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Evaluating a deep learning based 3D dose prediction model for quality assurance of organ at risk contours.

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Purpose: One of the recent methods to improve the efficiency, consistency and overall plan quality in radiotherapy is to use dose prediction. Based on prior experience of similar cases, deep neural networks can predict an achievable dose for a specific case. Instead of planning purposes, we are exploring the possibilities of using dose prediction in the QA of automatic segmentation. For this, we made a dose prediction model for the volumetric modulated arc therapy (VMAT) treatment of glioblastoma.
Methods: The data of 100 glioblastoma cases who received treatment at the InselSpital was collected. For all cases a VMAT plan was constructed according to a strict clinical dose prescription template. The resulting 100 dose distributions, the contours of the OARs and PTV and the planning CT were used to train the model. Training was performed in 3D on the OpenKPB dose prediction model [1]. Sixty cases were used for training and 20 cases each were used for validation and testing. The results of the predictions were compared with the reference plans on both the 3D dose score and the DVH score [1].
Results: The predictions of the test set had an overall 3D dose score of 0.906 ± 0.01 and a DVH score of 1.943 ± 0.04 , compared to the reference plans.
The worst results in the test set upon close examination where caused by irregular shaped targets that defy the physical limitation of the delivery technique, OARs overlapping with the target or planning inconsistencies of the reference plan.
Conclusion: With a carefully curated training set, the OpenKBP dose prediction model provides good predictions for VMAT glioblastoma treatment according to the clinical protocol that was used. Our next steps will be improve the training set to make predictions more robust to a broad range of scenarios.

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