Purpose:To evaluate the accuracy of automated contour deformation for head-and-neck cancer in adaptive treatment.

Methods:Data from 13 head-and-neck patients in a phase I trial for adaptive treatment were used. Adaptation was based on [18F]FDG-PET-guided dose painting by numbers (DPBN) plans. Each patient had two DPBN plans based on: (i) a pretreatment PET/CT scan and (ii) a during-treatment PET/CT scan acquired after 8 fractions. Contours manually drawn on the pretreatment CT scan were deformed using commercial deformable image registration software onto the during-treatment CT scan. Deformed contours of regions of interest (ROIdef) were visually inspected by an experienced radiation oncologist and, if necessary, adjusted (ROIdef_ad) and both sets of contours were compared to manually redrawn ROIs (ROIm) using Jaccard (JI) and overlap indices (OI). ROI indices and volumes were compared for all contour sets used a paired t-test and one-way ANOVA pairwise comparison, respectively.

Results:Almost all deformed ROIs in all patients required adjustment after visual inspection. The largest adjustments were made in GTVs when substantial tumor regression occured, e.g., ROIdef=9.2 cm3 vs. ROIdef_ad=2.2 cm3 vs. ROIm=2.1 cm3. The swallowing structures were the most frequently adjusted ROIs. The mandible was the most acurately propagated ROI requiring little or no adaptation: JI=0.7 and OI=0.8. The upper esophageal sphincter was the worst propagated ROI: JI=0.3 and OI=0.3 for the ROIdef, JI=0.5 and OI=0.6 for the ROIdef_ad. Despite the variation in indices, there was no statistically significant difference between ROIdef, ROIdef_ad and ROIm volumes. Generating ROIm took 4-6 hours, generating ROIdef took a few minutes and generating ROIdef_ad took less than 2 hours.

Conclusions:Deformable image co-registration followed by visual inspection does require adjustment of most deformed ROIs. Nevertheless, fast automatic ROI propagation followed by user-driven adjustments appears to be more efficient than labor intensive de-novo re-contouring.