

Evaluating iCBCT Image Quality at Halcyon Linac for Patient Set Up Verification

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INTRODUCTION

- Varian Halcyon Linac mandates patient imaging prior to daily treatment
- Daily imaging increases patient dose substantially compared to historical weekly imaging techniques
- Varian Halcyon Linac offers a new iterative cone beam (iCBCT) algorithm for daily imaging that supports metal artifact reduction (MAR)
- Filter-back projection (FBP) algorithm also available (kV CBCT)

AIM

- To reduce imaging dose to patients by reducing imaging exposure via iCBCT without losing standard image quality of FBP
- To quantify image quality via signal-to-noise ratios (SNR) for the new iCBCT algorithm on Halcyon against traditional filter back-projection algorithm for the kV imager
- To view metal artifact reduction (MAR) with the iCBCT algorithm when compared to the FBP algorithm

METHODS

- Image Quart and CatPhan phantoms under standard treatment workflow to simulate a patient's head and pelvis region respectively
- Use FBP on Halcyon with standard clinical exposure settings for head and pelvis kV CBCT for a background measurement (126 mAs and 1080 mAs respectively) with and without metal BB introduction
- Image both phantoms with incrementing exposure settings with the iCBCT algorithm with and without metal BB introduction
- Obtain SNR from **clinically relevant contrast regions under the same relevant window leveling** and compare SNR of all iCBCT against SNR of the related FBP scan

RESULTS

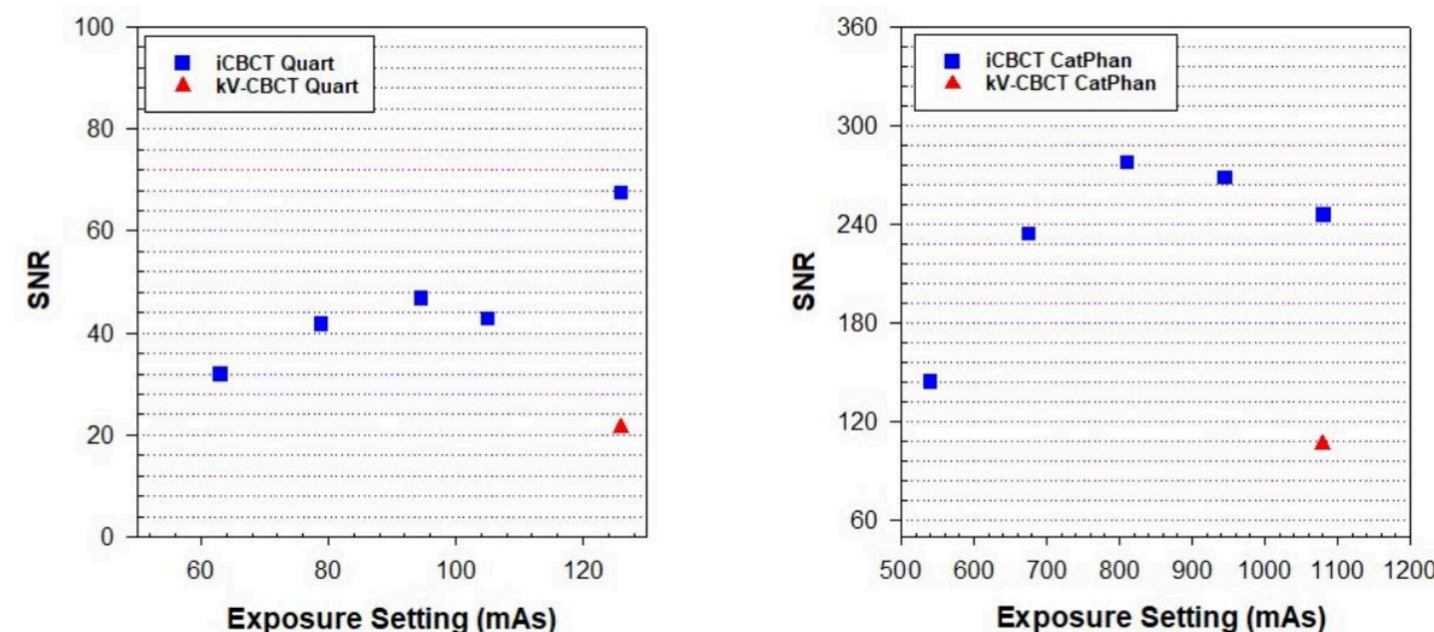


Figure 1. SNR of Quart and CatPhan for Various Exposure Settings. The SNR linearly increases with exposure for the head protocol with Quart phantom and exhibits a plateau in the CatPhan for a pelvis protocol. This indicates potential overexposure to the patient.

