Deep Learning Segmentation of Cardiac Substructures in Breast Cancer Radiotherapy Patients

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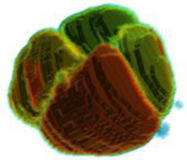
Background

- Measuring dose to cardiac substructures is critical for better understanding cardiotoxicity due to radiation therapy.
- Manually delineating non-contrast planning CT images can be time and effort consuming
- Aim: To develop and evaluate deep learning (DL) based auto-segmentation of cardiac substructures from non-contrast planning CT images in patients undergoing breast cancer radiotherapy.

Methods

Dataset: Nine substructures were delineated by physician on non-contrast CT images of 50 patients with breast cancer

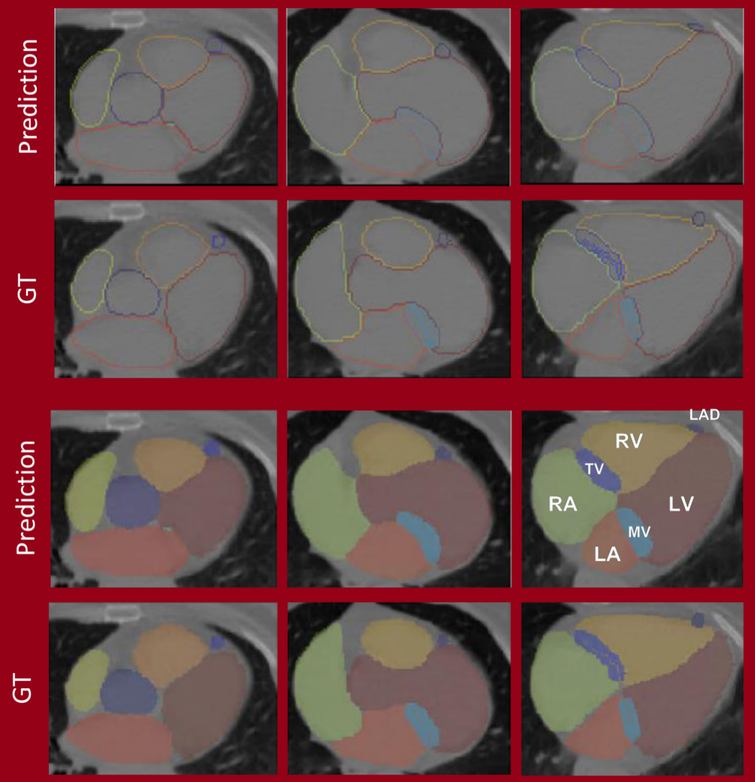


3D U-Net embedded with residual blocks was used for deep learning training

Data augmentation was implemented including rotation, shifting and zooming

Multiple loss functions were investigated

Automatic delineation of cardiac structures using deep learning is similar to physician's manual delineation



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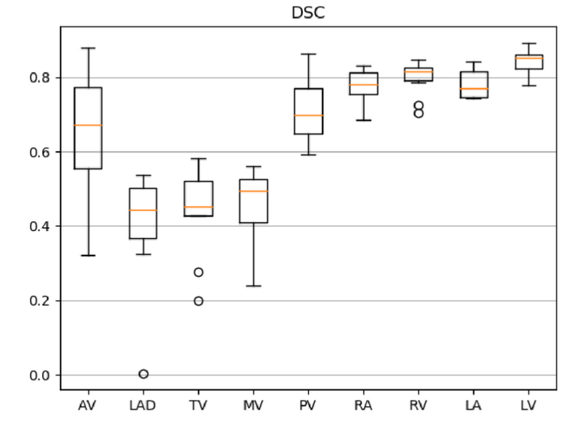
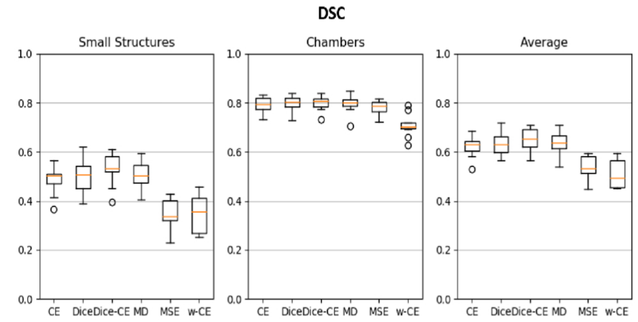
Automatic segmentation results – accuracy and volume similarity





- AV: aortic valve, LAD: left anterior descending artery, TV: tricuspid valve, MV: mitral valve, PV: pulmonic valve, RA: right atrium, RV: right ventricle, LA: left atrium, LV: left ventricle

Conclusions

- DL provides a fast and accurate segmentation of large cardiac substructures in non-contrast CT images, although performance for smaller structures was dependent on choice of loss function. Evaluation of clinical acceptability and integration into clinical workflow are pending.

References

- Morris, E. D. et al. (2019). Cardiac Substructure Segmentation with Deep Learning for Improved Cardiac Sparing. *Medical Physics*, mp.13940. https://doi.org/10.1002/mp.13940

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