AbstractID: 10111 Title: Assessment of proton beam in-vivo dose verification by directly comparing doses measured in tissue-equivalent polymer gels to proton-activated positron-emission distributions in the gels post irradiation

Purpose: An assessment of proton beam in-vivo dosimetry using PET imaging of dose distributions in polymer gel phantoms is presented. The next-generation 3D polymer gel dosimeter (BANG®-3-PRO-2) developed specifically for proton radiotherapy dosimetry has the capability of accurately reproducing dose in water from ion chamber scan data. Previous studies have focused on correlating model-based induced activity in various phantom materials to measured PET activity. In this work, we evaluate a new approach to correlating measured proton dose distributions directly to measured PET activity distributions using this new proton–sensitive, homogeneous, and tissue-equivalent gel.

Methods and Materials: Large volume (2.2 Liter) of the gel was irradiated with a proton therapy beam along the long axis of the gel. Most of the 15.1 cm range beam with SOBP of 5.0 cm was captured in the gel volume. The gel was imaged in a nearby PET/CT unit immediately (<3 min) after irradiation. The dose distribution was generated afterwards through an established optical scanning protocol. Direct spatial comparison of dose and activity distributions was then performed.

Results: Spatial correlations between PET activity and dose distributions maps at depths show a strong one-to-one correlation. Profiles along the beam path show that the distal fall off of the dose is nearly 2 cm deeper than the activity profile which is comparable to other studies.

Conclusion: In this work we demonstrate a unique approach to proton in-vivo dosimetry by direct comparison of measured proton dose distributions to proton-activated positron distributions in polymer gels. With this direct comparison capability, uncertainties of distal edge doses from modulated proton beams can be accurately quantified and systematically studied. This phantom study demonstrates that the gel medium could be potentially useful for assessing various physical factors that could affect PET activity range verification method and reproducibility.