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Optimization of Butterworth filter for brain SPECT imaging

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A method has been described to optimize the cutoff frequency of the Butterworth filter for brain SPECT imaging. Since a computer simulation study has demonstrated that separation between an object signal and the random noise in projection images in a spatial-frequency domain is influenced by the total number of counts, the cutoff frequency of the Butterworth filter should be optimized for individual subjects according to total counts in a study. To reveal the relationship between the optimal cutoff frequencies and total counts in brain SPECT study, we used a normal volunteer and ^{99m}Tc hexamethyl-propyleneamine oxime (HMPAO) to obtain projection sets with different total counts. High quality images were created from a projection set with an acquisition time of 300-seconds per projection. The filter was optimized by calculating mean square errors from high quality images visually inspecting filtered reconstructed images. Dependence between total counts and optimal cutoff frequencies was clearly demonstrated in a nomogram. Using this nomogram, the optimal cutoff frequency for each study can be estimated from total counts, maximizing visual image quality. The results suggest that the cutoff frequency of Butterworth filter should be determined by referring to total counts in each study.

Key words: single photon emission computed tomography, Butterworth filter, brain, optimization, computer simulation