Supplementary material

Title

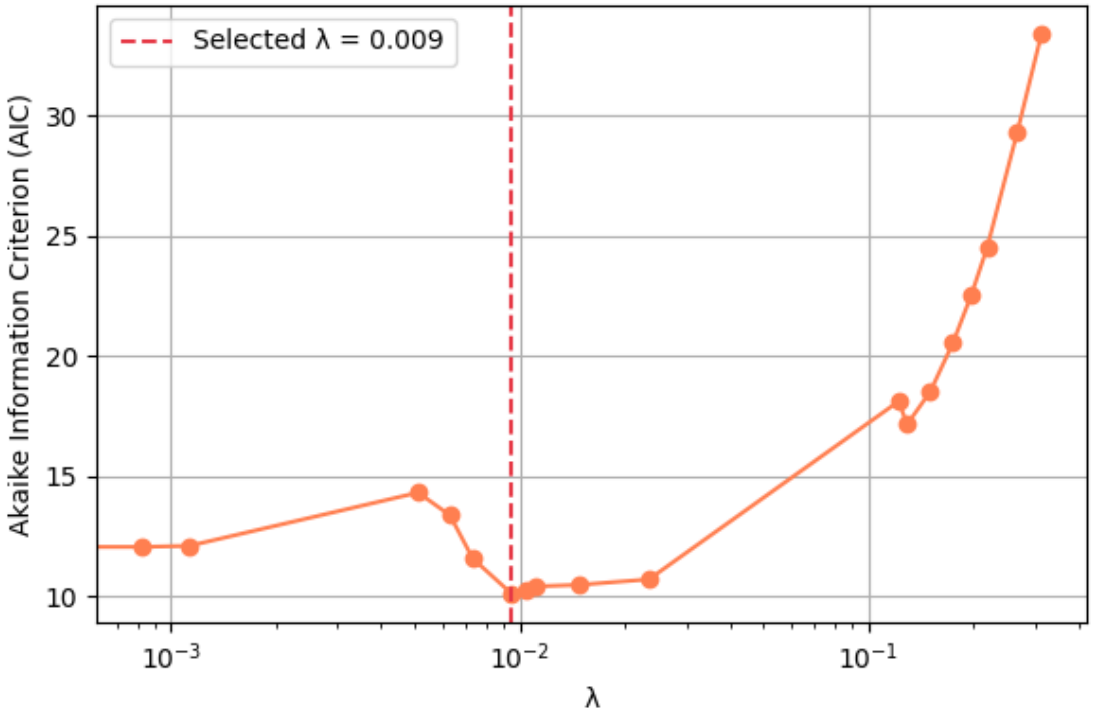
Radiomics modeling to predict the tumor immune-microenvironment of mucinous adenocarcinoma of gastric-type cervical cancer

