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# Baseline Radiomics Model Outperforms RECIST and Clinical Biomarkers in Stratifying Overall Survival in HNSCC Patients Receiving Standard-of-Care Immunotherapy

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## Introduction/Background

Standard-of-care (SOC) immunotherapy (IO) for head and neck squamous cell carcinoma (HNSCC) demonstrates limited efficacy, and current clinical biomarkers such as PD-L1 inadequately predict treatment benefit. Radiomic features extracted from routine imaging offer a non-invasive, quantitative window into tumor biology and biomarkers for precision oncology. We evaluated the performance of a radiomic model for overall survival (OS) prediction.

## Methods/Intervention

From a real world multimodal dataset of 100 HNSCC patients (96% male; mean age: 55 years; mean BMI: 22.6; ChemoIO: 85, IO only: 15), we used a cohort of 69 patients with OS information available, treated primarily with pembrolizumab or nivolumab ± chemotherapy in the first-line setting. Primary lesions were manually annotated and a segmentation model was applied to isolate adjacent tumor vasculature. Baseline radiomic features—including shape, texture, and quantitative vessel tortuosity (QVT)—were extracted using the Picture Health Px Platform. Features were grouped into clusters and used to train OS prediction models via cross-validation. Model performance was compared against PD-L1 CPS and RECIST 1.1 assessed at the second scan.

## Results/Outcome

The radiomic model identified a radiomic high risk group with superior prediction performance (HR = 2.63, p = 0.01) compared to PDL1 (CPS) non-high (HR = 1.25, p = 0.51) and non-response (SD and PD) per RECIST (HR = 1.96, p = 0.02), shown in Figure-1. Radiomic feature clusters selected for the model captured macroscale homogeneity, tissue structural heterogeneity and shape, as well as local texture variations and focal heterogeneity. Notably, radiomics captured risk stratification at baseline, prior to treatment initiation, unlike RECIST which relies on follow-up imaging.

## Conclusion

We developed a baseline radiomic model from CT scans outperforming RECIST and established clinical biomarkers in predicting survival for HNSCC patients receiving SOC IO. These findings highlight the potential of baseline radiomics as a scalable tool for early risk stratification, enabling identification of patients unlikely to benefit from standard immunotherapy upfront—thereby guiding more personalized treatment decisions and prioritizing high-risk individuals for alternative interventions.

## Statement of Impact

Our baseline radiomic model from routine CT scans outperforms RECIST and clinical biomarkers in predicting survival in HNSCC, enabling early, non-invasive risk stratification for personalized treatment.

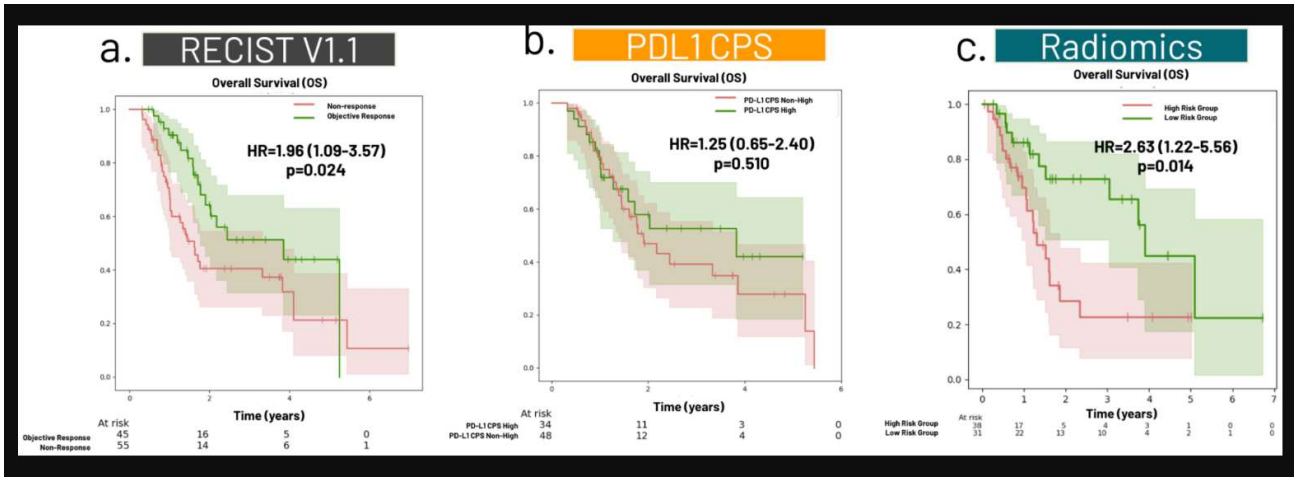


Figure 1. Performance of RECIST, PD-L1 status, and the Radiomic signature in predicting OS.

**Keywords**

Head and neck squamous cell carcinoma; Biomarkers; Artificial intelligence; Signature development