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Measurements of the relative output factors for CyberKnife collimators.

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OBJECTIVE: To determine accurately the relative output factors, defined as the ratio of the nominal dose rate for a given collimator to that of the 60-mm collimator. This is particularly important for radiosurgical treatment of functional disorders, such as trigeminal neuralgia, in which a single large radiation dose is delivered to the target with a small collimator, such as the 5-mm collimator for CyberKnife radiosurgery. Numerous studies on the output factors have been reported for the Leksell gamma knife unit but none for the CyberKnife system.

METHODS: Measurements of the relative output factors for all 12 collimators were performed by three different methods: silicon diode, radiographic film, and thermoluminescent dosimetry microcubes. The silicon diode is designed for measurements in small (1-50 MV) photon beams performed in water or air. Film and thermoluminescent dosimetry measurements were performed in a plastic phantom.

RESULTS: The measured relative output factors for the three methods were very similar except for the three smallest collimators (5, 7.5, and 10 mm). The measured difference between the above methods was approximately 2%. The mean value of the output factor for the 5-mm collimator was 0.686 +/- 0.024. The uncertainties of the output factors are expected to increase with the decrease of collimator diameter. They range from approximately 1 to 4% of the relative output factor.

CONCLUSION: The relative output factor can be measured with an acceptable accuracy even for the smallest (5-mm) CyberKnife collimators. This requires the selection of appropriate dosimetric detectors and measuring procedures. The results obtained with the diode are considered more accurate than with the other two methods.

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