Proton Therapy beyond cancer: The role in neurodegenerative disorders

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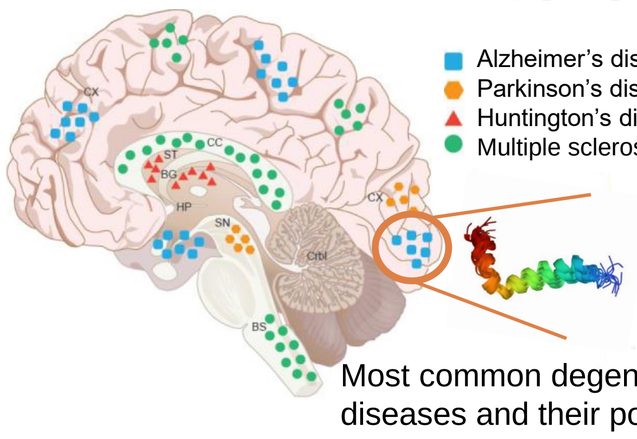
Introduction

Neurodegenerative diseases are characterized by the accumulation of misfolded proteins, known as amyloid, which resist degradation and disrupt normal cellular functioning [1,2].



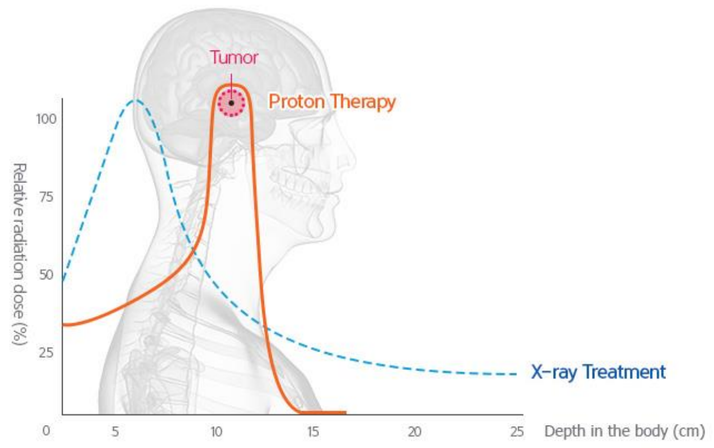
AD amyloid structure [3].

Most common degenerative cognitive diseases and their position in the brain [4].

Low-dose photon radiotherapy, has shown positive results on AD and PD [5,6].

Some clinical trials are ongoing.

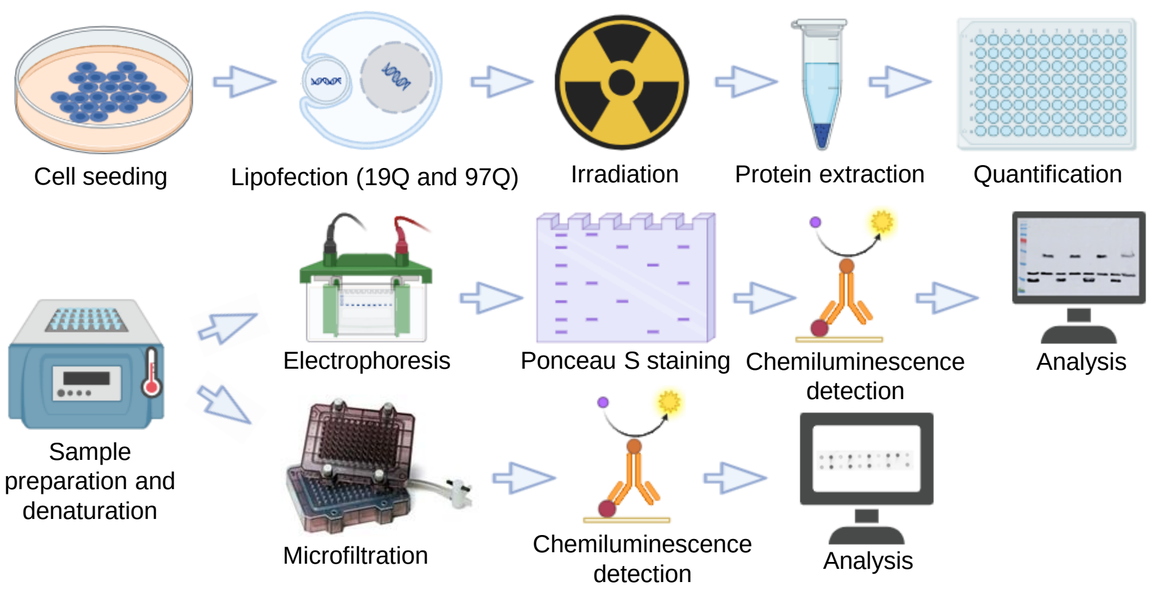
Proton therapy presents several **advantages** over conventional radiotherapy and is already clinically applied to noncancerous brain tumours [7].



