**Appendix S4: ICTOS calculation formula**

After feature selection, skewness, variance from GLCM (GLCM\_variance), and Long Run High Gray Level Emphasis from GLRLM (GLRLM\_LRHGLE) were identified by a multivariable Cox proportional hazards model using the modified covariate method. Skewness is a measure of the direction and degree of skewness of statistical data distribution. GLCM\_variance and GLRLM\_LRHGLE reflect the tumor’s texture.

The ICTOS model could be obtained using:

$$ICTOS=-0.688\*skewness-0.442\*GLCM\\_variance+0.410\*GLRLM\\_LRHGLE$$

, where skewness was obtained from the first order statistics; and GLCM\_variance and GLRLM\_LRHGLE are texture features filtered by XLH. The three features were all derived from the contrast enhanced T1-weighted images and were standardized by the z-score method (mean and standard deviation of skewness: -0.829 and 0.449, GLCM\_variance: 10.373 and 1.396, GLRLM\_LRHGLE: 588.932 and 56.297).

Detailed definitions of the selected features are as follows:

Let:

*X* denote the three dimensional image matrix with *N* voxels,

$P\left(i,j\right)$ be the GLCM for distance $δ=1$ and direction $α$ (0o, 45o, 90o, 135o),

$N\_{g}$ be the number of discrete intensity levels in the image,

$μ$ be the mean of $P\left(i,j\right)$,

$p(i,j|θ)$ be the $\left(i,j\right)$th entry in the given GLRLM $p$ for a direction $θ$ (0o, 45o, 90o, 135o),

$N\_{r}$ be the number of different run lengths.

**Skewness:**

$$skewness=\frac{\frac{1}{N}\sum\_{i=1}^{N}(X\left(i\right)-\overbar{X})^{3}}{(\sqrt{\frac{1}{N}\sum\_{i=1}^{N}(X\left(i\right)-\overbar{X})^{2}})^{3}}$$

where $\overbar{X}$ is the mean of *X*.

**GLCM\_variance:**

$$GLCM\\_variance= \sum\_{i=1}^{N\_{g}}\sum\_{j=1}^{N\_{g}}\left(i-μ\right)^{2}P(i,j)$$

**GLRLM\_LRHGLE:**

$$GLRLM\\_LRHGLE= \frac{\sum\_{i=1}^{N\_{g}}\sum\_{j=1}^{N\_{r}}p(i,j|θ)i^{2}j^{2}}{\sum\_{i=1}^{N\_{g}}\sum\_{j=1}^{N\_{r}}p(i,j|θ)}$$