Clinical implementation and range evaluation of in vivo PET dosimetry for particle irradiation in patients with primary glioma.

The physical and biological properties of ion-beams offer various advantages in comparison to conventional radiotherapy, though uncertainties concerning quality assurance are still left. Due to the inverted depth dose profile, range accuracy is of paramount importance. We investigated the range deviations between planning simulation and post-fractional PET/CT measurement from particle therapy in primary glioblastoma. 20 patients with glioblastoma undergoing particle therapy at our institution were selected. 10 received a proton-boost, 10 a carbon-ion-boost in addition to standard treatment. After two fractions, we performed a PET/CT-scan of the brain. We compared the resulting range deviation based on the Most-likely-shift method between the two measurements, and the measurements with corresponding expectations, calculated with the Monte-Carlo code FLUKA. A patient's two measurements deviated by 0.7mm (±0.7mm). Overall comparison between measurements and simulation resulted in a mean range deviation of 3.3mm (±2.2mm) with significant lower deviations in the (12)C-arm. The used planning concepts display the actual dose distributions adequately. The carbon ion group's results are below the used...
PTV safety margins (3mm). Further adjustments to the simulation are required for proton irradiations. Some anatomical situations require particular attention to ensure highest accuracy and safety.