Authors

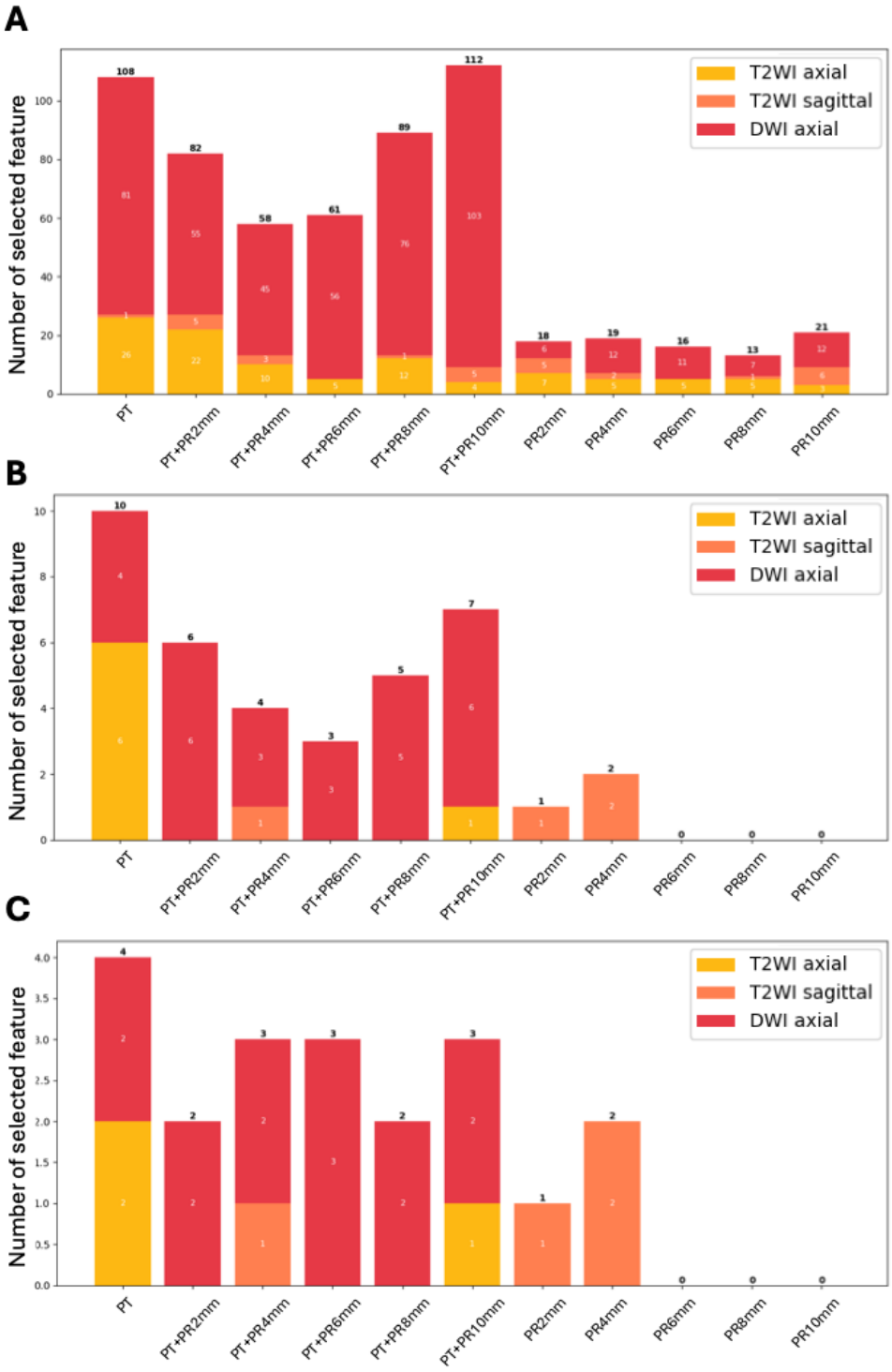
Risa Matsuda, Kohei Oguma, Hiroshi Nishio, Yutaka Shiraishi, Masafumi Sawada, Maho Kurihara, Masaki Sugawara, Miyuki Saito, Tomoya Matsui, Iwata Takashi, Masahiro Jinzaki, Wataru Yamagami, Atsuya Takeda

Image preprocessing

All MRI datasets underwent preprocessing as follows: (1) Image intensities were standardized in the pelvic region, with axial and sagittal T2-weighted images (T2WI) standardized to a mean of 700 and a standard deviation (SD) of 400, and axial diffusion-weighted images (DWI) standardized to a mean of 50 and an SD of 30, since MR image intensities are relative and not directly comparable across scans. The standardization parameters were derived from representative values of the intensity histograms of all images included in this study. (2) Each image was cropped using a three-dimensional bounding box around the primary tumor and subsequently resized to 64 × 64 × 64 voxels. (3) Finally, intensity binning was performed in the volume of interest, using a bin width of 30 for axial and sagittal T2WI, and 7 for axial DWI.

