Brain tumour radiotherapy with synchrotron radiation

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The fundamental goal of radiation therapy is to deliver a high therapeutic dose of ionizing radiation to the tumor without exceeding normal tissue tolerance. This limitation is particularly severe in the case of brain tumors because of the high risk of adverse normal tissue morbidity.
Two innovative radiotherapy techniques, namely the Microbeam Radiation Therapy (MRT) and the Stereotactic Synchrotron Radiation Therapy (SSRT), are under development at synchrotron radiation X-ray sources. MRT differs from other radiotherapy techniques in the use of array of spatially fractionated X-ray beams (typically few microns wide and some hundreds of microns spaced); in this way, high doses (several hundreds of grays in a single fraction, delivered in microbeams) are tolerated by healthy tissues. Several Experiments have confirmed the sparing effect on normal tissues when using microbeams. In parallel, it was shown that MRT protocols can ablate highly aggressive brain tumors. With the aim of knowing in detail the locally deposited dose, extensive theoretical (Monte Carlo) and experimental micro-dosimetric studies are also performed.
The SSRT technique is based on the injection of a drug ce containing a high Z element into the tumor, and on the irradiation of the target with monochromatic X-rays at energies above the K-edge of the element; this combination produces a local dose enhancement. The irradiation, performed in tomographic mode to deposit only a fraction of the dose in the tissues surrounding the tumor, was applied to rats bearing gliomas using iodine as a high Z material or the chemotherapic drug cisplatinum CDDP (i.e., to profit from both the dose enhancement and the chemotherapic effect). In SSRT, a significant number of aggressive-brain tumor bearing rats were cured.
Protocols for clinical trials in SSRT in humans are presently under an advanced stage of preparation, together with MRT protocols for treating spontaneous tumors in large animals.