

## ABSTRACT SUBMISSION FORM

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### PRESENTATION TITLE

**MR-based target definition for laryngeal cancer; The overall results of 8 years of research at the UMC Utrecht**

### AUTHOR(S)

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### ABSTRACT

**Purpose:** Target definition is the weakest link in the radiotherapy chain for head-and-neck tumours. It was the aim of this work to present the various successive optimisation steps in the definition of GTV, CTV and PTV for laryngeal cancer using MR imaging and quantify the combined results when applied in daily clinical practise.

#### Materials & Methods:

Dedicated MR protocols were developed for laryngeal cancer patients in their radiotherapy mask. GTV, CTV and PTV delineation was performed on these images and compared to the histopathology and the location of the actual tumour.

**GTV:** Delineations on pre-operative T1w, T1w-Gd, and T2w 1.5T MR images were compared to the delineations by head-and-neck pathologists on over 400 whole mount hematoxylin-eosin (H&E) stained slices of the specimen for 36 patients undergoing total laryngectomy. Overlap analysis between GTV<sub>MR</sub> and the tumour was performed and delineation guidelines were developed.

**CTV:** CTV margins dedicated for delineations on MR images were determined by analysing microscopically the extension of tumour cells outside the GTV<sub>MR</sub> in these specimen using H&E- and keratine-based staining.

**PTV:** The motion of the tumour was determined on 3T cine-MR images of 100 patients before treatment. Combined with the position verification results of 450 patients, a PTV margin accounting for both intra- and interfraction motion was determined.

#### Results:

**GTV:** Without dedicated guidelines, GTV<sub>MR</sub> overestimated the tumour volume by 90%. Guidelines for GTV<sub>MR</sub> delineations were developed: T2w or T1w-Gd signal intensity higher than that of the tumour bulk must not be included in the GTV. Volumes of strongly increased T2w signal intensity must not be

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included in the  $GTV_{MR}$ . By applying these guidelines, the overestimation of the tumour reduced to 50%.

**CTV:** Previously, a CTV margin of 10 mm was clinically applied. Using the new guidelines, microscopical analysis yielded that adequate tumour coverage (95% of the tumour contour covered for 95% of the patients) was obtained by applying a CTV margin of 6 mm.

**PTV:** A PTV margin of 6 mm was needed in cranial-caudal direction to compensate for intra- and interfraction motion. This margin was smaller than margin of 8-10 mm used clinically.

Combining the results of the various improvements in GTV, CTV and PTV definition, a reduction by approximately a factor of 2 was obtained in the volume of the PTV. This evidenced-based reduction of the volume receiving a high dose is obtained without compromising tumour coverage and directly results in a reduction of healthy tissue damage. All delineation procedures have been clinically implemented.

**Conclusions:** Accurate and evidence-based methods for GTV, CTV and PTV delineation for laryngeal cancer were developed and clinically introduced based on dedicated MR-imaging. The volume of healthy tissue receiving a high dose consequently reduced by a factor of two.



**Figure 1** Evidence-based GTV (red), CTV (blue) and PTV (green) contours for a T3N2c laryngeal tumour on a sagittal frame of a 3T cine-MR.