AbstractID: 13325 Title: Repair kinetic considerations in high-LET particle beam radiotherapy

Purpose: Present repair kinetic models are not specifically designed to be applicable to high-LET radiation beams. They thus inherently assume that full repair always takes place between fractions, with the risk that they may underestimate the increased biological effectiveness of high-LET treatments. A second-order repair kinetics model is developed to predict damage repair rates following low- or high-LET irradiations and to assess the amount of unrepairable damage produced by such radiations.

Materials and Methods: The model is a further development of an earlier version designed to test if low-LET radiation repair processes could be quantified in terms of second-order kinetics. The newer version allows calculation of both, the repair rate of the proportion of cells that repair according to second-order kinetics and the proportion of cells that do not repair. The original and the present versions, as well as other models presently used in clinical Radiotherapy, are compared in terms of their goodness-of-fit to a number of data sets obtained from different ion beams.

Results: The analysis demonstrates that the present model provides a better fit to the data in all cases studied. The proportions of unrepairable damage created by radiations of different LET predicted by the new model correspond well with previous studies on the increased effectiveness of high-LET radiations in inducing reproductive cell death.

Conclusion: The results show that the original model may underestimate the proportion of unrepaired damage at any given time after its creation and that it fails to predict very slow or unrepairable damage components which may result from high-LET irradiation. The low number of parameters present in the new model and its better fit to the data compared to other repair models currently used in clinical Radiotherapy, make it a powerful tool to estimate the impact of incomplete repair effects in fractionated high-LET radiotherapy.