**ABSTRACT SUBMISSION FORM**

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**PRESENTATION TITLE**

**Assessment of the stability of radiomic features in rectal cancer using test-retest MRI**

**AUTHOR(S)**

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**ABSTRACT**

**Purpose:**
Radiomics is the extraction of data from routine clinical imaging based on imaging features such as shape, texture and histogram distribution. There is growing interest in using standard of care rectal cancer scans from MRI to extract radiomic features, which may have the potential to give greater insight into tumour heterogeneity with the aim of predicting tumour response and treatment outcome (1). The aim of this study is to assess the reproducibility of radiomic features with test-retest measurements in rectal cancer patients and validate high performing features with repeat measurements in a phantom.

**Materials & Methods:**
Five patients with confirmed rectal adenocarcinoma were scanned in their radiotherapy planning position on MRI followed by a repeat scan after 10 minutes in the same position. The standard of care imaging protocol included a T2 weighted (T2-w) turbo spin echo (TSE) sequence which was used for radiomic analysis. A radiation oncologist contoured the CTV on both repeat T2-w sequences (Fig 1).

The CTV contour was analysed in MATLAB, and 76 radiomic features were calculated including first order statistics, shape and size, and various textural features from the GLCM, GLRLM, NGTDM and GLSZM. Lin’s Concordance Coefficient Correlation (CCC) test was performed to measure the reproducibility and stability of radiomic features in the repeat datasets (n=10). Features that returned an Rc (CCC) of ≥ 0.9 were considered to have an almost perfect strength of agreement (2). These features were further evaluated in a phantom, by measuring the coefficient of variation (COV) between repeat scans (n=4) at two time points. The phantom was designed in AutoCAD (Autodesk, 2017) (Fig 2) with varying shape and textural components and 3D printed in Polylactic acid and the
whole assembly set in gelatine. Repeat scans and analysis of three different regions of interest (ROIs) was performed in the phantom to assess the reproducibility and stability of features using the in vivo imaging protocol (T2-w TSE).

**Results:**

1. **In vivo Test-Retest**

Thirty five features returned an Rc of > 0.9 in the test-retest in vivo MRI scans. Twenty three features had substantial agreement (Rc = 0.8-0.9), 12 had moderate agreement (Rc = 0.65-0.8) and 6 had poor agreement (Rc < 0.65). The best performing feature for texture was GLCM - Long Run Low Gray Level Emphasis (LRGLE) with an Rc of 0.985 and 95% CI 0.915-0.998. Compactness 1 performed best out of the shape and size features with an Rc of 0.984 and 95% CI 0.924-0.997 and minimum and entropy performed best from first order statistics with an Rc (95% CI) of 0.999 (0.998-1) and 0.952 (0.741-0.991) respectively.

2. **Phantom Test-Retest**

Figure 3 shows the COV of the highest performing features from test-retest imaging in three ROIs in the phantom. COV varied depending on the ROI analysed with increase in variation for ROI 3 for the majority of features. GLCM-IDMNC had the least variation for the ROI 1, 2 and 3 with a COV of 0.08%, 0.34% and 0.68% respectively. GLCM-Cluster shade had the greatest amount of variation for the ROI 1, 2 and 3 with a COV of 3.29%, 34.87% and 61.05% respectively.

**Conclusions:**

We have shown that there can be highly varied results in radiomic features using the imaging sequence. Radiomic analysis for rectal cancer using MRI appears feasible however care must be taken when selecting features for the purposes of quantitative evaluation of tumour heterogeneity.

**References:**