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Investigation of the Radiation Induced Bystander Effect in pMBRT

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LhARA (Laser-hybrid Accelerator for Radiobiological Applications) is conceived as a novel, uniquely flexible facility dedicated to the study of the biological response to ionising radiation. The design for LhARA offers versatility, allowing for the production of spatially fractionated radiation therapy (SFRT) at the in-vitro and in-vivo end stations.

Background

SFRT aims to minimise radiation exposure to healthy tissues by separating the incident beam into fractions. The delivery of SFRT and the measurement of the dose distribution present a variety of challenges that must be explored to optimise the design of LhARA end stations. For example, a current body of research predicts that cells that have not been directly exposed to radiation still show biological changes in a process labelled the radiation-induced bystander effect. In reference to SFRT, this suggests that damage could accumulate in the valleys (unirradiated regions) over time.

Methods

An in-vitro experiment was carried out at the Birmingham MC40 beamline to investigate any indirect biological response FaDu tumour cells. Cells were irradiated, stained and imaged at different times post proton SFRT, detecting the γh2AX foci damage repair changes over time in the peaks and valleys to see if the damage migrates to the space between the directly irradiated regions.

Results

The preliminary in-vitro investigation saw evidence of damage increase in the valleys over time, most prominently at 10Gy for this cell line, though more experiments are required to establish significant results. The study is to be concluded ahead of the conference, finishing a full set of repeats in February 2024.

Conclusions

The observed increase in valley damage suggests a potential observation of the 'bystander effect,' emphasising the necessity for additional experiments to refine our understanding and formulate a comprehensive theory, warranting the study's timely conclusion before the upcoming conference.

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