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Simulating technetium-99m cerebral perfusion studies with a three-dimensional Hoffman brain phantom: Collimator and filter selection in SPECT neuroimaging

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The choice of a collimator and the selection of a filter can affect the quality of clinical SPECT images of the brain. The compromises that 4 different collimators make between spatial resolution and sensitivity were studied by imaging a three-dimensional Hoffman brain phantom. The planar data were acquired with each collimator on a three-headed SPECT system and were reconstructed with both a standard Butterworth filter and a Wiener pre-filter. The reconstructed images were then evaluated by specialists in nuclear medicine and were also quantitatively analyzed with specific regions of interest (ROI) in the brain.

All observers preferred the Wiener filter reconstructed images regardless of the collimator used to acquire the planar images. With this filter, the ultrahigh-resolution fan-beam collimator was the most subjectively preferable and quantitatively produced the highest contrast ratios. The findings support suggestions that higher resolution collimators are preferable to higher sensitivity collimators, and indicate that fan-beam collimators are preferable to parallel-hole collimators for clinical SPECT studies of cerebral perfusion. The results also suggest that the Wiener filter enhances the quality of SPECT brain images regardless of which collimator is used to acquire the data.

Key words: SPECT, collimator, filter, neuroimaging