Evaluation of the Stability of Radiomic Features of Non-Radiated Organs utilizing the RefleXion X1

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Introduction

- Non-Contrast CTs obtained normally during treatment lack sufficient quality for effective radiomic analysis.
- New linear accelerators like ReflexionX1 could possible enable radiomic analysis throughout the entire treatment process
- To best utilize the high-quality scans of RefleXion X1 for radiomic analyses of cancerous tissue, radiomic features that remain consistent through treatment in normal organs must first be identified.
- Stable features can be used for normalization to calculate radiomic features in tumors, enabling monitoring of response during treatment and early adaptation if required.

Methods and Materials

- Five patients underwent scanning with RefleXion X1 throughout their treatment.
- Evaluation of repeatability in non-irradiated organs: Liver, Spleen, Heart, and Spinal Cord.
- Evaluation was done looking at intraclass correlation coefficient (ICC) used with a 2-way mixed-effects model to measure repeatability and concordance correlation coefficient (CCC) employed to measure reproducibility.
- Stable features were defined as those with high ICC and CCC

Conclusion

- Radiomic analyses of cancerous tissue using RefleXion X1 imaging over the course of treatment would be feasible and might be useful as an ongoing assessment of response of treatment, thereby enabling personalized adaptive approaches. Future research can be done regarding these features to better understand how they change in tumors throughout treatment to better individualize treatment plans.

Results

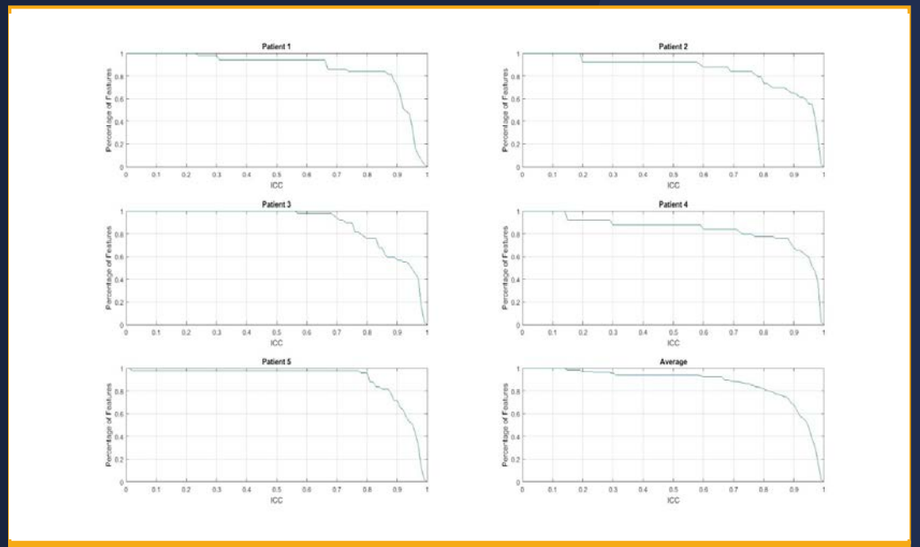

Figure 1: Individual and cumulative histogram demonstrating percentage of features with a certain ICC Level.

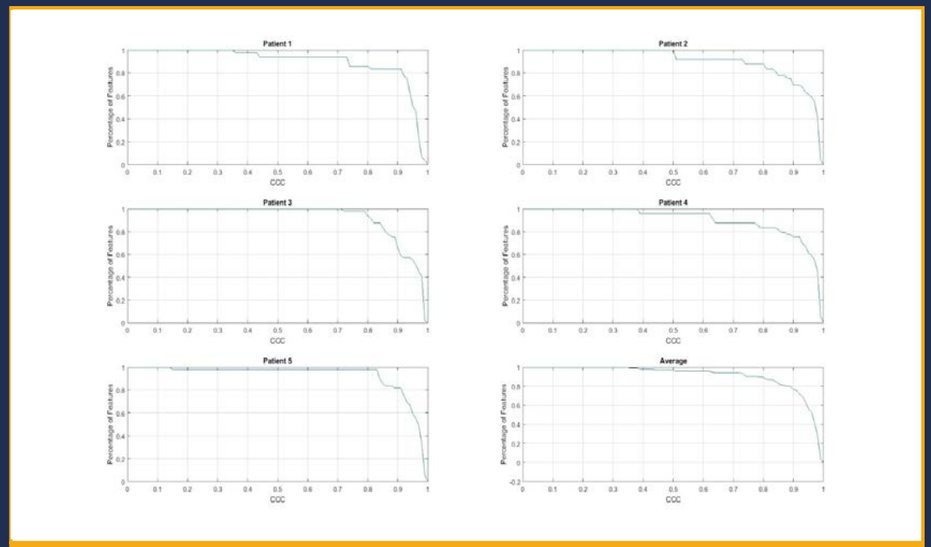

Figure 2: Individual and cumulative histogram demonstrating percentage of features with a certain CCC Level.

- Initial values of ICC and CCC were both individually evaluated to 49 separate radiomic features. These were then averaged out across the 5 patients.
- Of these 49 features, there were 40 features with an average ICC >0.8, noted as high repeatability
  - From these features, there were 29 features with average ICC >0.9, noted as very high repeatability
- These were done again with CCC comparing the mean of each feature (defined as the gold standard to minimize variance) to each individual fraction. Of these 49 features, there were 42 features with an average CCC >0.8, noted as high reproducibility
  - From these features, there were 34 features with an average CCC >0.9, noted as very high reproducibility

- Stable features were defined as those with ICC and CCC values both >0.8, Highly stable features were defined as ICC and CCC values both >0.9
- ICC was noted as the key limiting factor, with all ICC values >0.8 having CCC values also >0.8. As such, the same ICC values were used to identify the stable features.
- 82% of features were identified as stable accounting to a total of 40 features identified.
- 59% of features were identified as highly stable accounting to a total of 29 features identified.
- Stable features included 7 Conventional,10 discretized, 7 GLCM, 3 NGLDM, 7 GLZLM, 6 GLRLM
- Highly stable features included 5 conventional, 10 discretized, 7 GLCM, 3 NGLDM, 4 GLZLM, 3 GLRLM

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