Evaluation of an almost-autonomous dosimetric workflow for the management of laryngeal cancer in radiotherapy

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Purpose/Objective:
In radiotherapy, numerous studies have demonstrated the individual performance of autosegmentation and autoplanning solutions in saving time and in reducing the inter-operator variability (IOV) with the aim of harmonizing the treatment plan quality [1-2]. However, the feasibility of an entirely autonomous workflow was rarely investigated. Taking into perspective the IOV in CTVn delineation, we evaluated the feasibility of an almost automatic dosimetric workflow for the management of laryngeal cancer using a commercial Deep Learning (DL) autocontouring solution (ART-Plan Annotate, TheraPanacea) and a preclinical version of autoplanning solution based on an a priori multicriteria-optimization (MCO) algorithm (mCyle, Elekta).

Material/Methods:
Ten non-operated head-and-neck cancer patients having received 70Gy to the macroscopic tumor and 54.25Gy to the CTVn in 35 fractions, using VMAT technique were selected for the study. Target contours of the clinical plans were manually delineated from scratch by an expert physician (P1), whereas organs-at-risk (OARs) were automatically contoured, and corrected. OARs and CTVn-levels were retrospectively delineated entirely automatically and used to generate automatic plans, whereby volumes having received 70Gy were copied from the clinical plans. In parallel, CTVnII-IVa-levels were also manually delineated from scratch by 4 other expert physicians. The IOV in CTVn delineation and the variability in experts' contours towards autocontours (MAV) was quantified by calculating dice score (DSC), surface DSC and 95th percentile-Hausdorff distance (HD95%). Dose differences between auto- and clinical plans calculated on the clinical contours were quantified for OARs and targets. Finally, the dosimetric impact of uncorrected versus corrected OARs and the dosimetric effect of IOV in CTVn delineation were evaluated on manual and auto plans.

Results:
HD95% and surface DICE results indicated significant differences across all physicians' contours ($p \leq 0.04$). Significant difference between the IOV and the MAV across all metrics was found ($p < 0.001$). Automatic plans optimized on uncorrected autocontours generally resulted in better OARs' sparing while providing a higher coverage of PTVn. The dosimetric impact of uncorrected versus corrected OARs was not significantly different on manual and auto plans (Fig.1.). The impact of the IOV on PTVn coverage was found to be amplified on auto plans with an increased inter quartile-range by 42.8% (Fig.2.).