Clinical Implementation of AI-Generated Contours for Increased Efficiency in Radiotherapy Treatment Planning

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Background

In Radiotherapy planning, 'contouring' involves outlining organs on CT/MR images. Historically, this has been a manual and time-consuming process. Recent guidance has been published supporting the use of AI-generated 'auto-contours'.[1,2] In 2023, LTHT partnered with RaySearch Laboratories to help develop a commercial AI model. A multi-disciplinary team (MDT) safely implemented this novel technology into the clinic to help combat increasing workforce pressures.

Aims: (1) Evaluate the accuracy of AI contours. (2) Safely integrate AI technology into a complex clinical pathway. (3) Quantify workflow efficiencies.

STAGE 1

Contour Evaluation

A retrospective sample of 20-30 patients was selected for thorax, abdomen, head & neck treatment sites. AI contours were compared against gold standard manually drawn contours on CT images. Contour quality was assessed visually, geometrically (DICE), and dosimetrically (dose differences). AI contours were consistently geometrically accurate (DICE >0.7) and dosimetrically comparable (<2% dose difference). Occasional clinically significant differences were attributed to differences in contouring definitions (e.g. sup/inf extent of larynx), unusual anatomy, or imaging artefacts.

Lesson Learned: Numerical methods alone were not sensitive enough to capture all contouring failures. Visual assessment was most useful for identifying systematic differences between contours.

STAGE 2

Clinical Implementation

In 2024, AI-contouring was commissioned for thorax, abdomen, and head & neck. AI contours are checked and edited before use. Staff feedback has been positive. This was achieved via:

- Strong MDT approach to commissioning including Dosimetrists, Physicists, Clinicians.
- Clear documentation in the quality management system outlining guidelines for use and exclusion criteria.
- Training for staff on how to review and edit AI contours.

Lesson Learned: Radiotherapy planning is a complex clinical pathway with numerous steps. Managing the workflow changes required more time and effort than evaluating the AI contours.

STAGE 3

Post Deployment Monitoring

Pre- and post-implementation audits compared manual versus AI-assisted contouring times. Of 6550 patients treated in 2024, 4200 (65%) used auto-contours. Mean contouring time was reduced from 5-60 mins to 3-28 mins, saving approx.16.5 mins per patient (155 person-days annually). Greatest gains (>45 mins) were seen in Oesophagus and Liver cases.

Lesson Learned: Scripting was needed to automate additional tasks and preserve efficiency gains from auto-contouring.

AI Specific Challenges

(1) The model was developed with a diverse training dataset to improve accuracy for all patients.
(2) AI models can be prone to accuracy drift. Although our model is static, the input may change (e.g. new CT sequence). Our evaluation method can be easily repeated to provide post-deployment monitoring.
(3) Users trained on working with AI and spotting new contouring errors.

