Deformable Image Registration implementation for contour propagation for Head and Neck adaptive radiotherapy

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Résumé

Introduction: To implement a deformable image registration (DIR) workflow for clinical routine use in adaptive radiotherapy (ART) for head and neck (H&N) cancers.
Material and Methods: This retrospective study included 30 patients with H&N cancers who underwent ART, with both initial and adaptive CT scans available (CT initial and CT ART). This study was divided in 3 main steps. Two DIR methods available in the MIM Maestro software were evaluated: the first method applying only the deformable image registration (DIR1), while the second method was based on the "Reg Refine" tool (DIR2), allowing the definition of regions of interest to improve the DIR. The performance of these methods in evaluating targets and organs at risk (OAR) was measured using quantitative metrics (MDA and DSC), complemented by additional qualitative validation. A dosimetric validation of the DIR method was also performed. Subsequently, a semi-automatic workflow was developed in the MIM software, followed by a visual validation by the H&N radiation oncologist specialist.

Results: The comparison between the two methods (DIR1 and DIR2) did not reveal significant differences in target volumes and OAR. The DIR1 method was chosen for its automated process and user-independent nature. The mean MDA and DSC values were below 2 mm and above 0.8, respectively, for most structures, aligning with the TG-132 recommendations (1). For target structures, lower metrics were attributed to the (dis)appearance of tissue and the use of alternate imaging modalities, such as MRI for nodal GTV during initial contouring. For OARs, differences were primarily due to variations in organ contouring between the initial and the adaptive CTs.

The mean dose difference between manually contoured structures and those generated using DIR1 did not indicate clinically significant discrepancies. Some extreme values were observed within the range, which can be explained by the issues described above.

Finally, the workflow was validated by the radiation oncologist, with most contours rated as "Acceptable Contour".

*Intervenant

Conclusions: The workflow developed based on the DIR1 method has been successfully integrated into clinical practice, enabling the automation of certain tasks in ART for H&N cancers. This implementation demonstrated its feasibility and usefulness, particularly by providing a significant time saving during the contouring phase.

References

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Mots-Clés: Adaptive Radiotherapy, Deformable Image Registration, Head and Neck Cancer.