Figure S1 Cumulative incidence of patients achieving local failure at any structure receiving 70 Gy (A) and of cases only (B). The control subgroup is not shown given no structures receiving 70 Gy reached local failure. The 1 year actuarial rate for local failure was 30% for the entire cohort, 90% for cases, and 0% for controls.
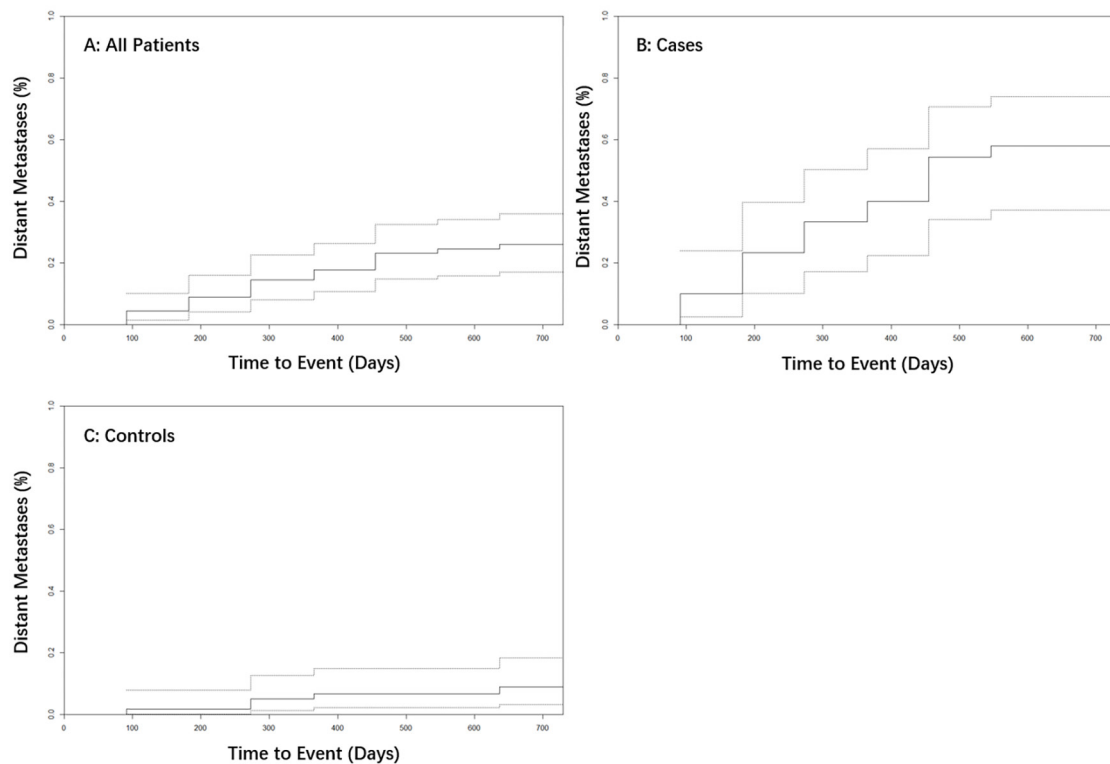

