System design and development of a pinhole SPECT system for quantitative functional imaging of small animals

Toshiyuki Aoi,*,** Tsutomu Zeniya,* Hiroshi Watabe,* Hossain M. Deloar,* Tetsuya Matsuda** and Hidehiro Iida*

*Department of Investigative Radiology, National Cardiovascular Center Research Institute
**Department of System Science, Graduate School of Informatics, Kyoto University

Recently, small animal imaging by pinhole SPECT has been widely investigated by several researchers. We developed a pinhole SPECT system specially designed for small animal imaging. The system consists of a rotation unit for a small animal and a SPECT camera attached with a pinhole collimator. In order to acquire complete data of the projections, the system has two orbits with angles of 90° and 45° with respect to the object. In this system, the position of the SPECT camera is kept fixed, and the animal is rotated in order to avoid misalignment of the center of rotation (COR). We implemented a three dimensional OSEM algorithm for the reconstruction of data acquired by the system from both the orbitals. A point source experiment revealed no significant COR misalignment using the proposed system. Experiments with a line phantom clearly indicated that our system succeeded in minimizing the misalignment of the COR. We performed a study with a rat and ^{99m}Tc-HMDP, an agent for bone scan, and demonstrated a dramatic improvement in the spatial resolution and uniformity achieved by our system in comparison with the conventional Feldkamp algorithm with one set of orbital data.

Key words: pinhole SPECT, complete data acquisition, small animal imaging