PENUMBRA CHARACTERISTICS OF SQUARE PHOTON BEAMS DELIMITED BY A GEMS MULTILEAF COLLIMATOR

E. BRIOT, F. JULIA
Physics Department, Institut Gustave-Roussy, Villejuif, France.

This MLC has been designed to replace directly the standard collimator of a SATURNE IV Series linac. It consists of 2 x 32 tungsten leaves and one set of upper block jaws.

Isodose curves and dose profiles were measured for symetric fields at the depth of the maximum and at reference depths for 6 MV, 10 MV, 18 MV photon beams.

The penumbra (80 % - 20 %) corresponding to the face and the side of the leaves are compared with the standard collimators.

Along the X direction, the field delimitation is performed primarily with the leaves which are continuously variable in position. Along the Y direction, the field is initially approximated by the closure of opposite leaf pairs ; then the Y upper jaws produce the exact size of the required field.

As the leaves move linearly the penumbra (80 % - 20 %) corresponding to the leaf ends is minimized and held constant at all positions by curvature of their faces.

Penumbra obtained with the superposition of leaves and Y jaws depend on their relative position. The penumbra is minimum when the leaf side and the Y jaw edge coïncide and the comparison of the measurement values with the conventional collimator shows that the differences are within 1 mm. When the leaves delineating the field are not entirely covered by the Y block upper jaws, the penumbra increases, and at the junction of the opposing leaves, a width increase up to 3.5 mm can be observed.

Evaluation of the penumbra of a multileaf collim

C. GINESTET*, E. LAFAY*, C. MALET*, C. M
Y.DESFARGES**, G.DUPIN**

* Radiation Physics department - Centre Léon Bé
** Philips Medical Systems - LYON - FRANCE

E.

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Since january 1995, we use a new Philips SL20 linear accelerator which is connected to a multileaf collimator. Computer-controlled multileaf collimators open up the opportunity to practice conformal radiotherapy. Its aim is to adjust as well as possible the Planning Target Volume (P.T.V) to the effective treated volume with an homogeneous dose distribution in the PTV , and to protect healthy tissues and delicate organs.

This is already possible with a multileaf collimator by increasing the number of complex fields with different incidences during a same session. Moreover, the "Beam's Eye View" (BEV) function of the three-dimensional treatment planning system allows to define the shape of complex fields. But if we want the beam to stick exactly to the P.T.V, we have to know precisely the penumbra.

For rectangular fields, the penumbra is defined by the distance between the 80% and 20% isodoses relative to the beam axis. It also seems us interesting to analyse the distances between, respectively, the 95% and 50% isodoses, the 90% and 50% isodoses, the 50% and 20% isodoses relative to the beam axis.

Today, when the leaves are set up automatically from a BEV or a simulation film, the optimization system doesn't take into account the penumbra.

This work is an evaluation of the different penumbras according to their different origins and of the different margins we have to take into account when we realize a treatment planning.

We therefore compared results obtained with different types of measures : several kinds of ionization chamber and several film densitometers.

The result of this work will give us the tool to ajust the reference isodose to the P.T.V, either by integrating this result into the dosimetry softwares, or by taking it into account for drawing the PTV.