Purpose: To quantify for brain CT scans the image quality difference under various dose reduction and adaptive statistical iterative reconstruction (ASIR) blending options, and to find the optimal combination without experimenting on patients.

Materials and methods: An anthropomorphic phantom (Atom, CIRS) was utilized with inserts for low- and high-contrast resolution. The low-contrast insert has various sized spherical (2 – 10 mm, 1-2% contrast) and cylindrical (1.2 – 7 mm, 1-2% contrast) targets. The high contrast insert contains line pair targets (6 - 12 lp/cm). Axial scans were conducted using a GE VCT with settings 120 kVp, 1 sec rotation, and 5 mm thickness. The baseline was set at 280 mA (CTDI_vol = 54 mGy) without ASIR. Other protocols utilized a combination of dose reduction rates between 20% and 50% and ASIR blending between 10% and 50%. The contrast-to-noise ratio (CNR) was computed for the biggest targets. The contrast detailed analysis was also conducted. To compare spatial resolution, a rectangular ROI was applied to the 6 lp/cm target. The resulting standard deviation was used as a descriptor for spatial resolution.

Results:For each dose level, CNR improved linearly with ASIR blending fraction but spatial resolution decreased linearly albeit at a lower rate. As the dose was reduced to 33 mGy or less, the spatial resolution reduction rate increased significantly (50%) while the contrast improvement rate was relatively stable. At the same ASIR blending fraction, the images at the lower dose showed lower contrast and spatial resolution.

Conclusions:Applying ASIR improves low contrast but reduces spatial resolution. As compared to the baseline (54 mGy), the overall image quality may be at optimal at 43 mGy or 37 mGy with 20% or 30% ASIR. The image quality at 33 mGy or less is appreciably decreased. The analysis on the low contrast detectability showed similar results