Computational Detection of Quantitative CBCT Instability from Routine MIMI Phantom QA

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Digital Poster Viewing

Purpose

Evaluate whether routine MIMI phantom CBCT can serve as an automated quantitative sentinel for longitudinal and intraday reconstructed-intensity instability.

Values are reconstructed voxel values, not calibrated HU.

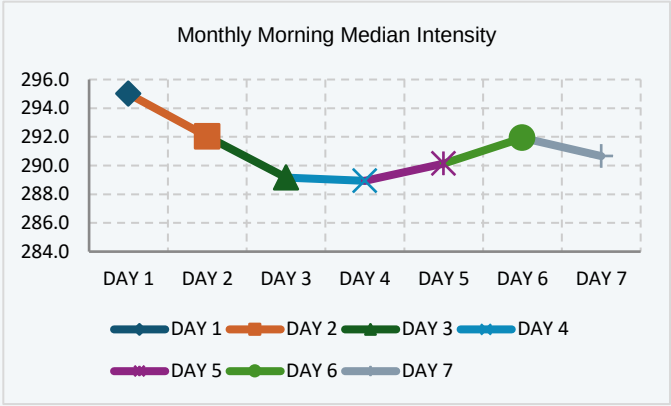
Methods and Quantitative Analysis

- **For intraday comparison**, three CBCT volumes from a single clinical day - morning, midday, and late-afternoon - were analyzed, with the morning scan as the within-day reference.
- **For longitudinal comparison,** seven routine morning CBCT volumes were analyzed within a month, with first day serving as the reference.
- Routine phantom CBCT DICOM series were automatically identified and reconstructed volumes localized.
- Each comparison volume underwent rigid 3D registration to its morning reference.
- A homogeneous interior mask excluded boundaries, inserts, markers, and high-gradient interfaces.
- Outputs included median reconstructed voxel values, within-mask SD, intensity distributions, voxel-wise differences, exceedance fraction, and temporal trend.

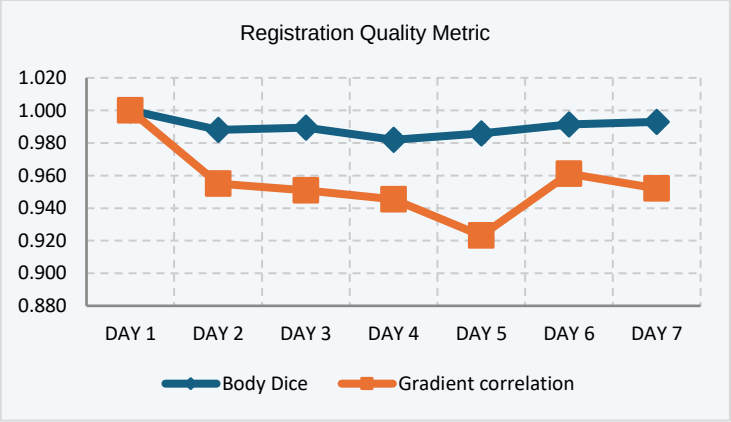
Quality Control and Limitations

- Values are reconstructed intensity units—not calibrated HU.
- Intraday comparisons used the same recorded protocol: Fast Head and Neck S20, 100 kVp.
- Registration was checked using body overlap and image-gradient correlation.
- A detected change may reflect acquisition, reconstruction, positioning, registration, or system behavior; causation requires independent review.
- Values are reconstructed intensity units—not calibrated HU.

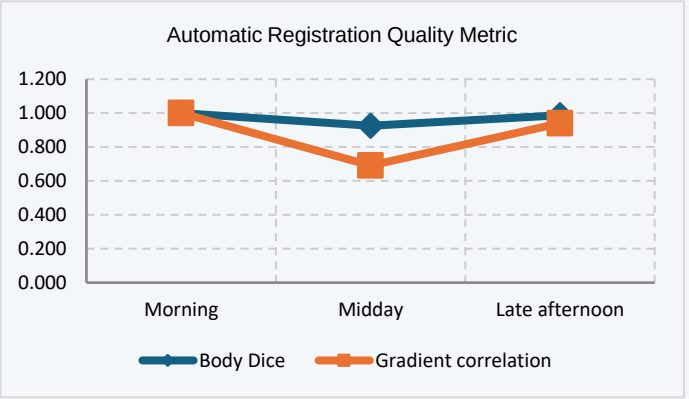
Longitudinal Stability Analysis



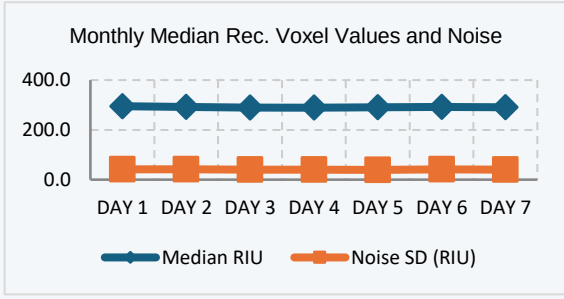
Longitudinal Quantitative Analysis



Intraday Quality Analysis



Registration and Difference Statistics



Conclusion: **Routine MIMI phantom QA can be leveraged for automated quantitative CBCT surveillance. In this pilot study, the framework detected a transient midday quantitative departure, whereas no significant longitudinal trend was observed across routine morning acquisitions, and late-afternoon measurements returned closer to the morning baseline. These findings demonstrate the sensitivity of the computational approach to detect quantitative changes but do not establish their cause. Larger datasets with repeated intraday sampling and independently validated control limits are needed before clinical implementation.**