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Assessing the robustness of normal tissue complication probability of head and neck treatment plans to contouring uncertainties

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Purpose
To assess the robustness of normal-tissue complication probability (NTCP) scores for xerostomia and dysphagia in treatment plans for head and neck squamous cell carcinoma (HNSCC) using volumetric modulated arc therapy (VMAT) and dynamic trajectory radiotherapy (DTRT) to contouring uncertainties.

Methods
In order to assess robustness of NTCP scores, an in-house developed software framework for flexible robustness assessment is extended to uniformly enlarge, shrink or shift contours of organs at risks (OARs). It is then connected to NTCP calculation using xerostomia and dysphagia models used in the Dutch indication protocol for proton therapy for HNSCC (LIPPv2.2, grade ≥ II and ≥ III, respectively). The software is applied to VMAT and DTRT treatment plans for two example loco-regionally advanced HNSCC cases with bilateral elective nodal irradiation (all sequential boost to 60/66/70 Gy in 2 Gy per fraction).
Robustness to systematic shrinking / enlarging of ±2 mm per contour and shifts of ±2 mm in all three directions of the OARs contained in the NTCP model is evaluated.

Results
Nominal (contours without shifts or size changes) DTRT plans for the two example cases score lower values compared to the respective VMAT plans for all investigated NTCP endpoints with up to -7.1% for xerostomia grade ≥ II for the first case. Deviations in NTCP scores were similar between cases (range 1.5% to 1.6% and 1.6% to 1.8%, respectively) and technique (range 1.6% to 1.8% for DTRT vs. 1.6% to 1.7% for VMAT). Larger deviations were observed for contour shifts (range 1.6% to 1.8%) compared to deviations resulting from size uncertainties (range 0.9% to 1.1%).

Conclusion
Software to assess NTCP robustness for HN cases to contouring uncertainties was successfully developed and applied to two cases. NTCP scores of both example HNSCC cases are less sensitive to systematic OAR contour shrinking / enlarging than shifts for the investigated uncertainties.

Disclosures
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