AbstractID: 10393 Title: In-room proton range verification using mobile NeuroPET - feasibility study

Purpose: At present a very promising method for an in vivo and non-invasive monitoring of radiation treatments with proton beams is positron emission tomography (PET). Offline (post treatment) PET/CT imaging is currently under investigation for proton range verification. However, the long (~15min) time interval between irradiation and PET imaging and the fact that the patients need to move to a different room for the PET scan introduces various uncertainties. This study investigates the feasibility and the potential advantages of using a mobile NeuroPET scanner in the treatment room compared to the offline PET/CT scanner.

Method and Materials: A circular SOBP proton field of 16 cm water equivalent range and 10 cm modulation was delivered to a PMMA phantom (9 x 9 x 20 cm^3). A total dose of 8 GyE(RBE=1.1) was administered. PET data were acquired in listmode starting within 7 min after irradiation once at the NeuroPET scanner and once at a commercial PET/CT scanner. For image coregistration markers that are recognizable in the CT as well as in the PET were used.

Results: The 50% distal fall-off position along the activity depth profiles of the two scanners were found to agree within 2.5 mm. The NeuroPET scanner showed comparable performance over the scanning period of 30 minutes than the conventional PET/CT scanner.

Conclusion: The promising results of the phantom study encourage first patient NeuroPET scans following proton treatment. The use of the movable NeuroPET scanner in the treatment room promises to enable high precision PET range verification with minimized disturbing influences of biological washout and reduced geometrical uncertainties due to patient repositioning.