

# ASSESSMENT OF MICRODIAMOND PTW 60019 DETECTOR AND ITS COMPARISON WITH OTHER DETECTORS FOR RELATIVE DOSIMETRY IN SMALL RADIOSURGERY FIELDS OF THE LEKSELL GAMMA KNIFE PERFEXION

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Purpose: Measurement of relative output factors (ROF) for the Leksell Gamma Knife (LGK) is not a trivial task due to strict demands of an accurate set up and small size of measured radiosurgery fields. The purpose of this study was to perform an assessment of a new synthetic single crystal MicroDiamond PTW 60019 detector (volume 0.004 mm<sup>3</sup>) for measurement of ROFs for 4 mm and 8 mm collimators for the LGK Perfexion. Small sensitive volume of this detector, near water equivalence and low energy dependence make it an attractive candidate for small field dosimetry. Results obtained in this study were compared with results measured by broad variety of different detectors and also Monte Carlo (MC) simulation. Method and Materials: MicroDiamond detector connected to PTW UNIDOS electrometer was positioned in ELEKTA spherical phantom and pre-irradiated to dose of 5 Gy. Measurements were performed in two different detector positions: 1) parallel with table axis, 2) orthogonal to table axis. Electrometer timer of 1 min was used to measure subsequently signal from 16 mm, 8 mm and 4 mm beams. Altogether ten measurements were performed for each of three collimator sizes. Results from MicroDiamond were compared with those obtained from various types of detectors used in the past by authors for measurement of LGK ROFs: i) two types of micro ion chambers: Exradin A16 (volume 0.007 cm<sup>3</sup>) and PTW 31016 PinPoint 3D (volume 0.016 cm<sup>3</sup>); ii) two types of diode detectors: IBA dosimetry PFD (diameter 2.00 mm, thickness 0.06 mm) and IBA dosimetry SFD (diameter 0.60 mm, thickness 0.06 mm); iii) three different film dosimeters: Kodak EDR2, Gafchromic EBT and Gafchromic MD-V2-55; iv) radiochromic gel dosimeter based on Turnbull blue dye (TB gel); v) alanine dosimeter (diameter 4.8 mm, thickness 3.0 mm) and vi) mini alanine dosimeter (diameter 3.0 mm, thickness 3.0 mm). All measurements were performed in the ELEKTA spherical ABS plastic phantom (160 mm diameter) except the measurements with TB gel. Home-made spherical PMMA phantom of diameter 160 mm was used for TB gel dosimeter measurements. MC simulation was done by using Geant4 for water as a phantom material. Results: Results of ROFs measured by MicroDiamond were 0.900 and 0.831 for 8 mm and 4 mm, respectively in detector parallel position and 0.903 and 0.830 for 8 mm and 4 mm, respectively in detector orthogonal position. Results are in a very good agreement with vendor recommended values 0.900 and 0.814. Overall the best agreement with vendor recommended values and MC is seen for measurements performed with film dosimeter, MicroDiamond and IBA dosimetry SFD diode detector. Other detectors appeared to have too large volume for this measurement, especially for the 4 mm collimator. Conclusion: New synthetic single crystal MicroDiamond PTW 60019 detector appears to be a very promising detector for relative output factor measurements in very small radiosurgery fields.