Implications of Dental Artifacts on Radiotherapy Planning for Head and Neck Cancer

William A. Gray[1], Shreya Sekaran[2], James A. Tanyi[2], John M. Holland[2]

Departments of [1]Oral & Maxillofacial Surgery and [2]Radiation Medicine
Oregon Health & Science University, Portland, Oregon

Purpose

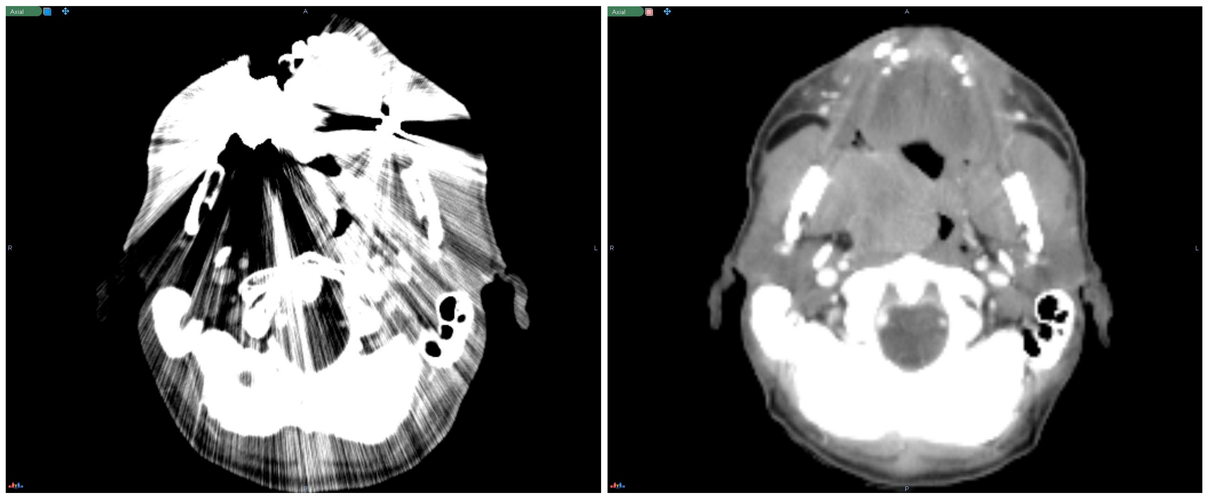
High density materials such as dental amalgams can lead to extensive streaking artifacts on computed tomography (CT) scans. These artifacts obscure the underlying anatomy, leading to uncertainty in the delineation of the target volumes and potentially compromising the integrity of the density representation that is crucial for accurate dose calculation. The purpose of the current study is to quantitatively evaluate of the effect of dental artifact on the delineation of target volumes and normal structures in treatment planning for head and neck cancers, and the ensuing dosimetric implications.

Materials and Methods

Three patients with pharyngeal carcinoma formed the basis of the current study. Each patient had two computed tomographic scans; a pre-extraction scan (with evidence of dental artifacts) and a post-extraction scan (with little or no streak artifacts). Each post-extraction image set (moving image) was deformably co-registered onto its corresponding pre-extraction CT (stationary image), allowing for auto-propagation of planning target volume and organ-at-risk (OARs) contours on the latter image set. Slices of the propagated contours were deleted at the level of the streak artifacts, termed the region of interest (ROI). Two physicians with experience in head and neck cancer delineated target volumes and OARs on these slices, with difference between them attributed to the presence of the artifacts. The Dice coefficient was used to quantify inter-observer variability in terms of contours at the ROI, as well as the entire contours of the selected organs. In addition, inter-observer dosimetric differences were quantified for both the ROI cases and the full contour scenario.

Results

Mean Dice coefficient difference between observers ranged from 1.3% to 13.4% when considering the entire contour set, and 13.8% to 64.3% when only evaluating the ROI. Inter-observer-induced mean dosimetric differences in mean target and OAR doses were as much as 7% (for the ROI) and 4.5% (when considering the entire contour). The largest discrepancies were observed in disease of the soft palate, and the least in disease of the base of the tongue.



Fiigure 1: Improved image quality from pre-dental-extraction (Left) and post-dental-extraction (right) scans

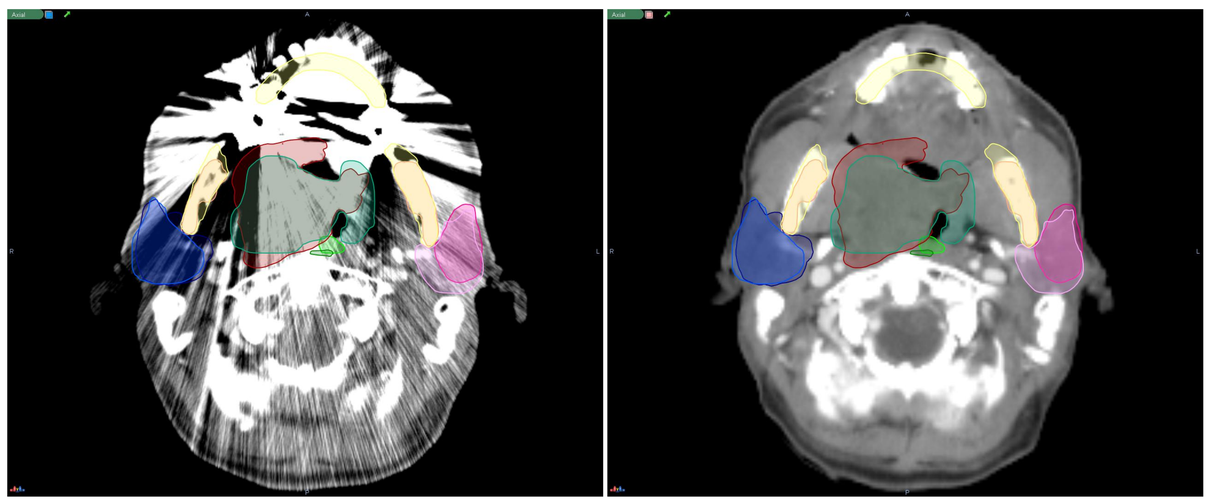


Figure 2: Artifact-induced observer variability; contours from pre-dental-extraction (Left) overlaid onto the post-dental-extraction (right) CT scan

Conclusion

Dental artifacts can affect physician target and OAR delineation accuracy with potential significant implications on therapy.

Knight Cancer Institute
at Oregon Health & Science University