Evaluation of a Hybrid Iterative Reconstruction technique "iDose" for CT Dose Reduction and Image Quality

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Purpose:
To investigate the use of a commercial designed hybrid iterative reconstruction technique iDose (by Philips Medical Systems) for CT radiation dose reduction and its effect on image quality.
Methods:
A catphan®504 phantom was scanned using a 64-slice CT (Ingenuity, Philips Medical Systems) with two different tube voltages (100 kVp, and 120 kVp) at three different doses, a reference dose ($CTDI_{vol}$) of 42 mGy and two reduced doses of about 50% and 75% of the reference. Images were reconstructed with standard filtered-back-projection (FBP) and with iDose algorithms. Six different iDose levels were employed. Quantitative evaluation of spatial resolution, image noise, noise power spectrum (NPS), and low-contrast detectability were carried out.
Results:
For any given dose level, there was a static noise reduction with increased iDose level over the FBP. To match the "standard" noise resulted from the FBP at the "reference dose", a minimum iDose level of 4 and 6 was required for 50% and 75% dose reduction respectively. NPS showed moderate shift towards the lower frequency as the iDose level increased. The NPS shift was consistent with the observed subtle change of noise texture. This shift also correlated with the change in low-contrast detectability among images with the same noise level, the higher the iDose level that was used in image reconstruction, the lower the low-contrast detectability.
Conclusions:
The iDose algorithm clearly demonstrates effectiveness in noise suppression over the FBP. The low-contrast detectability depends on noise but also on NPS, which is shifted by iDose algorithm. At very low-dose levels, greater iDose levels would be needed to reduce the image noise but may not improve the low-contrast detectability. This findings indicate that for any given specific clinical task, the lowest dose limit achievable is determined by an "optimal" iDose level ascertaining the noise reduction as well as maintaining desired low-contrast detectability.