Proton therapy (PT) dose deposition profile [8]. While protons penetrate the tissue, they gradually slow down and transfer energy to the tissue. Near the end of the beam range, there is a sharp increase in energy transfer, after which the beam stops, and the energy transfer drops to zero.

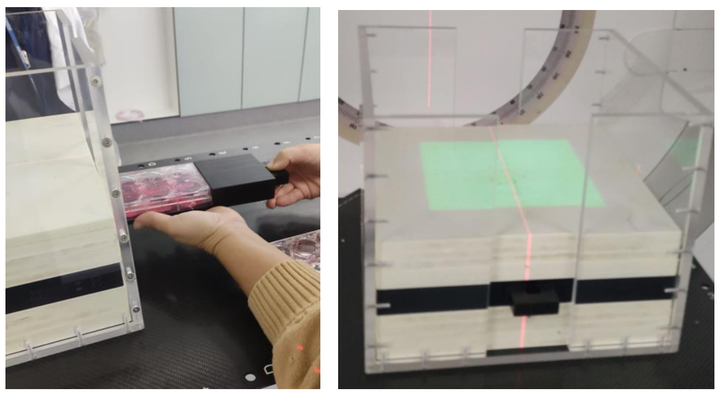
Multidisciplinary Approach: Biochemistry and Nuclear Physics join forces

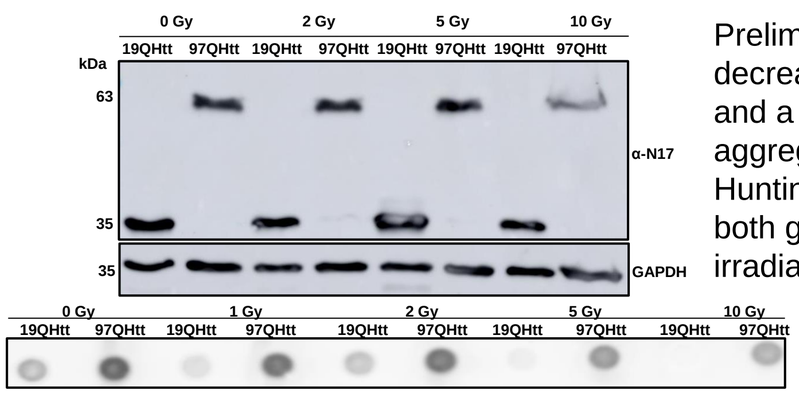
Study the radiation effects on the brain using established cell lines



Schematic representation of the experimental procedure to study the expression and aggregation of proteins associated with neurodegeneration in HeLa cells expressing the wild type (19Q) or the mutant (97Q) Huntingtin protein after irradiation.

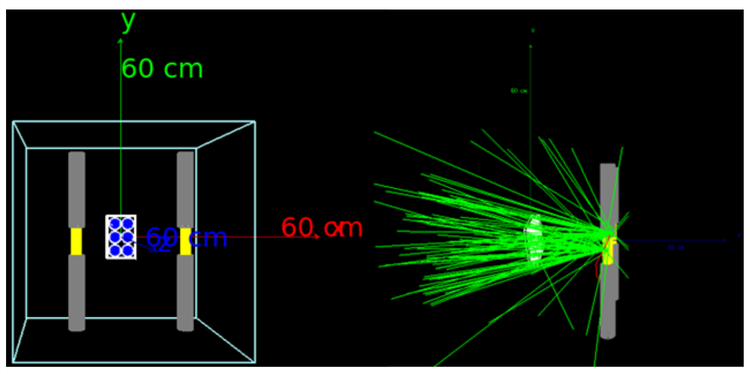
Placement of the biological samples in the radiobiological phantom and confirmation of the alignment at a clinical linear accelerator facility.