Figure S2 Cumulative incidence of patients achieving distant metastases for the entire cohort (A), for cases (B), and for controls (C). The 1 year actuarial rate for distant metastases was 17.8% for the entire cohort, 40% for cases, and 6.7% for controls. Distant metastasis rates of cases were significantly higher (worse) than controls (P<0.001).
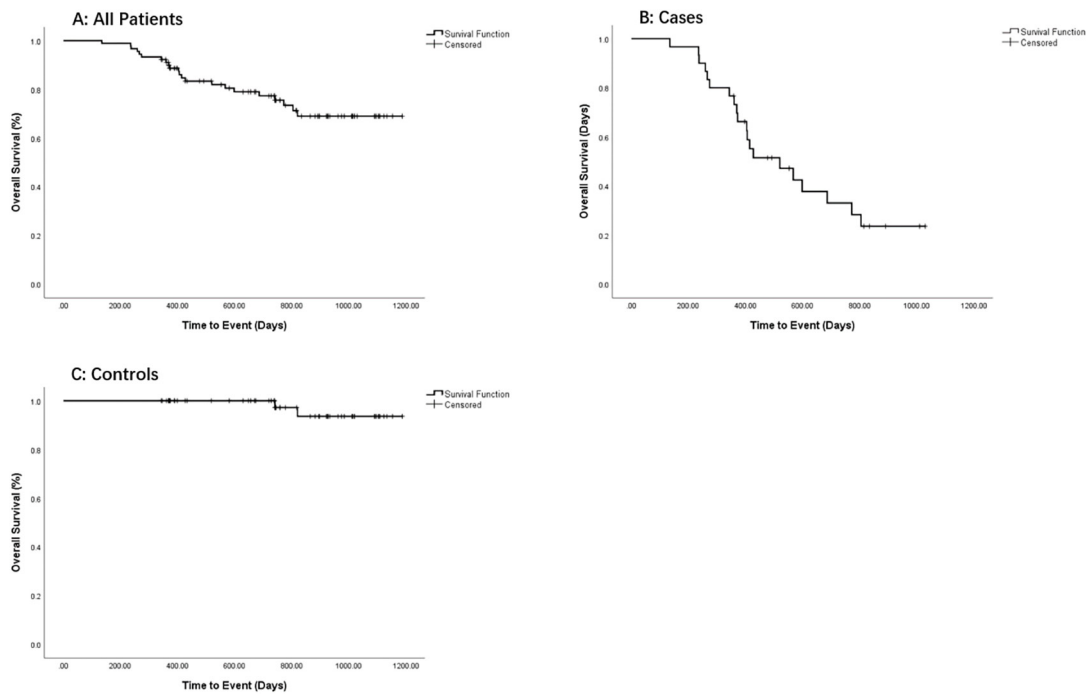
Figure S3 Kaplan-Meier curves of overall survival for the entire cohort (A), cases (B), and controls (C). Actuarial 1yr and 2yr overall survival was 91.1% and 77.3% for the entire cohort, 73.2% and 33.0% for cases, and 100% and 100% for controls. Cases (log rank P<0.001). Overall survival rates of cases were significantly lower (worse) than controls (P<0.001).
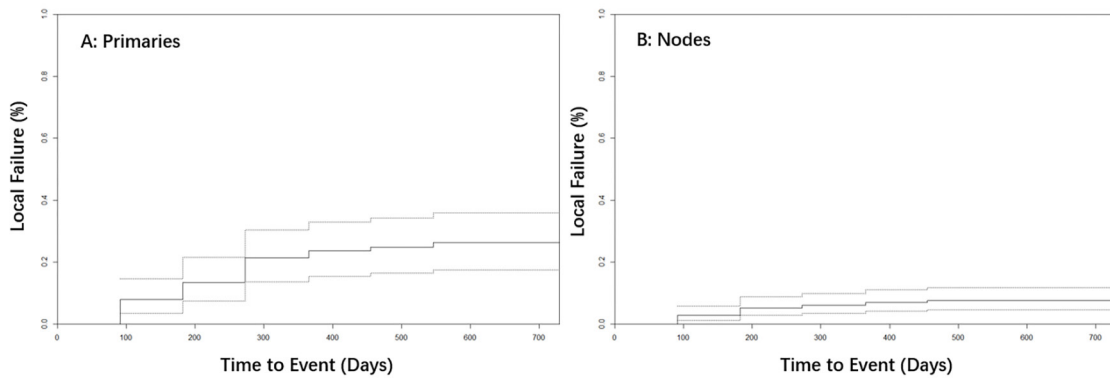
Figure S4 Cumulative incidence of primary structures achieving local failure at any structure receiving 70 Gy (A) and of nodal structures (B). The 1 year actuarial rate of local failure for primary structures was 33.7% and for nodes was 7.0%. Note that the crude rate of events was 23 (of 89 structures) primary events at any time point (21 occurring at or before year 1) and 19 (of 213 structures) nodal events at any time point (15 occurring at or before year 1).
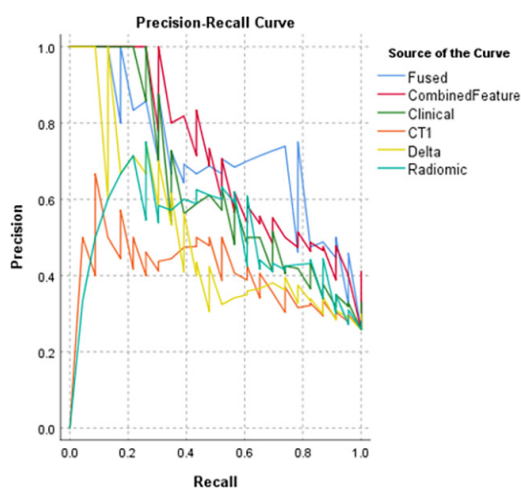
Figure S5 Precision-recall curves of the ensemble models predicting local failure of *primary* structures.
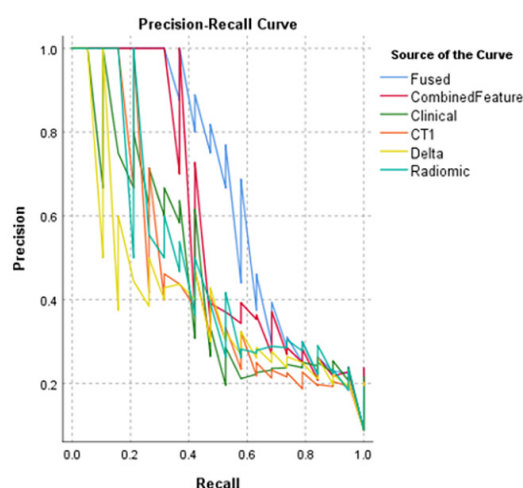
Figure S6 Precision-recall curves of the ensemble models predicting local failure of *nodal* structures.

