A new variable parallel holes collimator for scintigraphic device with validation method based on Monte Carlo simulations

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Abstract

The aim of this work is to show a new scintigraphic device able to change automatically the length of its collimator in order to adapt the spatial resolution value to gamma source distance. This patented technique replaces the need for collimator change that standard gamma cameras still feature. Monte Carlo simulations represent the best tool in searching new technological solutions for such an innovative collimation structure. They also provide a valid analysis on response of gamma cameras performances as well as on advantages and limits of this new solution. Specifically, Monte Carlo simulations are realized with GEANT4 (GEometry ANd Tracking) framework and the specific simulation object is a collimation method based on separate blocks that can be brought closer and farther, in order to reach and maintain specific spatial resolution values for all source-detector distances. To verify the accuracy and the faithfulness of these simulations, we have realized experimental measurements with identical setup and conditions. This confirms the power of the simulation as an extremely useful tool, especially where new technological solutions need to be studied, tested and analyzed before their practical realization. The final aim of this new collimation system is the improvement of the SPECT techniques, with the real control of the spatial resolution value during tomographic acquisitions. This principle did allow us to simulate a tomographic acquisition of two capillaries of radioactive solution, in order to verify the possibility to clearly distinguish them.