Purpose: Conventional determination of output factors for photon beams relies on the assumption that the product of stopping-power ratio and fluence perturbation correction factors is constant; thus output factors are determined as ratios of detector readings, rather than by ratios of absorbed doses. For small fields this assumption may be wrong, which combined with possible volume averaging effects, may introduce dosimetry errors for detector sizes comparable to the dose profile FWHM of the beam to be calibrated. The aim of the work was to determine corrections to measured detector readings, in order to derive dose-based output factors for detectors used in the Co-60 beams of the Leksell Gamma Knife® (LGK) models 4C and Perfexion.

Methods: The k(Q, f-clin) correction factor has been defined as the quotient of two MC calculated absorbed dose ratios, water to detector, for a clinical field relative to the machine-specific-reference field. Absorbed doses were calculated with the MC system Penelope for spherical phantoms, where the inserted detectors of various types were simulated in great detail. Correction factors were determined for all field sizes of the LGK.

Results: Detectors simulated were alanine, TLD, a PTW diode and liquid chamber. Calculated corrections for 14 mm and 8 mm circular fields were smaller than 1 % for all detectors. For 4 mm fields the resulting corrections were 0.96 for the diode, 0.98 for the TLD, less than 1.01 for the liquid ion chamber, and 1.16 for alanine.

Conclusions: Most of the detectors investigated are generally well suited for output factor measurements on the Leksell GK fields provided k(Q, f-clin) correction factors are available. The exception is alanine for the smallest field size, as its relative volume becomes too large. Additional results for other detector types are in progress.

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One of the authors (J. Johansson) is employed by Elekta, the manufacturers of Leksell Gamma Knife.