Table S1 Baseline characteristics for case-control cohort

	Cases		Controls		P value
	n	%	n	%	
Primary side					0.366[†]
Right	15	50.0	24	40.0	
Left	9	30.0	27	45.0	
Midline or bilateral	6	20.0	9	15.0	
Primary site					0.021[†]
Base of tongue	5	16.7	21	35.0	
Tonsil	10	33.3	11	18.3	
Soft palate	0	0.0	2	3.3	
Oropharynx NOS	2	6.7	5	8.3	
Supraglottic	4	13.3	16	26.7	
Glottic	5	16.7	1	1.7	
Hypopharynx	4	13.3	4	6.7	
Smoking status					0.418[†]
Never	8	26.7	17	28.3	
Yes, <10 pack years	4	13.3	2	3.3	
Yes, >10 pack years	14	46.7	31	51.7	
Yes, unknown pack years	4	13.3	10	16.7	

Table S1 (*continued*)

Table S1 (*continued*)

	Cases		Controls		P value
	n	%	n	%	
p16 status					0.032[†]
Negative	10	33.3	6	10.0	
Positive	10	33.3	32	53.3	
Equivocal			2	3.3	
Unknown or NA	10	33.3	20	33.3	
Chemotherapy					0.225[†]
Cisplatin	20	66.7	45	75.0	
Cetuximab	5	16.7	4	6.7	
Carboplatin alone	1	3.3	0	0.0	
Carbo/Taxol	3	10.0	10	16.7	
None/altered fractionation	1	3.3	1	1.7	
T stage (AJCC 7)					0.17[‡]
T1	3	10.0	8	13.3	
T2	5	16.7	16	26.7	
T3	11	36.7	20	33.3	
T4a	9	30.0	16	26.7	
T4b	2	6.7	0	0.0	
N stage (AJCC 7)					0.493[‡]
N0	6	20.0	9	15.0	
N1	0	0.0	6	10.0	
N2a	1	3.3	3	5.0	
N2b	11	36.7	22	36.7	
N2c	10	33.3	19	31.7	
N3	2	6.7	1	1.7	
Follow-up (days)					
Median	420.5		758.5		
IQR	358.5–664		617–976.5		
Range	135–1029		343–1187		
Number of structures per patient					0.519[§]
1	9	30.0	9	15.0	
2	5	16.7	18	30.0	
3	2	6.7	11	18.3	
4	4	13.3	8	13.3	

Table S1 (*continued*)

Table S1 (*continued*)

	Cases		Controls		P value
	n	%	n	%	
5	5	16.7	7	11.7	
6	1	3.3	3	5.0	
7	1	3.3	1	1.7	
8	1	3.3	2	3.3	
9	1	3.3	1	1.7	
10	0	0.0	0	0.0	
11	1	3.3	0	0.0	
Distant metastases during follow-up					
Yes	18	60.0	5	8.3	
No	12	40.0	55	91.7	
Death during follow-up					
Yes	20	66.7	2	3.3	
No	10	33.3	58	96.7	

All statistical analyses were performed in SPSS version 26 with significance defined as a P value <0.05 on a 2-sided test, with either Fisher's exact test[†], Mann-Whitney U test[‡], or an independent samples *t*-test[§].

