

AbstractID: 8427 Title: A protocol to extend on-board cone-beam CT longitudinal coverage with multiple orbits

**Purpose:** To develop, evaluate and optimize a protocol for acquiring on-board cone-beam CT (CBCT) images for larger longitudinal coverage than the maximum 14 cm coverage allowed by the Varian OBI half-fan single-orbit mode. Extended coverage is needed to fully image many standard pelvic, thoracic, and head-and-neck treatment volumes and to support such tasks as deformable image registration and dose reconstruction on serial CBCT images.

**Method and Materials:** Multiple Varian single-orbit data acquisitions separated by couch shifts were performed with small overlaps to provide the desired coverage. Simple approaches to aligning the two image volumes based on the nominal couch shift were validated against rigid image registration based upon orthogonal radiographic projections. An automatic algorithm was devised to decode the DICOM headers of the original slices and get corresponding position information, subsequently join the volumes, and finally rewrite the headers so that the resultant CBCT image set will be correlated as a single DICOM image volume. Validation of the volume reconstruction was performed with AP/PA radiographs and CatPhan QA phantom to evaluate the combining accuracy and the image quality in the abutment region where data sampling violates Tuy's data sufficiency condition.

**Results:** The above protocol successfully provides OBI CBCT images with any desirable longitudinal coverage. An optimized protocol is implemented clinically, based upon the dose consequences and application simplicity.

**Conclusions:** A practical method was developed to effectively extend the OBI longitudinal coverage, which improved the applicability of the OBI CBCT images in image-guided adaptive radiation therapy.

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