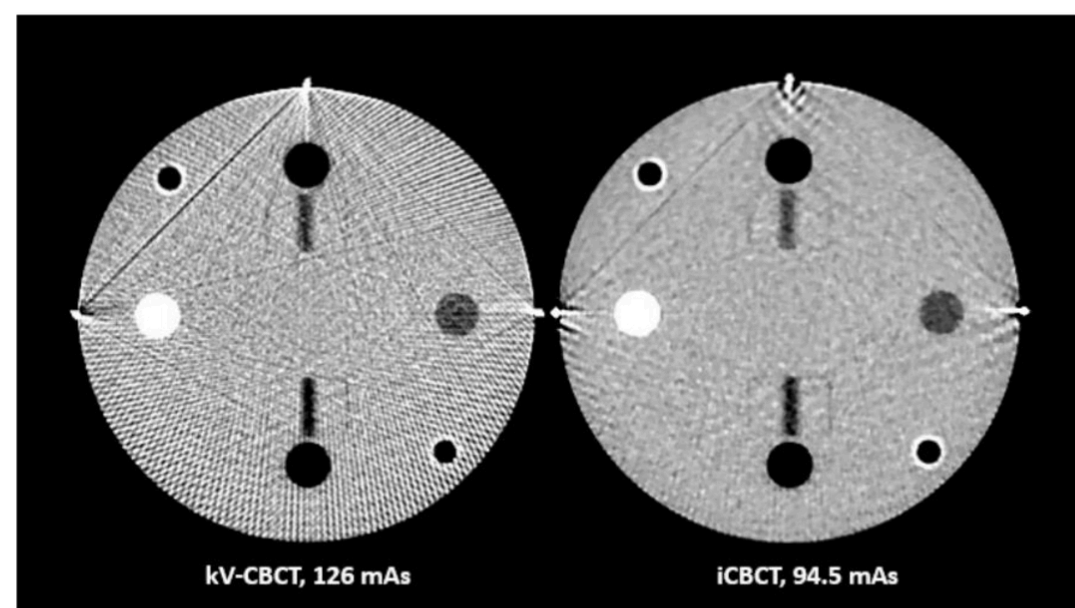


Figure 2. Comparison of kV-CBCT and iCBCT Slices of Quart Phantom. Note the significant reduction of metal streaking artifacts using iCBCT with a lower exposure setting – potentially reducing patient dose.

CONCLUSIONS

- All exposure settings exhibited a higher SNR with iCBCT than FBP.
- The head scan iCBCT exposure trend demonstrated expected results with higher SNR values with increasing exposure. 126 mAs is recommended for highest SNR image quality unless necessary to reduce imaging dose.
- The iCBCT pelvis scan's peak of SNR at 810 mAs demonstrates a possibility to reduce the exposure setting, and dose, to achieve a better image quality through SNR.
- Streaking metal artifacts were reduced with iCBCT imaging. MAR with iCBCT may be a method over MV CBCT delivery to reduce patient dose and to improve spatial resolution of the image for IGRT.
- Based solely on SNR values, we recommend a lower exposure setting for the iterative algorithm can be used over the filter back-projection.
- Further study is warranted to investigate the qualitative trade off from spatial resolution as it is critical for patient alignment on daily basis.

SUMMARY

- Quart and CatPhan phantoms were imaged with clinically relevant protocols with both new iCBCT and traditional kV-CBCT reconstruction algorithms.
- It was determined that iCBCT can provide higher SNR and image quality for a lower mAs while reducing patient imaging dose.

REFERENCES

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