Table S2 MetaData for included scans: baseline CT simulation scan (CT1), CBCT prior to first fraction (CBCT01), CBCT prior to twenty-first fraction (CBCT21), and test and retest CBCT scans (CBCTa and CBCTb, respectively)

	CT1	CBCT01	CBCT21	CBCTa	CBCTb
Slice thickness					
Median	3.000	1.990	1.990	1.990	1.990
IQR	3.000 to 3.000	1.990 to 1.990	1.990 to 1.990	1.990 to 1.990	1.990 to 1.990
Range	1.500 to 3.000	1.989 to 1.992	1.990 to 1.992	1.990 to 1.990	1.990 to 1.990
Pixel spacing					
Median	1.171	0.511	0.511	0.511	0.511
IQR	1.171 to 1.171	0.511 to 0.511	0.511 to 0.511	0.511 to 0.511	0.511 to 0.511
Range	1.171 to 1.367	0.511 to 0.512	0.511 to 0.512	0.511 to 0.511	0.511 to 0.511
KVP					
Median	120	100	100	100	100
IQR	120 to 120	100 to 100	100 to 100	100 to 100	100 to 100
Range	120 to 120	100 to 125	100 to 125	100 to 125	100 to 125
Exposure					
Median	300	150	150	150	150
IQR	300 to 300	150 to 150	150 to 150	150 to 150	150 to 150
Range	299 to 300	74 to 751	145 to 751	149 to 751	149 to 751

All CBCT matrix sizes were 512×512×93 pixels. CT matrix sizes were similar except for the Z dimension which varied based on provider selection at time of CT simulation.

Table S3 Baseline characteristics for primary structures

	Cases		Controls		
	n	%	n	%	P value
Structure side					0.653[†]
Right	10	43.5	27	40.9	
Left	8	34.8	29	43.9	
Midline or bilateral	5	21.7	10	15.2	
Primary site					0.004[†]
Base of tongue	3	13.0	24	36.4	
Tonsil	7	30.4	12	18.2	
Soft palate	0	0.0	2	3.0	
Oropharynx NOS	1	4.3	6	9.1	
Supraglottic	3	13.0	17	25.8	
Glottic	5	21.7	1	1.5	
Hypopharynx	4	17.4	4	6.1	
Smoking status					0.212[†]
Never	7	30.4	17	25.8	
Yes, ≤10 pack years	3	13.0	2	3.0	
Yes, >10 pack years	9	39.1	37	56.1	
Yes, unknown pack years	4	17.4	10	15.2	
p16 status					0.323[†]
Negative	7	30.4	10	15.2	
Positive	8	34.8	32	48.5	
Equivocal	0	0.0	2	3.0	
Unknown or NA	8	34.8	22	33.3	
Chemotherapy					0.157[†]
Cisplatin	15	65.2	49	74.2	
Cetuximab	4	17.4	5	7.6	
Carboplatin alone	1	4.3	0	0.0	
Carbo/Taxol	2	8.7	11	16.7	
None/altered fractionation	1	4.3	1	1.5	
T stage (AJCC 7)					0.047[‡]
T1	0	0.0	9	13.6	
T2	4	17.4	17	25.8	
T3	10	43.5	21	31.8	
T4a	7	30.4	19	28.8	
T4b	2	8.7	0	0.0	

Table S3 (*continued*)

Table S3 (*continued*)

	Cases		Controls		P value
	n	%	n	%	
N stage (AJCC 7)					0.904[‡]
N0	6	26.1	10	15.2	
N1	0	0.0	6	9.1	
N2a	0	0.0	4	6.1	
N2b	8	34.8	24	36.4	
N2c	9	39.1	20	30.3	
N3	0	0.0	2	3.0	
Follow-up (days)					
Median	427		751.5		
IQR	364.5–642		448.5–971		
Range	236–1029		135–1187		

All statistical analyses were performed in SPSS version 26 with significance defined as a P value <0.05 on a 2-sided test, with either Fisher's exact test[†] or a Mann-Whitney U test[‡].

Table S4 Baseline characteristics of nodal structures

	Cases		Controls		P value
	n	%	n	%	
Primary side					0.8[†]
Right	11	57.9	95	49.0	
Left	6	31.6	70	36.1	
Mid	2	10.5	29	14.9	
Primary site					0.973[†]
Base of tongue	7	36.8	77	39.7	
Tonsil	7	36.8	53	27.3	
Soft palate	0	0.0	1	0.5	
Oropharynx NOS	1	5.3	15	7.7	
Supraglottic	0	0.0	33	17.0	
Glottic	3	15.8	1	0.5	
Hypopharynx	1	5.3	14	7.2	
Nodal laterality					1[†]
Ipsilateral	12	63.2	116	59.8	
Contralateral	5	26.3	49	25.3	
NA (primary midline or bilateral)	2	10.5	29	14.9	

Table S4 (*continued*)

Table S4 (*continued*)

