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Development of A Collision Model for Advanced Proton Treatment Planning and Delivery

Shupeng Chen
Beaumont Health

Lewei Zhao
Beaumont Health

Weili Zheng
Beaumont Health

An Qin
Beaumont Health

Rohan Deraniyagala
Beaumont Health

See next page for additional authors

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Authors
Shupeng Chen, Lewei Zhao, Weili Zheng, An Qin, Rohan Deraniyagala, and Xuanfeng Ding

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distribution from each of the uniform fields investigated. The dose was sampled using regions of interest that were designed to mimic the individual ion chambers in the MLIC. The distal 90% range (D90) calculated for each beam/scan were compared to the MLIC-measured value**. Results:** The average difference between range measurements and calculations based on DirectSPR and SECT, respectively, was 0 mm versus 1.7 mm for the 164.8 MeV beam and 0.1 mm versus 2.6 mm for 227.2 MeV beam**. Conclusion:** We demonstrated that DirectSPR datasets can be successfully used for better predicting proton dose distributions and these predictions agree much more closely to measurements than those based on the more traditional use of SECT data.

PO-GePV-T-142, Development of A Collision Model for Advanced Proton Treatment Planning and Delivery: S Chen*, L Zhao, W Zheng, A Qin, R Deraniyagala, X Ding, William Beaumont Hospital, Royal Oak, MI

Purpose: A major barrier to implementing advanced proton therapy delivery techniques, such as proton arc/4pi delivery is the unknown characteristics of the collision zones, i.e., the combinations of couch and gantry angles that result in a mechanical collision between the gantry and couch or patient. This study aims to develop a collision model for the determination of patient-specific collision zones to enable safe and deliverable noncoplanar proton therapy treatment planning**. Methods:** The detailed geometric parameters of the treatment machine including the nozzle, the snout, and the size and the location of the range shifter were measured from an IBA Proteus ONE machine with the gantry rotation capability. The coordinate of the patient body and the treatment couch was obtained from the patient dicom RT structure. The patient body surface was aligned virtually to the treatment machine model with the gantry and the couch can be rotated to test for a potential collision. The combination of the feasible gantry and couch angles was searched in the whole 4pi space. A user interface of the collision model was developed using the MATLAB platform and evaluated on 3 head and neck (HN) patients, 3 brain patients, and 3 abdomen patients to identify the potential collision zones**. Results:** With the Drs2iso, distance from the surface of the range shifter to isocenter, to be 40cm, the collision zones were (50.3±7.3)%, (45.6±9.1)%, and (42.7±1)% within the 4pi space for HN, brain, and abdomen patients, respectively. Increasing the Drs2iso to be 50cm, the corresponding collision zones reduced to be (34.4±7)%, (29.9±7.9)%, and (26.4±1.4)%**Conclusion:** A collision model was developed to determine patient-specific collision zones that enable the safe application of arc/4pi delivery. Further improvement of the model accuracy would be needed by including details of the robotic couch base and other directions of couch movement.

PO-GePV-T-143, Multi-Isocenter Congruence Tracking with a Custom In-House Software Package: A Faught*, J Zhang, L Wilson, S Al-Ward, E Batin, St. Jude Children's Research Hospital, Memphis, TN

Purpose: Our proton therapy center uses a conical scintillation detector to track coincidence between radiation and imaging isocenters. The novel, four imaging-isocenter configuration of our treatment rooms necessitated an efficient means of spatially relating each unique imaging isocenter to the others and to radiation isocenter**. Methods:** Custom, in-house software was developed to scrape the output files of a commercial detector system and accompanying vendor software. Raw image data scraped from the vendor software included a proton spot produced by a pencil beam incident on the detector, which contained a radio-opaque BB aligned to imaging isocenter. The relative offset of the spot signal to the BB shadow was calculated from the centroid of the respective regions of interest. Offset vectors were transformed into the proton system's native coordinate space based on the gantry angle of delivery. The median of 2D offsets manually identified by four independent users was compared to the corresponding software-identified offsets for 84 images spanning 12 months of clinical quality assurance measurements**. Results:** The average difference between the software-identified offset and the corresponding median of user-defined offsets was less than 0.1 mm in the image x- and y- directions with standard deviations of 0.1 mm and 0.2 mm for x- and y-, respectively. A paired student's t test showed no significant difference in mean y offset (p = 0.60) and significance in mean x offset (p = 0.02) between the two identification methods. **Conclusion:** Accurate and precise identification of imaging and radiation isocenters was achieved with the custom software. Quantitative and visual means of tracking multiple isocenters with the software is supported.

PO-GePV-T-144, Attachment Reproducibility of the Accessory Tray-Mounted Proton Dynamic Collimation System: T Geoghegan[1]*, K Patwardhan[1], L Bennett [1], J Yu[2], A Gutierrez[2], P Hill[3], R Flynn[1], D Hyer[1],(1) University of Iowa, Iowa City, IA, (2) Miami Cancer Institute, Miami, FL (3) University of Wisconsin, Madison, Madison, WI

Purpose: An important aspect of any add-on accessory in radiation therapy is understanding the associated quality assurance that must be performed prior to use. Since the Dynamic Collimation System (DCS) has been designed to be used as an aftermarket add-on collimator that mounts via the accessory tray, an investigation of the mounting accuracy and reproducibility must be conducted prior to clinical use. The purpose of this work was to characterize the

