Film Dosimetry of small electron fields

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Keywords: Radiotherapy, electron beams, small fields, film dosimetry.

INTRODUCTION
Radiotherapy patients are often treated with small electron fields produced by inserting cutouts in regular electron beam applicators. The dosimetric characteristics of such shaped beams are quite different from those of the open applicator. Although several investigations of small electron field dosimetry have been published [1 – 3], for appropriate treatment of patients, dosimetric measurements are required for each specific accelerator.

Film dosimetry is the most common method for determining electron beam dose distribution characteristics because it is rapid and has good spatial resolution. However, precautions must be taken to ensure reliability [4].

In this preliminary report we describe the application of the film dosimetry method to generate the central axis percent depth doses (PDD) of a range of small electron fields from an accelerator installed at the Rambam Medical Center.

DESCRIPTION
The measurements were made for a Varian Clinac 1800 accelerator, which provides electron beams with nominal energies 6, 9, 12, 16 and 20 MeV. The smallest standard applicator defines a field with size 6 cm x 6 cm at 100 cm from the target.

Small square fields with dimensions 1 x 1, 2 x 2, 3 x 3, 4 x 4 and 5 x 5 (cm x cm) were produced by inserting cerrobend cutouts 1 cm thick into the 6 cm x 6 cm applicator.

For depth-dose measurements, Kodak type V films were placed between sheets of water equivalent plastic and exposed along the beam axis. Optical density-to-dose conversion factors were determined from films exposed in the phantom perpendicular to the beam axis for a range of applied doses. This was done for all the available energies.

The validity of the film dosimetry methodology was confirmed by comparing PDD curves obtained using film with those determined by ion-chamber measurements. Within an overall experimental error of 1-2%, the two methods gave identical results for all the energies. A typical comparison is shown in Fig. 1.
RESULTS
Measured PDD distributions for 6 and 12 MeV for all the small field sizes are shown in Fig. 2 and Fig. 3. Each curve is normalized to 100% at is depth of maximum dose. Similar results were obtained for 9, 16 and 20 MeV beams.

The curves exhibit a pronounced field-size dependence. For example, as the size of the electron field becomes smaller, the depth of maximum dose is shifted toward the surface and the beam penetration decreases.

Small electron field depth doses reported for another Varian Clinac 1800 accelerator [3] are similar, but sufficiently different to affirm the need for independent measurements.

Before patients can be treated with the small electron fields, the off-axis behavior of the dose and the electron beam output as a function of field size must be determined.

REFERENCES
Fig. 1. Comparison between film dosimetry and Ion chamber measurements of electron beam depth doses – 6 MeV, 6 x 6 field.

Fig. 2. Percent of depth dose for small electron fields-6 MeV
Fig. 3. Percent of depth dose for small electron fields-12 MeV