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Thema: MRT in der Strahlentherapie

Titel: **Training and validation of an AI-based MRI auto-contouring method for pelvic organs**

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Text: Today, MRI plays an important role for MR-simulation, target volume delineation and most importantly real-time MR-guidance, where fast and reliable contour adaptation is crucial. Deep learning methods offer promising perspective for CT-auto-contouring, but so far, artificial intelligence (AI) based auto-contouring solutions for MRI are missing. The aim of this work was to train and validate a deep neural network for automatic contouring of T2w MRI in the pelvic region using ART-Plan (TheraPanacea, Paris, France).

Methods and Materials
ART-Plan is a CE-marked solution for automatic delineation of organs at risk (OAR) and targets in radiation therapy (RT) harnessing anatomically preserving deep learning ensemble networks. In this study, AI models were trained for pelvis T2w MR imaging data. The data set contained T2w MR data from 47 patients treated at a 1.5 T MR-Linac. For each patient, MR images of five different RT fractions were available (n=235). For each of these MRIs, rectum and bladder were offline manually delineated by two board-certified radiation oncologists (SB, MR). Anatomically preserving data augmentation was performed (mapping of the data to 4 reference anatomies), generating 940 training samples. A full end-to-end ensemble neural networks approach involving three steps was deployed: (i) a localization algorithm using affine registration to templates (ii) automatic delineation of anatomical structures through a unique combination of data-driven & decisional AI (iii) a winner takes all approach and enforces anatomical consistency. Multiple networks are trained using different template scans as reference space.

Ten additional, unseen MR data sets of were auto-segmented and evaluation of the contours was done by two radiation oncologists (SB, MR) using the following criteria: A (accepted), B (minor changes necessary), C (major changes necessary) or D (reject).

Results
A deep neural network for AI-based auto-contouring of pelvis T2w MR imaging data in ART-Plan was successfully trained and applied to a set of unseen MR data sets (n=10). Automatic generation of rectum and bladder contours for those patients was realized in a mean time of 15s.

Out of ten contours, seven rectum contours were accepted (70%) without changes, two would need minor (20%) and one major changes (10%). For the bladder contours, six of the AI-based contours were accepted (60%) as they were, two would need minor (20%) and two major changes (20%).

Discussion
To the best of our knowledge this is the first approach to AI-based automatic OAR segmentation of pelvis T2w MRI in the context of MR-guided RT. Despite the fairly limited size of the training cohort, the combination of decisional and data-driven AI leads to highly promising results for future AI-based real-time MR segmentation, which is one of most crucial steps in online MR-guided adaptive RT.

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