	Experiment title: Biological effects of proton and X-ray microbeam irradiation on a three-dimensional human skin model in vitro	**Experiment number**: **MD-695**
Beamline:	**Date of experiment**: from: 19.10.2012 to: 22.10.2012	**Date of report**:
Shifts:	**Local contact(s)**: **BRAUER Elke**	*Received at ESRF:*

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Report:

Introduction:

The aim of radiation therapy is to deliver a dose to the tumor to kill all cancer cells or cancer stem cells while sparing healthy tissue and sensitive organs as much as possible. The risk of developing normal tissue injuries limits the radiation dose that can be applied in tumor patients. MRT (Microbeam Radiation Therapy), a spatially fractionated radiotherapy at the European Synchrotron Radiation Facility (ESRF), uses an array of microscopically thin and nearly parallel synchrotron-generated X-ray beams. A different approach using focused proton microbeams spreading out into the tumor was recently invented at the ion microprobe SNAKE in Munich. Our aim was to investigate if microbeam irradiations with micrometer sized X-ray and proton beams can minimize the risk of normal tissue damage in radiotherapy and to elucidate the biological normal tissue sparing effects of MRT as observed in earlier studies at ESRF.

Material and Methods

Skin tissues were irradiated with a mean dose of 2 Gy over the irradiated area either with parallel synchrotron-generated X-ray beams at the ESRF and with 20 MeV protons at the ion

microbeam SNAKE in Munich in four different irradiation modes: homogeneous field, parallel lines (ESRF only) of 50 µm width, separated by 400 µm, spots of 50x50 μm^2 set by a 500x500 μm^2 matrix and spots of 180x180 μm^2 set by a 1800x1800 μm^2 matrix. The MTT assay was used to measure the metabolic activity of cells. The micronuclei assay was used to detect genetic damage in the keratinocytes. The MTT test was performed 40 hours after irradiation

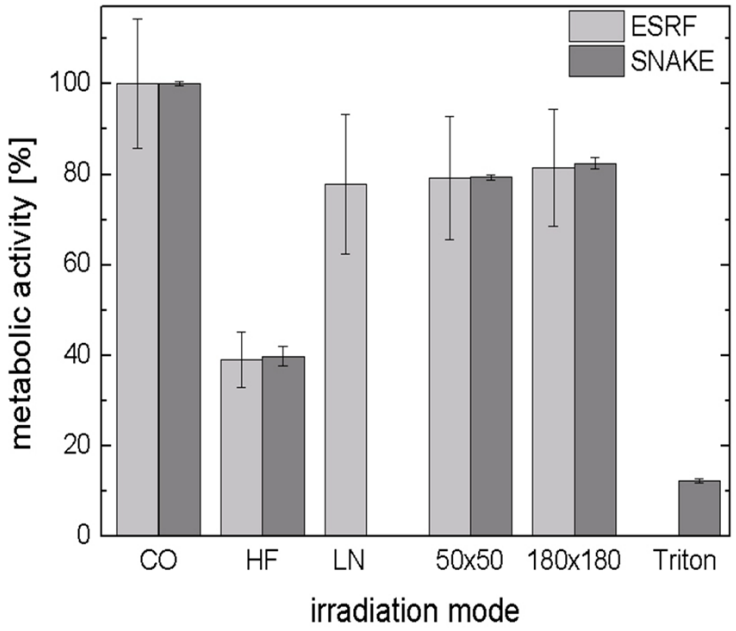

Figure 1: Result of the MTT Test

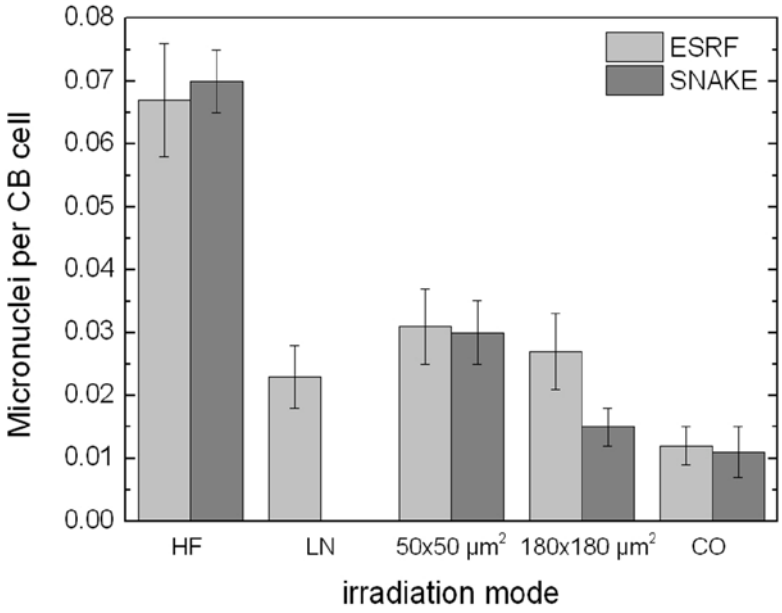

Figure 2: Result of the micronuclei test

Results:
Normal tissue viability as determined in an MTT test was significantly higher after proton or x-ray microchannel irradiation compared to a homogeneous field irradiation. Irrespectively of the size and distances of the channels, the number of micronuclei in keratinocytes was significantly higher with homogeneous irradiation compared to channel irradiation. No significant differences were observed with synchrotron X-rays vs. protons.

Conclusion:
Our data show that normal tissue irradiation using parallel synchrotron-generated X-ray beams as well as microchannel proton irradiation maintained higher cell viability and lower genetic damage compared to conventional homogenous irradiation. Normal tissue sparing in radiation therapy might be improvable by microbeam irradiation in the future

Reference

Girst S, Marx C, Bräuer-Krisch E, Bravin A, Bartzsch S, Oelfke U, Greubel C, Reindl J, Siebenwirth C, Zlobinskaya O, Multhoff G, Dollinger G, Schmid TE, Wilkens JJ. Improved normal tissue protection by proton and X-ray microchannels compared to homogeneous field irradiation.Phys Med. 2015 Sep;31(6):615-20.