Evaluation of MR-Linac Delta-Radiomics Features As Predictors of Response In Hepatocellular Carcinoma

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INTRODUCTION

- Day-to-day pre-treatment imaging is available with use of an MR-linac
- Radiomics features are quantitative imaging biomarkers with spatial characterization of intratumor heterogeneity
- Radiomics feature have been shown to change over the course of treatment due to the introduction of radiotherapy
- Delta-radiomics investigates the changes of radiomics features over time
- Delta-radiomics features may be identified that are predictive of response
- If changes in radiomics features are predictive of response, treatment can be adapted early on

AIM

The aim of this work was to build, validate, and compare delta-radiomics models in patients with hepatocellular carcinoma (HCC) treated on an MR-linac

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METHODS

- 44 metastases total from 35 patients with HCC
- Each were treated with 5 fractions of radiotherapy using the MR-linac (Viewray)
- 0.35T MR images acquired pre-treatment for every fraction
- 43 first- and second-order radiomics features were extracted from each of these images
- Delta-radiomics features were calculated between each fraction of treatment (% change)
- Features were calculated with various pixel expansions of the GTV volume to account for possible delineation issues
- Delta-features were fed into a random forest feature selection algorithm to determine which were most associated with response
- Cross-validated logistic regression models were created with top selected features versus local response (mRECIST)
- ROC curve analysis used to assess the discriminative performance of each model

RESULTS

- Feature selection was variable across pixel expansions and delta-pairs
- Certain features were ranked, on average, very highly for certain datasets
- The feature with the highest average ranking among all data sets was GLCM Homogeneity
- This top feature reached AUC > 0.80 for some data sets
- AUC performance was variable across all pixel expansions and delta-pairs

RESULTS

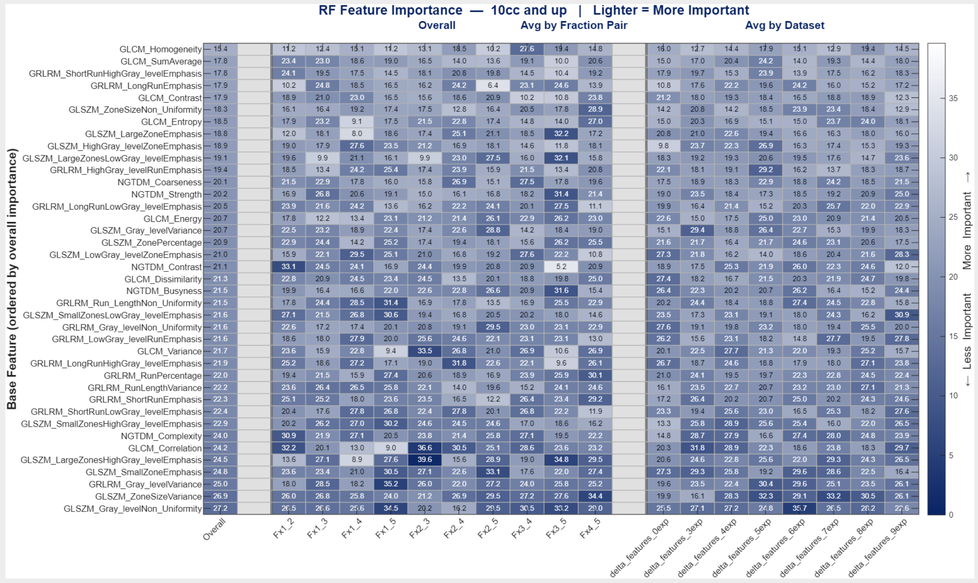

Figure 1: Average delta-radiomics feature ranking across all data sets. Far left is averaged across all datasets. Middle block is averaged across all pixel expansion for each delta-pair. Right block is averaged across all delta-pairs for each pixel expansion.

