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High-resolution Medium-sized Animal Multi-pinhole SPECT with Stationary Detectors

F. van der Have^{1,2,3}, O. Ivashchenko^{1,2,3}, H. C. Groen^{2,3}, R. M. Ramakers^{1,2,3}, H. During², F. J. Beekman^{1,2,3}; ¹Section Radiation, Detection & Medical Imaging, Delft University of Technology, Delft, NETHERLANDS, ²MILabs B.V., Utrecht, NETHERLANDS, ³Department of Translational Neuroscience, Brain Center Rudolf Magnus, University Medical Center Utrecht, Utrecht, NETHERLANDS.

Aim: Medium-sized animal SPECT is mostly performed with parallel hole or fan beam collimation (e.g. in adapted clinical brain SPECT devices) with a typical resolution of > 6 mm. We developed dedicated medium-sized-animal (MSA) SPECT based on pinhole collimation and the stationary detector set-up present in the U-SPECT+ system (MILabs, The Netherlands). Here we evaluate its imaging performance in phantoms and rabbits. **Methods:** The collimator consists of a 135 mm cylinder with 33 pinholes of 2.5 mm diameter that are positioned in three rings. The system's geometry information required for iterative image reconstruction was obtained with a scanning Tc-99m point source after which the system matrix was calculated by analytical ray tracing. Images were reconstructed using Pixel-based OSEM with compensation for distance dependent sensitivity and resolution recovery. The performance of the collimator was evaluated with resolution phantoms as well as *in vivo* rabbit [Tc-99m]-sestamibi cardiac and -DMSA kidney scans. **Results:** Image resolution in terms of rod visibility in a mini Jaszczak phantom was determined to be < 2.0 mm with Tc-99m. A DMSA kidney scan clearly shows the renal cortex structure with the renal pelvis opening readily visible. In both gated and static cardiac images the left ventricle wall including papillary muscles, and the right ventricle wall can clearly be distinguished. **Conclusions:** The new MSA collimator opens up new avenues for carrying out SPECT in medium-sized animals with unprecedented high levels of detail. A wide range of possibilities to non-invasively study models of disease in these animals comes now within reach.