Purpose:
We examined the ability of a template-based method for partial volume effect correction (PVEC) to improve activity distributions inside tumors.

Methods:
We simulated oncology SPECT scans with an 80mL cylindrical object representing the tumor. This object was divided into two parts filled with different activities. In total, three cases with different activity ratios in those parts were considered and, correspondingly, the spill-in and spill-out between (i) tumor/background and (ii) parts of the tumor were modeled. We assumed that a structural imaging modality could be used to visualize the boundaries of our tumor-like object, but not the internal boundary between the parts of the object. From simulated SPECT acquisitions, we first reconstructed images by method M1 with corrections for attenuation, scatter, and resolution loss, portraying the most advanced reconstruction currently available in clinics. Secondly, we applied our PVEC technique M2, which iteratively updates activity both inside and outside the delineated tumor. This method takes into account that not only is the tumor affected by spill-out, but also the surrounding background is affected by spill-in.

Results:
Our PVEC effectively corrected for the partial volume effect by accurately modeling spill-in and spill-out through known “external” boundaries of the tumor-like object. In three considered cases, method M1 underestimated total activities in tumors by 5-21%. After applying PVEC, these errors ranged from 8% to 12%. Additionally, method M2 improved the activity distribution. The relative error of the voxelized tumor activity distribution was 21-26% for method M1 and 11-17% for method M2. However, as the borderline between tumor parts was unavailable, accurate restoration of activity in this zone could not be performed. This limitation becomes more pronounced as the ratio of activities in these two parts increases.

Conclusions:
Template-based PVECs can considerably improve not only the total activity, but also vozelized activity distributions in tumors.