ESTRO

Abstract

Title

AI surpassing human expert: a multi-centric evaluation for organ at risk delineation

Authors

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Purpose or Objective

MRgRT treatment online planning and adaptation offers new perspectives for pelvic and abdominal radiation treatment (RT). It is associated with better soft tissue visualization, functional information about tumor proliferation, adaptation without additional toxicity at each RT fraction while enabling online target volume tracking capabilities. However, MR-Linac throughput is unfavorably compared with conventional RT delivery devices (factor of 3) since treatment adaptation and delivery sessions take 45min on average. Contouring of organs at risk (OARs) during replanning accounts in general to a third of this time. The aim of this study is to evaluate the feasibility of introducing an AI-based auto-contouring (AC) solution and compare its clinical acceptability to expert delineated contours.

Materials and Methods

ART-Net® is a CE-marked, FDA-cleared three stage anatomically preserving deep learning ensemble architecture for AC of OARs in RT. This architecture was trained for AC of pelvic OARs for ViewRay MRIdian® TrueFISP sequence based on a multi-centric cohort with delineations on 487 fractions. A multi-centric cohort of 30 unforeseen patients was used for testing whereby experts' contours used for RT delivery were blended with the ones delineated by ART-Net® at a 50%-50% ratio. Random blending at the patient level was performed guaranteeing that, among contours being evaluated per patient and OAR, the 50%-50% split was satisfied. Contours were scored as A/acceptable, B/ acceptable after minor corrections, and C/ not acceptable for clinical use.

Results

Overall clinical acceptability after aggregating blinded evaluations coming from 6 different centers for the combined categories (A+B) was 99% both for ART-Net® and experts' treatment contours. ART-Net® acceptability with respect to A (clinical usable without any modification) was at 79% while for clinical experts' contours acceptability was at 69%. The best performing structure for ART-Net® was the anal canal (96% of A), compared to the experts' anal canal (89% of A). The least performing structure for ART-Net® was the penile bulb (60% of A), compared to the experts' prostate (52% of A). Notable performance differences are observed: (i) in favor of ART-Net® for prostate (84% vs 52%), seminal vesicle (84% vs 55%) and rectum (71% vs 55%) and (ii) in favor of experts' delineations for penile bulb (66% vs 60%). Finally, ART-Net® outperformed human expert on seven structures, while human reader outdid ART-Net® in two structures.

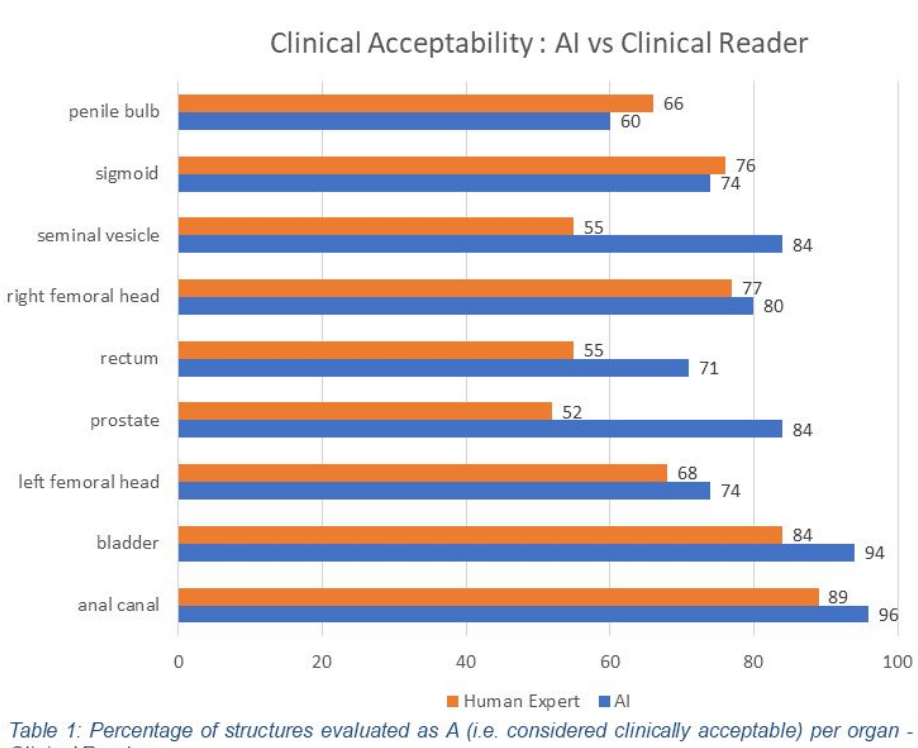

Table 1: Percentage of structures evaluated as A (i.e. considered clinically acceptable) per organ - AI vs Clinical Reader

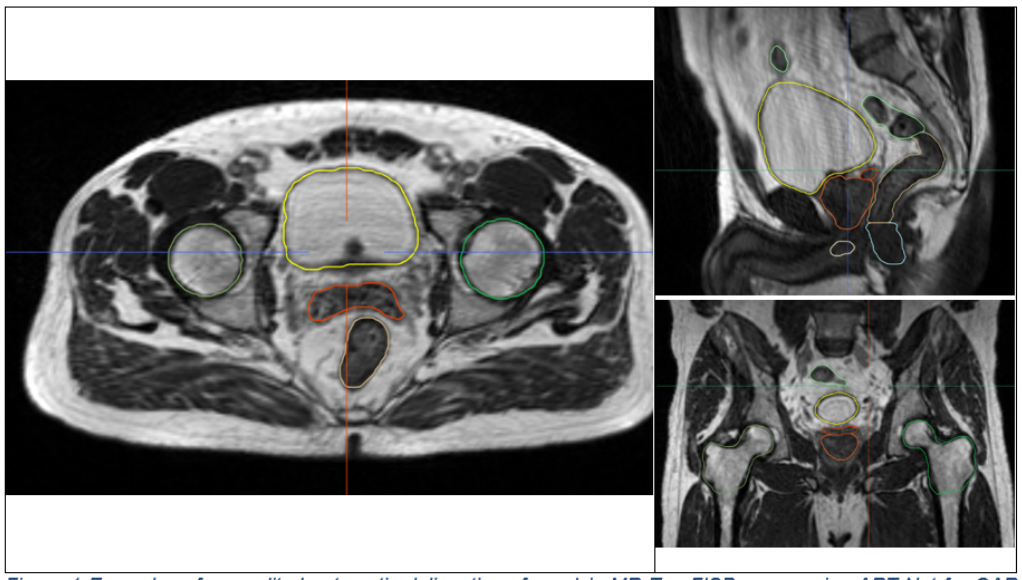

Figure 1 Examples of non-edited automatic delineations for pelvic MR TrueFISP scans using ART-Net for OAR delineation (bladder, rectum, penile bulb, sigmoid, seminal, vesicle, prostate, anal canal, left femoral head and right femoral head)

Conclusion

This work successfully evaluated the relevance of ART-Net® AC for adaptive MRgRT planning in the context of pelvic tumors treated with ViewRay MRIdian®. Our results suggest that ART-Net® can be a viable alternative to the human expert delineation as it consistently generates delineations with high clinical acceptability (higher even than contours by clinical experts) at a fraction of the time (less than 30 seconds as compared to 15min for the expert).

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