

AbstractID: 11331 Title: Quantitative Analysis of the Influence of KV Beam Characteristics and Image Acquisition Parameters on Image Quality in Cone-Beam CT

Purpose:

Image quality in cone-beam CT (CBCT) imaging is influenced by a variety of factors associated with the selection of image acquisition parameters like kVp, tube current, field size, beam filter, number of projections, and reconstruction filter. An improper selection of scan protocols may lead to unoptimized image quality and unnecessary dose to the patient. Therefore, a rigorous study of CBCT image quality and its dependence on beam characteristics is vital. In this work, the relative influences of pertinent image acquisition parameters are evaluated for a clinical Elekta XVI CBCT system.

Method and Materials:

Image quality measurements were conducted using a conventional CatPhan phantom, wherein the line-pair bar inserts and uniform slices were used to characterize spatial resolution and noise via modulation transfer function (MTF) and noise power spectrum (NPS) respectively for several combinations of kVp/current, field size, beam filters, and gantry rotation arcs. CTDI dose estimates were also acquired for each scan protocol. Overall image quality was evaluated in terms of the detective quantum efficiency (DQE), obtained from MTF and NPS spectra and normalized using the CTDI doses and a fluence – CTDI dose conversion factor obtained from Monte Carlo simulations.

Results:

The MTF, NPS and DQE measurements indicated that overall image quality was severely affected by the increased scatter from larger field sizes, and from the use of incomplete projection arcs. The use of beam filters led to some reduction in scatter and improved image quality, while also reducing patient dose.

Conclusions:

The image quality measurements indicated that the appropriate choice of scan parameters can lead to improved image quality and sparing of patient dose. However, more detailed investigations may be necessary to optimize CBCT image quality, including a better choice of beam compensators and possible use of anti-scatter grids.