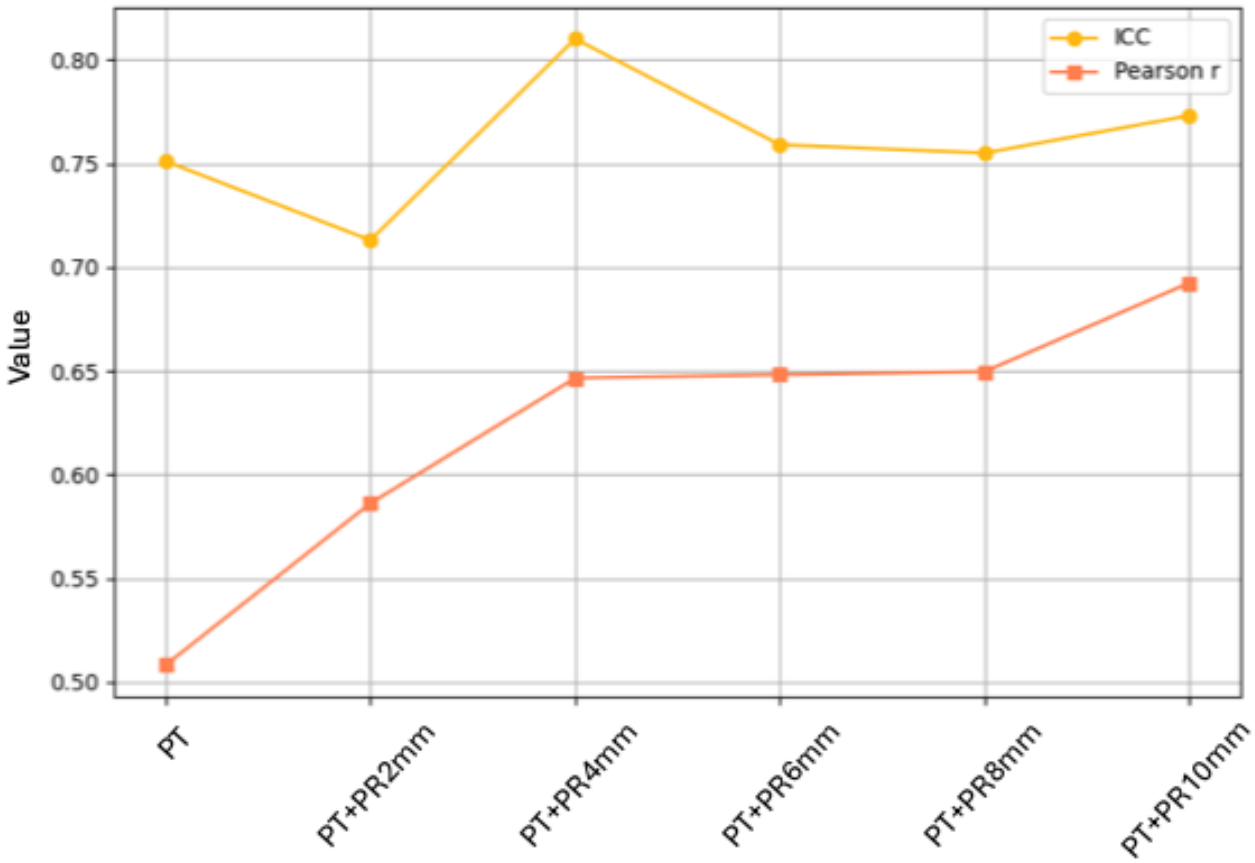


Supplementary Fig. S1. Grid search optimization of the least absolute shrinkage and selection operator (LASSO) regularization parameter (λ) using Akaike Information Criterion; the selected λ was 0.009.

