Prospective In-Silico Quality Assurance Study of Contouring Target Volumes in Thoracic Tumors within a Cooperative Group Setting

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• No conflicts of interest to disclose
The goal of this study is to ascertain to what degree protocol modification can ameliorate target and organ-at-risk (OAR) delineation variance; a significant technical impediment in cooperative group trials which employ conformal radiotherapy protocols.
Outline

1. Research design
2. Results
3. Conclusions & Future directions
Four Pancoast tumor patients
Methods

• 17 SWOG-affiliated radiation oncologists were asked to plan 4 cases of Pancoast tumors as per pre-set protocol guidelines (Phase 1).

• Two patients had simulation 4D-CT and FDG-PET-CT while two patients had 3D-CT and FDG-PET-CT.

• Target, OAR, plan and dose data were collected centrally. Interim analysis was performed using quantitative software-assisted analysis of contour, dose and imaging data.
A modified protocol will be delivered to observers, and the planning process repeated with the modified instructions (Phase 2).
Phase I represents the user baseline function with the current RT guidelines.

Phase II: is designed to represent the user target delineation capabilities after exposure to modified RT guidelines, as well as an atlas-based OAR delineation educational intervention.
Data Submission Information

SWOG Data Checklists

Facility Survey: Please go to the IROC Houston website to update or complete a Facility Questionnaire.

SWOG Lung Target Delineation Project (the IN-SiLO study)

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SWOG Lung Target Delineation Project (the IN-Silico study)

Instructions
Survey

Planning Data Sets for download:
- Patient 1 (408 MB)
- Patient 2 (432 MB)
- Patient 3 (106 MB)
- Patient 4 (110 MB)

DVD available upon request

Downloaded data
Contours, plan and surveys submission
Definitions of deviation
Treatment planning & dose constraints
Target dose prescription guidelines
Target volumes/OAR definitions

QARC
QUALITY ASSURANCE REVIEW CENTER
Six board-certified thoracic radiation oncologists were designated as the ‘Expert observers’ for this study.
Their delineations were used to create a simultaneous truth and performance level estimation (STAPLE) contour which provides probabilistic estimate of the true delineation and a measure of the performance level represented by each expert user; using ADMIRE software (Elekta AB, Sweden 2017).
• Individual observer contours were then compared with expert’s STAPLE contours.
In-Silico imaging analytics
Imaging analytics: Evaluation metrics

- **Dice Similarity Coefficient (DSC):** a spatial overlap index and a reproducibility validation metric. The value of a DSC ranges from 0, indicating no spatial overlap to 1, indicating complete overlap between two sets of binary segmentation results.

- **Hausdorff metric:** gives the mean (Mean Surface Distance) or the largest length (Maximum Hausdorff Distance) out of the set of all distances between each point of a set (individual contour) to the closest point of a second set (expert composite).
When compared to Expert’s STAPLE, GTV_P had the best agreement among all observers with median DSC of 0.87 (range: 0.78-0.94), while GTV_N showed the lowest agreement with median DSC of 0.35 (range: 0.1-0.46).
Likewise, GTV_P demonstrated the lowest median HD & MSD values; 12.6 mm (range 10.1-17.7) and 0.37 mm (range 0.15-0.81, respectively.)
There were no statistically significant differences in all studied parameters for all TVs for cases with 4D-CT versus cases with 3D-CT simulation scans.
Conclusions

• High degree of inter-observer variation was noted for all target volumes except for GTV_P

• This unveils potentials for protocol modification for future SWOG IMRT studies.

• We are planning to expand these pilot data into a modified protocol that will be delivered to observers, and the planning process repeated with the modified instructions (Phase II). Statistical analyses will focus on estimation of potential radiotherapy plan quality improvement. (Phase II vs Phase I)
Future directions: Phase II

By defining and streamlining such a process, future SWOG IMRT studies could execute time-efficient credentialing/QA efforts.
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