Abstract Title:
Investigating the Risk of Radiation-Induced Brain Necrosis Based on Ionization Detail (ID) Parameters in Proton Therapy for Skull Base Tumors

Abstract:
Proton therapy is a leading treatment modality for skull base tumors due to its ability to precisely target tumors while minimizing damage to surrounding healthy tissues. Traditionally, treatment planning has focused on parameters such as Linear Energy Transfer (LET) and Relative Biological Effectiveness (RBE) to optimize therapy. However, these measures alone may not fully capture the complexity of radiation-induced damage, particularly concerning the risk of brain necrosis.

This project aims to investigate the potential correlation between radiation-induced brain necrosis and Ionization Detail (ID) parameters, which offer a more detailed understanding of the biological effects of radiation. ID parameters focus on the specific ionization patterns created by proton, particularly the ionization clusters responsible for complex DNA damage. By shifting the focus from LET and RBE to ID parameters, this research intends to explore a more refined framework for assessing brain necrosis risk in proton therapy of skull base tumors.

The study will analyze patient post-treatment MRI data to identify possible links between voxelized ID parameters and the risk of brain necrosis in patients treated for skull base tumors. The goal is to assess whether ID parameters can improve predictive power compared to traditional models. This approach could lead to improved treatment planning in proton therapy, reducing the risk of radiation-induced complications.

While this project is still in its early stages, future work will use an analytical approach to examine ID parameters modeled in both necrotic and non-necrotic brain regions. This research can potentially contribute to developing safer and more effective treatment strategies in proton therapy by advancing our understanding of the biological mechanisms underlying radiation-induced damage.