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Topic (read-only)

Brachytherapy: Gynaecology

Keywords (read-only)

brachytherapy, gynecology, auto-segmentation

Abstract title (read-only)

Performance Evaluation of an AI-Driven Auto-Segmentation Tool for MR-Based Cervical Cancer Brachytherapy Planning

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Purpose/Objective (read-only)

Manual delineation of organs-at-risk (OARs) for cervical brachytherapy is labor intensive, time consuming, and subject to inter-observer variability. Deep-learning auto-segmentation offers a promising alternative that can accelerate treatment planning, thereby reducing the time between applicator implantation and start of treatment. We quantitatively assessed the clinical performance of an automatic-contouring solution for MR-based brachytherapy treatments and compared it with expert-generated contours. A clinical acceptability assessment was then performed with two radiation oncologists (ROs).

Material/Methods (read-only)

annotated by ROs. A test dataset of 42 patients (independent cohorts from two centers, 25 patients from the same European center as the training data and 17 patients from another US center) was used to assess model performance. The quantitative evaluation was done by computing Dice (DSC) and Hausdorff distance 95 (HD95) metrics between expert-based ground truth contours and the AI-based automatic contours. A subset of 18 patients from the test dataset was used to assess the clinical acceptability of the contours through a qualitative review of two expert ROs. A three-point scale was used to assess the clinical acceptability of each contour predicted by the model: A/ Acceptable without modifications, B/ acceptable after minor corrections, and C/ not acceptable for clinical use.

Results (read-only)

The mean DSC and HD95 for all contours are summarized in Table 1, together with the results of the qualitative review. Three out of four OAR had a mean DSC ≥ 0.80 in the combined test dataset. Clinical acceptability (A + B scores) among the 2 experts reached 94% for bladder, 100% for rectum, 86% for sigmoid, and 92% for bowel. Figure 1 shows an example contour using the deep-learning algorithm compared to the ground truth contours.

	Quantitative metrics (Manual vs AI contours)						Qualitative evaluation of the AI contours
	Combined datasets		Dataset 1 (N=25)		Dataset 2 (N=17)		
OAR	Mean DSC	Mean HD95 (mm)	Mean DSC	Mean HD95 (mm)	Mean DSC	Mean HD95 (mm)	Mean (A%+B%)
Bladder	0.9±0.04	4.4±4.0	0.91±0.1	4.8±4.8	0.9±0.1	4.2±3.5	94%
Rectum	0.86±0.1	7.2±7.7	0.85±0.1	8.5±8.1	0.86±0.1	6.2±7.5	100%
Sigmoid	0.75±0.1	29.7±26.	0.79±0.1	28.3±31.3	0.72±0.2	30.6±23.	86%
Bowel	0.8±0.1	22.8±19.2	0.83±0.1	21.9±24.3	0.78±0.1	23.3±15.4	92%

Table 1: Quantitative and qualitative evaluation results

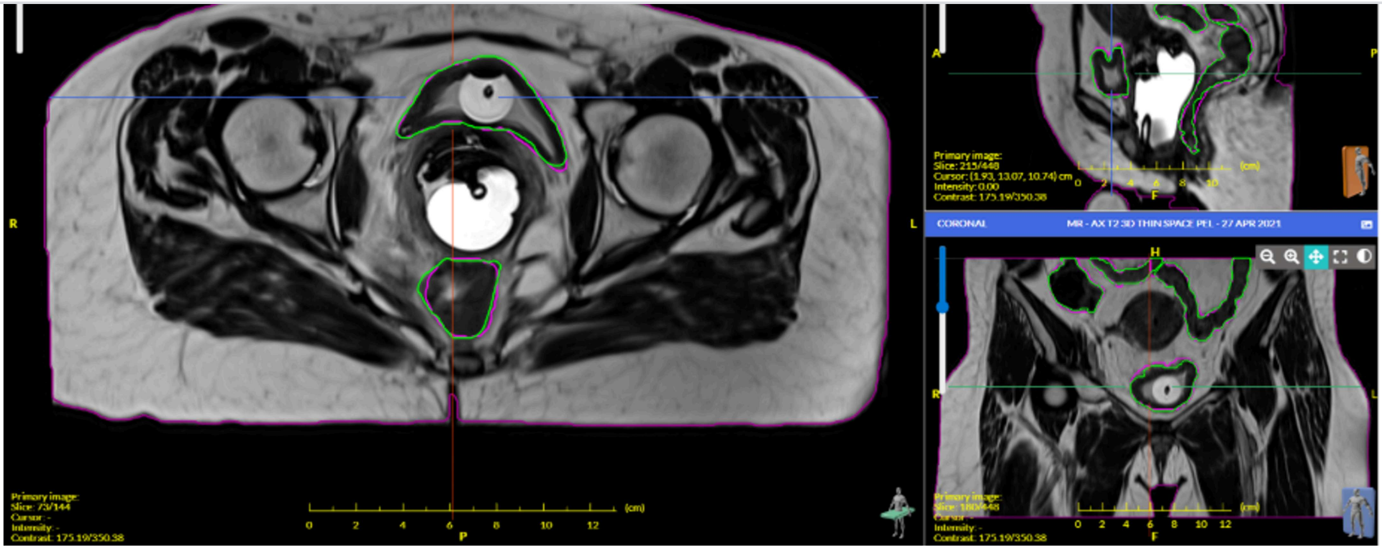

Figure 1. An example of manual contours in green and AI contours in pink

Conclusion (read-only)

The robust AI-driven auto-segmentation solution trained using MRI images from a single center delivers highly accurate, clinically acceptable contours for MR-based brachytherapy treatments. By automating this labor-intensive step, this tool may shorten the critical gap between MRI acquisition and treatment delivery, optimizing the most time intensive step of the treatment workflow.

References (read-only)

[1] Ronneberger O, Fischer P, Brox T. U-Net: Convolutional Networks for Biomedical Image Segmentation. In: Medical Image Computing and Computer-Assisted Intervention (MICCAI). Springer, Cham; 2015. pp. 234–241.

Conflict of Interest Disclosure (read-only)

- (selected) I do not have a Conflict of Interest to disclose.
- I do have a Conflict of Interest to disclose.

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