Improving radiotherapy workflow through implementation of delineation guidelines & AI-based annotation

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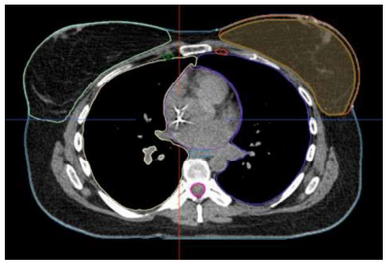
PURPOSE/OBJECTIVE(S)

- Incidence of breast cancer is increasing as the number of radiotherapy treatments.
- Delineation of target volumes and organs at risk (OARs) is time-consuming and suffers from expert variability.
- The objective of this work was twofold:
  - **assess the benefit of ESTRO delineation guidelines proposed in 2015 (1)**
  - **assess the added value of the use of an AI-driven delineation solution in terms of quality and resource gain.**

MATERIAL

- A **CE-marked solution for automatic delineation** of 80+ organs at risk and target volumes harnessing a unique combination of anatomically preserving and deep learning delineation concept was developed (Annotate)
- Using transfer learning **the model was re-trained according to the latest ESTRO guidelines (1)**, through the integration of 256 cases randomly selected from the HYPOG-01 trial (2) (Figure 1).

Figure 1. Edited automatic delineation by Annotate



METHODS

- **One hundred** unseen cases were selected for evaluation: **50 cases were delineated based on the ESTRO guidelines (C1) and 50 cases were delineated before guidelines implementation (C2) by experts.**
- For each case, **automatic delineations (AD) were generated** and blended with the ones corresponding to the experts for qualitative and independent evaluation. **33% of AD structures, 33% of manual structures from C1 and 33% of manual structures from C2** were scored by 4 radiation oncologist breast experts as A for "No correction required", B for "Minor correction required" and C for "Major corrections required" (Figure 2).
- **C2: Correction effort** towards moving AD to clinically-acceptable target volumes and OARs (heart, lungs, spinal cord, esophagus and thyroid) were measured.

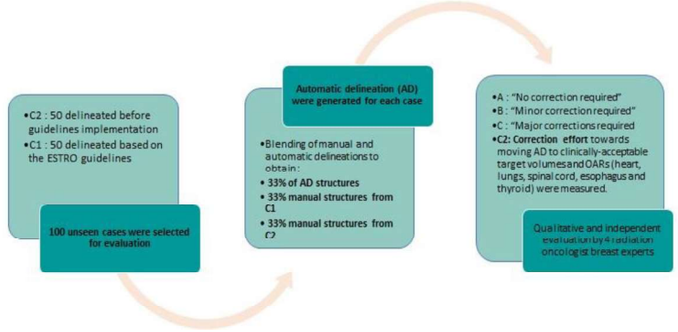


Figure 2. Methods of the study

SUMMARY/CONCLUSION

- This systematic, blinded, random evaluation suggests that using AD in breast cancer has **high potential for delineation guidelines propagation, homogenization of practices and time saving.**
- Only minor corrections were required, showing the clinical relevance of the developed AI-based software.

REFERENCES

1. Offersen B, Boersma L, ESTRO consensus guideline on target volume delineation for elective radiation therapy of early stage breast cancer, Radiotherapy&Oncology 114(2015) 3-10

2. ClinicalTrials.gov Identifier: NCT03127995

RESULTS

- **Significant gain was observed on expert delineations between C1 & C2 (Figure 3).** Some OARs were not delineated before guidelines implementation such as thyroid, esophagus and liver.
- The delineations of experts were assessed **clinically acceptable (A+B) for 93% of C1 cases, while the percentage ramped down to 83% in C2 (Figure 3)**.
- **93% of the AD in C1 & C2 were considered as clinically acceptable** (A: 49%; B: 44%), reaching human expertise **(Figure 4)**.
- **All target volumes were better scored with AD** (92% and 94% of A+B for breast and nodes for AD vs. 86% and 87% respectively for manual delineations).
- **Spinal cord, lungs and thyroid were better scored using AD**
- **35% of the AD brachial plexus required major corrections** (13% for the manual ones).
- **The mean time to correct an AD case was 2.6±1.9 min** (4.3±1.6 min for cases with nodal treatment; 1.8±1.0 min without).

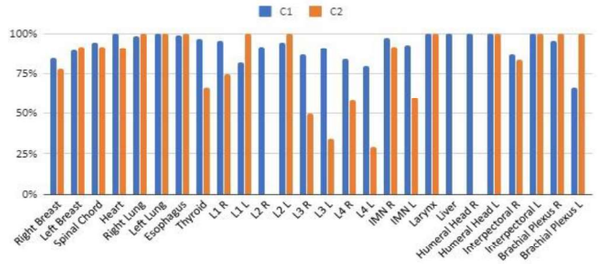


Figure 3. Percentages of clinically acceptable (A + B) manual delineations of OARs and target volumes before (C2) and after ESTRO recommendations (C1)

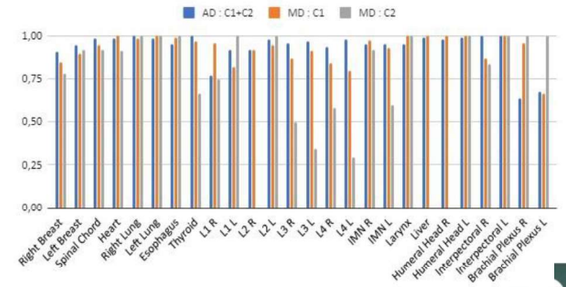


Figure 4. Percentages of clinically acceptable delineations of OARs and target volumes: MD in C1 versus MD in C2 versus AD (C1&C2)

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