

The treatment of small and irregularly shaped lesions especially in the head is a challenging problem in radiotherapy. The use of isocentric circular fields does not generally yield the desired degree of dose conformation to the target volume. Multiple shot Gamma knife or multiple isocenter linac treatments give better conformation but may lead to unacceptable dose inhomogeneities in the target volume and may be difficult to plan and treat. It has been shown that much better results can be achieved with multiple individually shaped irregular fields instead of circular fields. Unfortunately, most commercial multileaf collimators are not well suited to perform accurate field shaping for small lesions because their projected leaf width of 1 cm is too coarse. This holds especially for cases where the target volume is very close to small critical structures such as the optic nerves.

This lecture deals with miniature multileaf collimators (mMLC) with a projected leaf width of less than 5 mm, which are specifically designed for such stereotactic applications and offered by various vendors of equipment for stereotactic radiotherapy (e.g., Brainlab (Heimstetten, Germany), Leibinger (Freiburg, Germany), Radionics (Burlington, MA)). The design characteristics of the mMLCs will be presented and their pros and cons will be evaluated with respect to three different modes of application:

1. multiple static fields,
2. multiple dynamic arc treatments, and
3. intensity modulated treatments.

The technical requirements on the mMLCs increase in this order.

First of all we will discuss and compare the geometrical design features such as parallel or focused leaf design, leaf end shape (rounded or straight), projected leaf width, maximum field size, travel over the centerline, clearance to isocenter, and tongue and groove construction. Then we will describe basic technical features such as the maximum leaf speed and the accuracy of leaf positioning. In the third part we will talk about dosimetric characteristics such as penumbra, leaf transmission and interleaf leakage. Some aspects of how to perform dosimetry for mMLCs with films and diamond detectors will also be covered. Finally, we will briefly address the techniques and the potential of intensity modulated treatments of small lesions using an mMLC, thereby focusing on the aspect of penumbra sharpening.

Educational Objectives:

1. To provide useful information to institutions who wish to start stereotactic MLC treatments.
2. To learn the most important features of commercial mMLCs.
3. To understand the significance of these features for various modes of application (static, dynamic, IMRT).
4. To learn about the potential merit of mMLC treatments as compared to conventional treatments with regular fields.