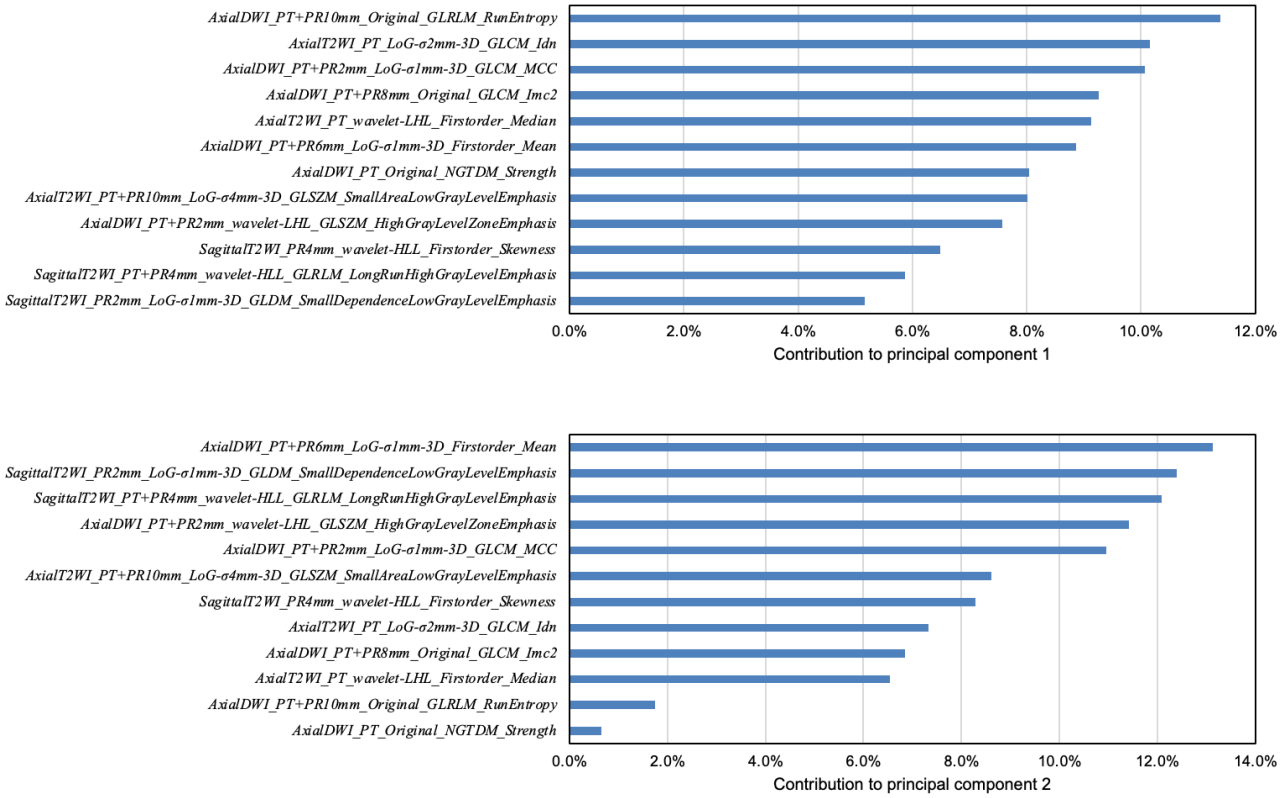


Supplementary Fig. S2. Number of radiomic features retained at each step of the preselection process, stratified by image type and volume of interest. (A) Number of radiomic features with an intraclass correlation coefficient > 0.75. (B) Number of radiomic features showing a moderate or stronger correlation with the tumor-infiltrating lymphocyte density index. (C) Number of radiomic features after excluding those with very strong inter-feature correlation. DWI = Diffusion-Weighted Imaging; T2WI = T2-Weighted Imaging; PT = Primary Tumor; PRxmm = peritumoral region with an isotropic margin of

x mm.



Supplementary Fig. S3. Reproducibility and predictive performance of a radiomic feature, *RunEntropy* from the gray-level run-length matrix (GLRLM), extracted from axial diffusion-weighted imaging according to peritumoral margin size. Intraclass correlation coefficients (yellow) and Pearson correlation coefficients with the tumor-infiltrating lymphocyte density index (orange) are shown for *RunEntropy* extracted from the primary tumor (PT) and from the PT with peritumoral regions (PR) of 2, 4, 6, 8, and 10 mm. *RunEntropy* exhibited more consistent reproducibility and predictive performance when extracted from the PT with an additional PR of 4–10 mm.



Supplementary Fig. S4. Contributions of selected radiomic features to principal components 1 and 2.

Supplementary Table S1. Radiomic features selected by least absolute shrinkage and selection operator (LASSO) regression from the 12 preselected features.

Multivariate model	Coefficient	p value	VIF
Axial DWI_PT+PR10mm_Original_GLRLM_RunEntropy	0.17	0.273	4.69
Axial T2WI_PT_LoG (σ=2mm)_GLCM_InverseDifferenceNormalized	0.08	0.419	2.28
Axial T2WI_PT+PR10mm_LoG (σ=4mm)_GLSZM_SmallAreaLowGrayLevelEmphasis	-0.24	0.144	5.09
Axial DWI_PT+PR8mm_Original_GLCM_InformationalMeasureOfCorrelation2	-0.17	0.358	7.66
Sagittal T2WI _PR4mm_wavelet-HLL_Firstorder_Skewness	0.06	0.516	2.05
Sagittal T2WI _PR2mm_LoG (σ=1mm)_GLDM_SmallDependenceLowGrayLevelEmphasis	0.16	0.06	1.18
Sagittal T2WI _PT+PR4mm_wavelet-HLL_GLRLM_LongRunHighGrayLevelEmphasis	-0.08	0.386	1.93
Axial DWI_PT_Original_NGTDM_Strength	0.05	0.539	1.70
Intercept	2.71	**<0.001**	1.00

Abbreviations: DWI = Diffusion-Weighted Imaging; T2WI = T2-Weighted Imaging; PT = Primary Tumor; PRxmm = peritumoral region with an isotropic margin of x mm; LoG-σxmm = Laplacian of Gaussian filter with σ = x mm; wavelet-XYZ = wavelet-decomposed image in which each letter (X, Y, Z) denotes low-pass (L) or high-pass (H) filtering applied along the corresponding image axis; GLCM = Gray-Level Co-occurrence Matrix; GLRLM = Gray-Level Run-Length Matrix; GLSZM = Gray-Level Size-Zone Matrix; GLDM = Gray-Level Dependence Matrix; NGTDM = Neighborhood Gray-Tone Difference Matrix.