Abstract Overview

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

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Purpose

- Manual delineation of organs-at-risk (OARs) for cervical brachytherapy is labor intensive, time consuming, and subject to inter-observer variability.

Mat&Methods

- Structures: Bladder, rectum, sigmoid, bowel.
- Training N=327 MR T2 images with varied brachytherapy applicators (Vienna, Geneva, Ring, Venezia or personalized mold) from a single center in Europe.
- Testing N=42 patients from 2 centers (EU and US).
- Evaluation Metric : DICE, and HD95 & qualitative evaluation from 2 rad Oncs.

Results

- DSC: Bladder = 0.9, Rectum= 0.86, Sigmoid = 0.75, bowel = 0.8.
- Clinical acceptability after Physicis Review (with minor corrections):
  - Bladder 94%, Rectum 100%, Sigmod 86% and Bowel 92%.

Conclusion

- This tool may shorten the critical gap between MRI acquisition and treatment delivery, optimizing the most time intensive step of the treatment workflow.

- High geometric accuracy and clinical acceptability across datasets and applicator types.
  The AI tool achieves strong performance for OAR delineation in Cervical cancer Brachytherapy, with DSC up to 0.9 and clinical acceptability rates up to 100% after minor corrections. (Trained on diverse MRI data and validated on independent multicenter cohorts, showing consistent results across different clinical settings.)
- Reduces a critical workflow bottleneck.
  Automates a labor-intensive step, helping shorten the time between MRI acquisition and treatment delivery.

	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±26.8	0.79±0.1	28.3±31.3	0.72±0.2	30.6±23.9	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.

Internal