What is the Benefit of an Adaptive Statistical Iterative Reconstruction Method over Conventional CT Reconstruction Approaches?

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Introduction

Adaptive Statistical Iterative Reconstruction (ASIR) is a new imaging reconstruction technique recently introduced by General Electric (GE) in last generation computed tomography (CT) scanner units. This technique, when combined with a conventional filtered backprojection (FBP) approach [1], allows in particular to taking into account the statistical fluctuation of noise [2]. To quantify the benefits provided on the image quality by the ASIR method with respect to the FBP one, the standard deviation (SD), modulation transfer function (MTF), noise power spectrum (NPS), signal-to-noise ratio (SNR) and low contrast detectability were determined from phantom images.

Material and Methods

A multidetector-row CT (MDCT) was employed. Measurements were performed on a Catphan600 phantom when varying the CT dose index ($CTDI_{vol}$) and the reconstruction kernels. Images were reconstructed on a CT console for different percentage of ASIR (0% pure FTB, 100% pure ASIR). To evaluate the iterative method, metrics were computed and compared using an in-house program written in MatLab 7.7 (Mathworks, USA).

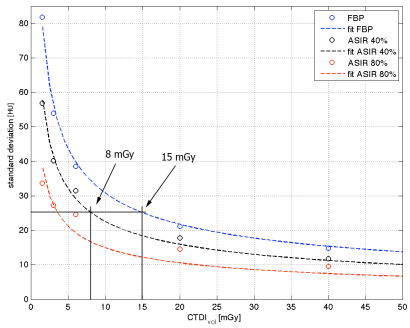

Figure 1: The standard deviation as a function of $CTDI_{vol}$ for different percentages of ASIR.

Results

Figure 1 shows the decrease of SD, when $CTDI_{vol}$ increases. For a fixed value of SD (σ = 25 HU), $CTDI_{vol}$ can be divided by 2 and up to 3.5 if 40% and 80% of ASIR are used, respectively. It can be shown that SD decreases linearly when increasing the percentage of ASIR and the benefit is higher at lower doses. For all reconstruction kernels, MTF medium frequencies were slightly improved whereas low frequencies and the cutoff frequency were not modified. Modifications of the NPS shape curve were observed as well. However, in spite of the global improvement of the image quality metrics, clinical images with more than ~50%-60% of ASIR were considered by radiologists to be unacceptable for diagnosis establishments. This is due to the global aspect of the image that tends to be artificial (image less realistic) for high ASIR percentage.

Discussion

The results of the present study indicated that the combination of the FBP and ASIR methods improve the image quality on phantoms by decreasing SD and increasing MTF as well as NPS. In clinical environment, however, 50% of ASIR is used because it produces the best trade-off between noise reduction and image aspect.

References

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