varies obviously in the buildup region, and maintains constant beyond that region.

In the case of using wedged fields under the influence of magnetic field, the degree of electron contamination of surface dose increases with higher wedge angle. In the case with block tray, the dose in the buildup region is higher than that without tray, and the degree of electron contamination of surface dose increases with the strength of magnetic field.

In the clinical situation, surface doses are decreased in all cases stated above although the degree of decrement at each point measured is variable. When we add magnet on the head of the linear accelerator, the percentage depth dose varies markedly only in the buildup region, and maintains constant beyond that region. It is not required to change the calculation program. Therefore, the magnetic device used in this study is convenient and applicable clinically.