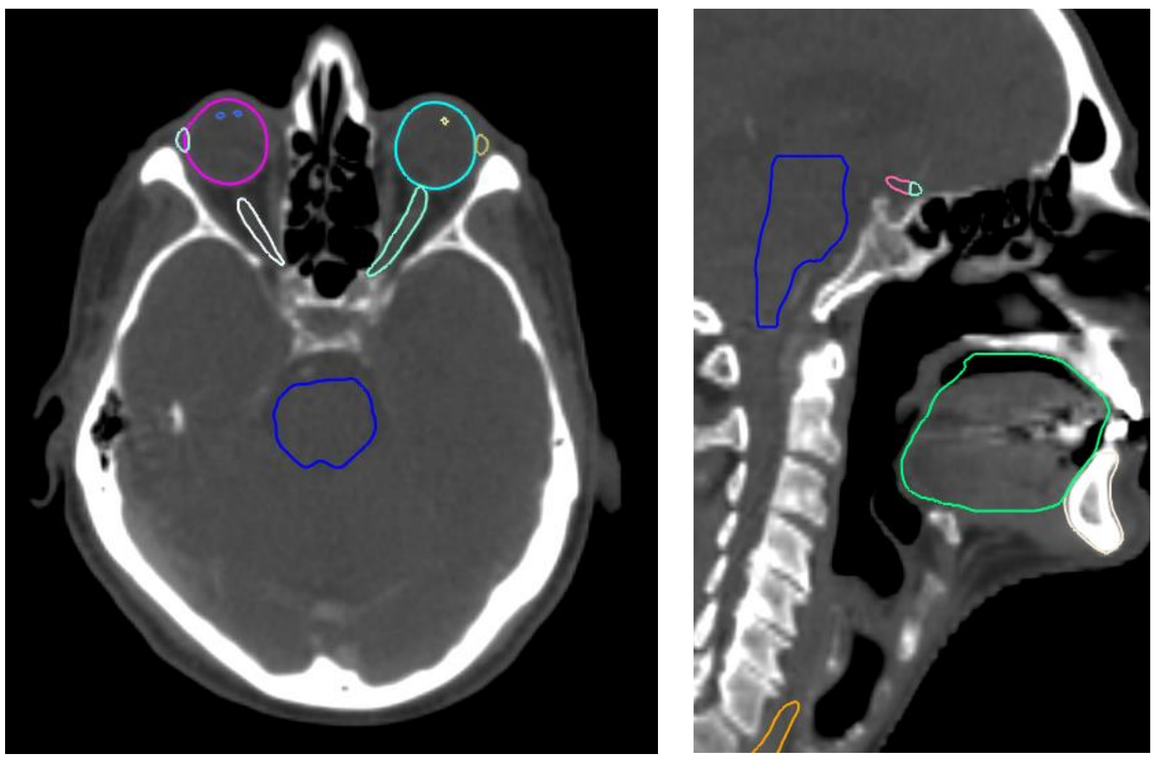

Fig 1. *AI-generated contours used to plan Radiotherapy for a patient with head & neck cancer.*

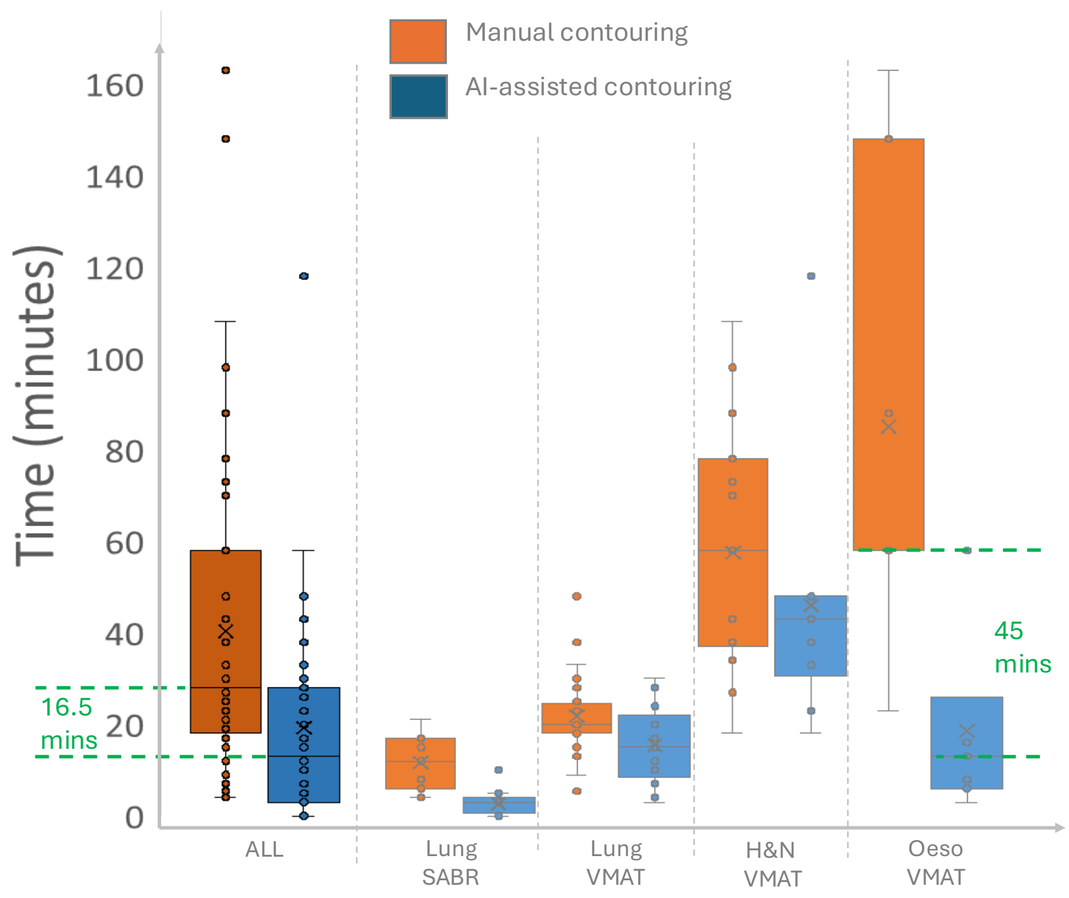

Fig 2. *Results of efficiency audit comparing contouring time pre- and post-implementation of AI-contouring for different treatment sites.*

References

[1] NICE. (2023) Artificial intelligence technologies to aid contouring for radiotherapy treatment planning: early value assessment. https://www.nice.org.uk/guidance/gidhte10015/ documents/draft-guidance.
[2] RCR. (2024) Clinical Oncology: Guidance on auto-contouring in radiotherapy. https://www.rcr.ac.uk/our-services/all-our-publications/clinical-oncology-publications/ auto-contouring-in-radiotherapy/

Conclusions - AI-contouring has been safely and successfully implemented into the Radiotherapy pathway. Increased efficiency has helped combat increasing workforce pressures and enabled staff to focus on higher-value aspects of patient care. Future work for the department includes expanding AI-contouring to additional sites (e.g. Pelvis) and working with commercial partners to develop auto-contouring for MRI images which are being used more frequently in Radiotherapy.

RaySearch Laboratories

NHS The Leeds Teaching Hospitals NHS Trust