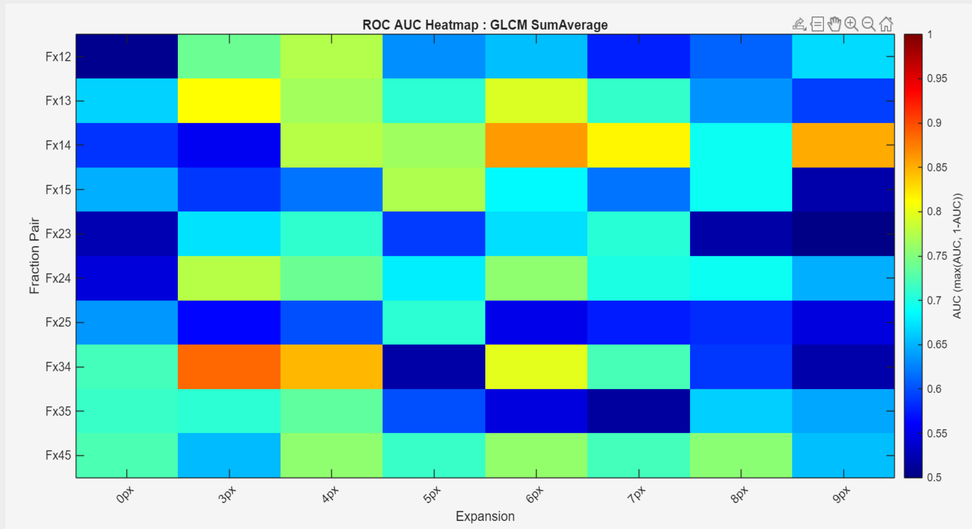

Figure 2: Average AUC heatmap for GLCM SumAverage models for each fraction pair and pixel expansion.

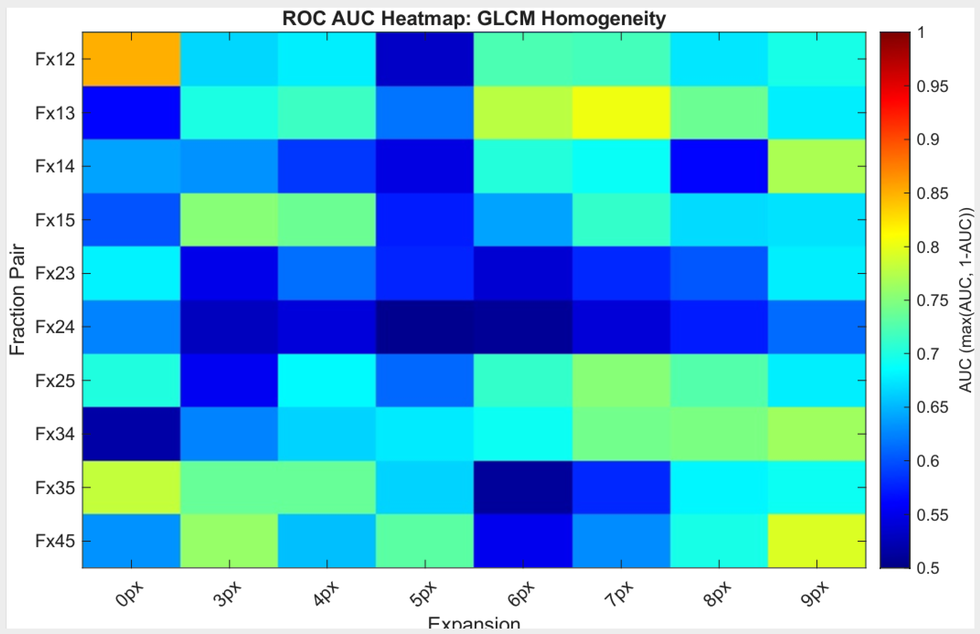

Figure 3: Average AUC heatmap for GLCM Homogeneity models for each fraction pair and pixel expansion.

DISCUSSION

- It is possible to identify delta-radiomics features that are consistently predictive over the course of treatment
- The size of GTV volume contours had a significant effect on feature selection ranking and AUC performance
- Some delta-radiomics features exhibited modest predictive performance of response over the course of treatment
- These results may not be reproducible on other machines
- More work is necessary to determine which features are most relevant to prognosis

CONCLUSIONS

- There is value in investigating delta-radiomics for response prediction in HCC
- Delta-radiomics features need to be studied further to try and expand their robustness and reproducibility

REFERENCES

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2. Cousin, F., et al., *Radiomics and Delta-Radiomics Signatures to Predict Response and Survival in Patients with Non-Small-Cell Lung Cancer Treated with Immune Checkpoint Inhibitors.* Cancers (Basel), 2023. **15**(7).

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