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Safe proton radiotherapy for patients with metallic spine stabilization system

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Introduction

Since the beginning of proton radiotherapy in Krakow, skull base tumors are the main sites treated here. Due to the need to deliver a high dose of ionizing radiation (70-74Gy RBE) and the close presence of critical structures, such brainstem, optic chiasm, optic nerves, the use of a proton beam creates better opportunities for dose escalation to the target volume compared to photon radiotherapy. The problem when planning such treatment is the presence of metal stabilizers in about 40% of patients, which increase the uncertainty of the planned dose deposition.

Material and methods

Acquisitions of CT layers necessary for treatment planning were performed on the Siemens Somatom Definition AS apparatus using the iMAR, an optimized iterative algorithm for reducing metal artifacts. Then, a dedicated calibration curve for the Varian Eclipse treatment planning system (HU vs. RSP) was prepared. For each patient with a stabilizer, computed tomography was additionally reconstructed in the extended HU scale to transfer the necessary information about the implant density for treatment planning algorithm. Treatment plans were also based on individually defined structures - so-called target per field (volume to be irradiated from a given therapeutic field - beam) in order to avoid fragmented areas of artifacts reconstructed in an unacceptable way. The geometry of the beams was also optimized in relation to the metal element and critical organs.

Results and conclusions

The presented procedure allowed for the safe proton radiotherapy treatment using scanning beam in over 50 patients with metallic stabilizers, which was additionally confirmed by Monte Carlo simulations with the FRED tool (Fast paRticle thErapy Dose evaluator).

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