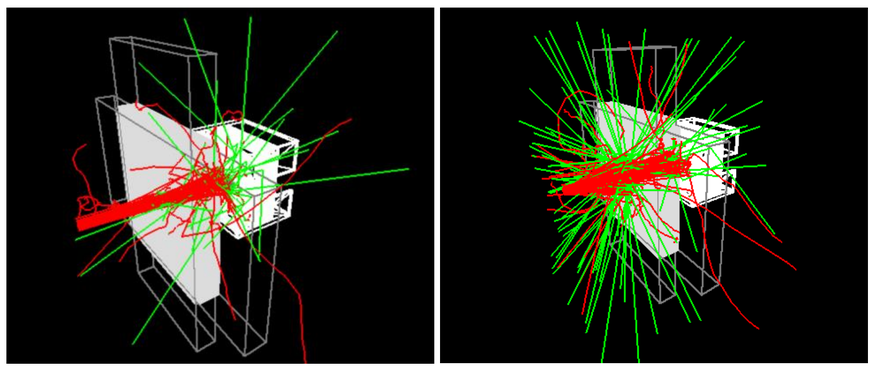
Preliminary results show a decrease in the expression and a reduction in the aggregation of mutant Huntingtin (Htt) induced by both gamma and photon irradiations.

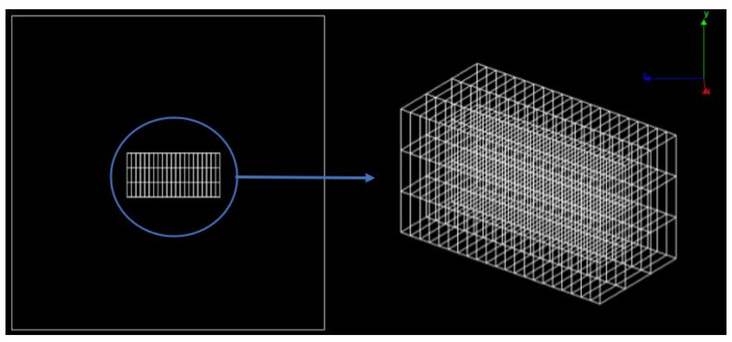
Monte Carlo simulations



The geometric design of the Monte Carlo simulations aims to characterize the ^{60}Co sources used in the irradiation of biological samples. The experimentally obtained dose and energy deposition will be compared to the simulated data.

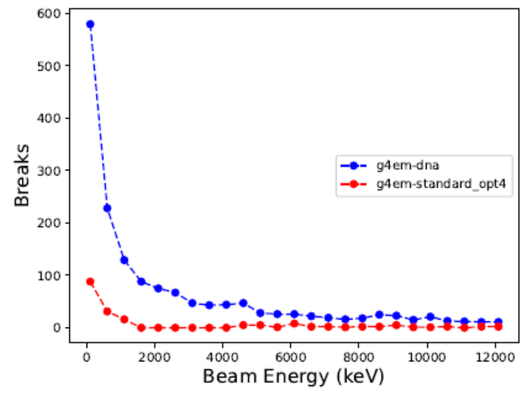
Simulation of 2 x-ray beam profiles: a pencil beam with a cylindrical shape and a cone beam that shoots particles at an angle relative to the z axis of the phantom [9].





The geometry defined for the amyloid structure, retrieved from the Protein Data Bank, was replicated along the x, y and z axes to increase the probability of energy deposition occurring near an atom of the amyloid [10].

Total number of strand breaks on the amyloid induced by a proton beam ranging from 100 keV to 12.5 MeV, using two different physics lists [10].



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