

## **Synchrotron Radiation Therapy from Radiation Biology to Clinical Trials. Scientific Issues – Preclinical and Clinical Trials**

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Preclinical trials and basic radiation biology studies using synchrotron radiation (SR) have been widely developed over the past two decades in different teams and locations. Different radiation techniques were used in various healthy and pathological preclinical models with an emphasis on brain tumor models. Both microbeam radiation therapy (MRT) and synchrotron stereotactic radiation therapy (SSRT) were developed and their effects on cells and tissues were assessed. The efficiency of these techniques was analysed with regard to the following factors: *in vitro* healthy and cancerous cells SR toxicity and DNA repair mechanisms, association with high-Z loaded contrast agents or nanoparticles, dosimetry issues at different scales including modelling tissue-photon interactions, platinum-derived or other associated chemotherapies, delivery dose enhancer strategies, tumor models, microvasculature response, survival studies, comparison with conventional X-ray sources etc.

These efforts have greatly contributed to increase and improve the use of synchrotron radiation in neurooncology research. Interesting results were obtained and new developments in synchrotron radiation oncology greatly depend on their analysis and reproducibility.

However, the studies already carried out and the related results permit the preparation of first clinical trials using SR. These SR therapy clinical trials are a new step in the history of medical applications of synchrotron radiation.

Basic research to understand mechanisms as well as preclinical and clinical studies in radiation oncology using synchrotron radiation and conventional sources should be fostered and reinforced as new sources and beamlines become operational. As a result, the use of various SR radiotherapy methods in radiation oncology will likely be better delineated either in basic and preclinical biomedical research or in clinical applications.