ABSTRACT

Detection of low-contrast objects in computed tomography (CT) imaging remains a challenge due to the trade-off between image noise and spatial resolution. The use of an appropriate reconstruction kernel can enhance image quality without increasing patient dose. This study aims to analyze the effects of reconstruction kernel variation and object size on low-contrast detectability (LCD) in ACR CT phantom images using the two-alternative forced choice (2-AFC) method. The phantom was scanned using a Philips MX 16-slice CT scanner with the filtered back projection (FBP) reconstruction method and three soft tissue kernel variations: smooth (SA), standard (SB), and sharp (SC). LCD analysis focused on objects measuring 4, 5, and 6 mm in diameter. Each 2-AFC task provided two image options: one containing the object (correct answer) and one containing only the background (incorrect answer). A total of 100 multiple-choice items were created for each combination of kernel type and object size, resulting in 900 items in total (3 sizes × 3 kernels × 100 items). The 2-AFC items were then evaluated by three medical physicist observers with a minimum of 5 years of clinical experience. The 2-AFC output was the percent correct (PC) score. The results showed that both reconstruction kernel and object size significantly affected LCD. The PC score increased with larger object sizes and decreased with greater kernel sharpness. The SA kernel yielded the highest detectability, followed by SB and SC. For objects measuring 6 mm, the SA, SB, and SC kernels achieved PC scores of 84%, 75%, and 71%, respectively. Statistical analysis yielded a p-value > 0.05, indicating that inter-observer variability did not significantly influence the LCD outcomes. These findings underscore the importance of selecting an appropriate reconstruction kernel for optimizing LCD in clinical CT imaging.

Keywords: Low Contrast Detectability, 2-AFC, Reconstruction Kernel, Object Size, Noise.