Application of PVA – GTA Fricke gel detectors and
Gafchromic ™ EBT3 Ballcube I dosimetric films for the analysis of blocked radiation beams in the Gamma Knife® technique.

ABSTRACT

Radiotherapy, which uses the energy of ionizing radiation, is one of the methods of local treatment of both malignant and benign tumors. Technological development helps to improve this method of treatment both in the field of radiotherapy equipment and treatment planning systems. The improvement of working tools and the introduction of new, advanced irradiation techniques make it possible to deliver a given dose to the target area with increasingly better precision.

The main research objective of this dissertation is to analyze the dose distributions of blocked radiation beams in the LGK PFX technique. Blocked beams effectively minimize the dose to organs at risk, among others, during the trigeminal neuralgia treatment. The study was performed using Gafchromic™ EBT3 Ballcube I dosimetric films and gel detectors. The use of a new type of gel detector based on Fricke gel PVA - GTA was possible through cooperation with a scientific foreign center engaged in the production of various types of detectors for clinical dosimetry. The irradiation of some gel detectors and the graphical analysis of all irradiated gel detectors were performed in collaboration with the Katowice Oncology Center.

The study was conducted in several stages. An important part of this dissertation was the development of optimal operating conditions for the gel detectors used in the LGK PFX technique. In addition, individual phantoms were prepared and used during the irradiation of gel detectors and dosimetry films. This study used two devices applied in radiotherapy: the LGK PFX and a linear accelerator. Nine treatment plans that included the most commonly used systems of interlocked sectors in beams for the treatment of trigeminal neuralgia and their hybrid plans were analyzed.

The objectives set in the dissertation were achieved. The applied detectors allowed for a very detailed analysis of the obtained dose distributions, mainly in terms of the effects specific to the blocked beams. Very promising results were obtained when using the Fricke gel PVA - GTA detector in clinical dosimetry for LGK PFX.

Keys words: Gamma Knife, stereotactic radiosurgery, blocked radiation beams, Fricke gel PVA – GTA detectors, Gafchromic™ EBT3 Ballcube I films.