Dosimetry of Very Irregular Electron Fields

It is well understood that small field dimensions produce shifts in electron isodose distributions but the effects of a larger perpendicular direction are not as well understood. In many clinica circumstances, parts of the field have dimensions which permit electronic and side scatter equilibrium and other parts do not. The dose distributions from geometrically small regions of the field may be affected by adjacent larger regions and equilibrium generalizations based on square field geometries may not apply. The purpose of this study is to establish guidelines for changes in isodose distributions for very irregularly shaped electron fields used clinically.

We compared depth dose and isodose curves for regular fields of small dimensions (2 cm – 5 cm) for 6, 9 and 12 MeV mean incident energy electron beams. Dose distributions from small square fields were compared with dose distributions from rectangular fields with the same small width but long (12 cm) in the perpendicular direction. Measurements were taken in a polystyrene phantom using therapy verification film which was oriented parallel to the beam axis. The film technique was verified by comparisons to ionization measurements in a water phantom and separately in a polystyrene phantom. Changes in the depth of dose maximum and penumbra were compared between the square and rectangular fields. The results from these measurements were then applied to several very irregular fields. From this data, a set of clinical guidelines was developed to aid physicians in prescribing field margins and beam energies.