

PhD Dissertation Title: ^{18}F -FDG PET/CT Based Radiomics For The Prediction Of Radiochemotherapy Treatment Outcomes Of Cervical Cancer

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ABSTRACT:

Cervical cancer remains the third most commonly diagnosed gynecological malignancy in the United States and throughout the world despite being potentially preventable. Patients diagnosed with cervical cancer may develop local recurrence in the cervix and surrounding structures (vaginal apex, parametrial, or paracervical), regional recurrence in pelvic lymph nodes, distant metastasis, or a combination of all. The management of such treatment outcomes has not been subject to rigorous investigation. Therefore, there is a need for studies and clinical trials that focus on decision making to support the choice of the best treatment modality that leads to the minimal number of adverse treatment outcomes.

Medical imaging plays a vital role in the initial diagnosis, staging, and guiding treatment decisions for cancer patients. Positron Emission Tomography-Computed Tomography (PET/CT) hybrid scanner has proven to be a primary functional imaging modality in the oncology clinic. A typical oncological application of PET/CT aims to examine the whole body for high tracer uptake as a sign of tumorous lesions or metastasis using ^{18}F -Fluoro-2-deoxy-D-glucose (^{18}F -FDG). This radiopharmaceutical has been proven to be useful for the quantitative determination of regional glucose metabolism localized in the brain, heart, bladder, and, fortunately, in tumors. Currently, ^{18}F -FDG measured on PET is the prominent radiotracer in cancer staging and follow-up imaging.

In the -omics era, mining data to derive inherent information about a system has influenced the medical field, especially oncological imaging. The process of radiomics involves high throughput analysis of medical images to extract a large number of quantified features that are presented as a decision supporting tool for clinicians in terms of various clinical tasks such as staging, prediction, and prognosis. In recent studies, the focus of radiomics has exceeded the whole-tumor analysis to include the quantification of habitats, sub-regions within the tumor volume defined based on specific criteria, with the intent to investigate the diversity extent of the intratumor heterogeneity as robust descriptors and predictors of clinicopathological factors. The presented work is a retrospective analysis of a cohort consisting of pretreatment PET/CT hybrid scans of cervical cancer patients consecutively treated with radiochemotherapy.

The suffix –omics is often used to describe life sciences studies, which focuses on the extraction of large- scale data/information to understand the object of interest (e.g., genomics, proteomics, and metabolomics).

We extracted radiomic features from the primary cervical tumor volumes, and voxel intensity-based features from tumor habitats to analyze the tumors' heterogeneity based on ¹⁸F-fluorodeoxyglucose (18F-FDG) uptake of PET, and Hounsfield Units (HU) of CT to obtain useful tumor information, which might be associated with treatment outcomes. To our knowledge, a limited number of studies have focused on investigating the potential role of radiomic features on cervical cancer PET/CT images.

Briefly, the workflow of this study consisted of investigating parameters that might affect radiomic features predictive performance by evaluating the reproducibility of radiomic features extracted from ¹⁸F-FDG PET images for segmentation methods, gray levels discretization, and PET reconstruction algorithms. Afterward, we used these features to predict cervical treatment outcomes after radiochemotherapy. Due to the use of human data, this research study acquired the approval of the institutional review board (IRB) at the University of South Florida.

References to author publications that relate specifically to the dissertation:

1. **Altazi, Baderaldeen A.**, Geoffrey G. Zhang, Daniel C. Fernandez, Michael E. Montejo, Dylan Hunt, Joan Werner, Matthew C. Biagioli, and Eduardo G. Moros. "*Reproducibility of F18-FDG PET radiomic features for different cervical tumor segmentation methods, gray-level discretization, and reconstruction algorithms.*" *Journal of Applied Clinical Medical Physics* 18, no. 6 (2017): 32-48.
2. **Altazi B. A.**, Fernandez D. C., Zhang G. G., Hawkins S., Naqvi S., Kim Y., Hunt D., Latifi K., Matthew B., Venkat P., Moros E. "*Investigating Multi-Radiomic Models for Enhancing Prediction Power of Cervical Cancer Treatment Outcomes.*" *European Journal of Medical Physics (Physica Medica)*, DOI: <https://doi.org/10.1016/j.ejmp.2017.10.009>