

**Purpose:** Deformable image registration promises to solve the problem of co-registering images acquired at different patient positioning and has recently become clinically available. This study seeks to compare deformable registration with rigid body registration among FDG-PET/CT and CT images in the delineation of target volumes of head-and-neck cancers.

**Methods:** Eight patients with head-and-neck cancers were retrospectively selected based on the availability of FDG-PET/CT images acquired within one month of planning CT simulation. FDG-PET/CT, planning CT images, and the treated clinical target volume (CTV) were imported from ADAC Pinnacle into Velocity AI program where they were co-registered around the regions of CTV using rigid body transformation and multi-pass deformable registration respectively. Following rigid and deformable registrations of FDG-PET/CT with planning CT, gross tumor volumes (GTVs) were automatically generated using an adaptive threshold technique with FDG-PET and then the GTV-rigid and GTV-deformable of each patient were compared in terms of volume. The target centers of the GTV-rigid and GTV-deformable were calculated to measure the registration discrepancy.

**Results:** Deformable image registration significantly reduced the registration error due to different head and neck positioning between the planning CT acquisition and the FDG-PET/CT. We found that the volume of GTV-deformable increased by  $(5.2\pm 4.0)$  percent compared to those of GTV-rigid. We observed significant shape changes between the GTV-rigid and GTV-deformable. The center-of-mass shifts between the GTV-rigid and GTV-deformable are  $2.8\pm 1.7$  mm in the anterior-posterior direction,  $2.8\pm 2.7$  mm in the lateral direction, and  $5.2\pm 4.4$  mm in the superior-inferior direction.

**Conclusions:** Significant shape and positional changes of GTVs were observed in the comparison between rigid body registration and deformable image registration, although the volume of GTV changed very little between the two techniques. Further assessment is still needed such as volume and positional analysis of normal structures before the full implementation of the deformable image registration technique in the clinic.