	Cases		Controls		P value
	n	%	n	%	
Smoking status					0.056[†]
Never	2	10.5	67	34.5	
Yes, <10 pack years	1	5.3	11	5.7	
Yes, >10 pack years	14	73.7	83	42.8	
Yes, unknown pack years	2	10.5	33	17.0	
p16 status					0.001[†]
Negative	11	57.9	29	14.9	
Positive	4	21.1	101	52.1	
Equivocal	0	0.0	8	4.1	
Unknown or NA	4	21.1	56	28.9	
Chemotherapy					0.099[†]
Cisplatin	12	63.2	149	76.8	
Cetuximab	3	15.8	18	9.3	
Carboplatin alone	1	5.3	0	0.0	
Carbo/Taxol	3	15.8	26	13.4	
None/altered fractionation	0	0.0	1	0.5	
T stage (AJCC 7)					0.013[‡]
T1	5	26.3	22	11.3	
T2	7	36.8	42	21.6	
T3	4	21.1	69	35.6	
T4a	3	15.8	56	28.9	
T4b	0	0.0	5	2.6	
N stage (AJCC 7)					0.342[‡]
N0	0	0.0	5	2.6	
N1	0	0.0	7	3.6	
N2a	1	5.3	3	1.5	
N2b	7	36.8	77	39.7	
N2c	9	47.4	101	52.1	
N3	2	10.5	1	0.5	
Follow-up (days)					
Median	414		728		
IQR	266–809		427–926		
Range	135–890		237–1187		

All statistical analyses were performed in SPSS version 26 with significance defined as a P value <0.05 on a 2-sided test, with either Fisher's exact test[†] or a Mann-Whitney U test[‡].

Table S5 Intra-class correlation coefficients of CBCT radiomic values

	Primaries (ICC)	Nodes (ICC)
shape_Elongation	0.963	0.980
shape_Flatness	0.982	0.981
shape_LeastAxisLength	0.998	0.999
shape_MajorAxisLength	0.990	0.999
shape_Maximum2DDiameterColumn	0.994	0.999
shape_Maximum2DDiameterRow	0.992	0.999
shape_Maximum2DDiameterSlice	0.995	0.999
shape_Maximum3DDiameter	0.993	0.999
shape_MeshVolume	0.999	1.000
shape_MinorAxisLength	0.996	0.999
shape_Sphericity	0.988	0.994
shape_SurfaceArea	0.999	1.000
shape_SurfaceVolumeRatio	0.995	0.970
shape_VoxelVolume	0.999	1.000
firstorder_10Percentile	0.772	0.836
firstorder_90Percentile	0.735	0.904
firstorder_Energy	0.948	0.988
firstorder_Entropy	0.849	0.866
firstorder_InterquartileRange	0.858	0.892
firstorder_Kurtosis	0.609	0.832
firstorder_Maximum	0.812	0.877
firstorder_MeanAbsoluteDeviation	0.849	0.913
firstorder_Mean	0.602	0.861
firstorder_Median	0.546	0.849
firstorder_Minimum	0.000	0.626
firstorder_Range	0.812	0.878
firstorder_RobustMeanAbsoluteDeviation	0.856	0.893
firstorder_RootMeanSquared	0.746	0.906
firstorder_Skewness	0.733	0.770
firstorder_TotalEnergy	0.948	0.988
firstorder_Uniformity	0.846	0.775
firstorder_Variance	0.836	0.914
glcm_Autocorrelation	0.589	0.832
glcm_ClusterProminence	0.502	0.887
glcm_ClusterShade	0.648	0.962

Table S5 (*continued*)

Table S5 (*continued*)

	Primaries (ICC)	Nodes (ICC)
glcm_ClusterTendency	0.814	0.961
glcm_Contrast	0.921	0.968
glcm_Correlation	0.787	0.795
glcm_DifferenceAverage	0.934	0.969
glcm_DifferenceEntropy	0.932	0.963
glcm_DifferenceVariance	0.917	0.968
glcm_Id	0.948	0.957
glcm_Idm	0.948	0.958
glcm_Idmn	0.747	0.732
glcm_Idn	0.821	0.875
glcm_Imc1	0.939	0.851
glcm_Imc2	0.782	0.662
glcm_InverseVariance	0.892	0.911
glcm_JointAverage	0.596	0.808
glcm_JointEnergy	0.846	0.863
glcm_JointEntropy	0.894	0.923
glcm_MCC	0.726	0.723
glcm_MaximumProbability	0.868	0.807
glcm_SumAverage	0.596	0.808
glcm_SumEntropy	0.841	0.865
glcm_SumSquares	0.840	0.973
glrlm_GrayLevelNonUniformity	0.992	0.998
glrlm_GrayLevelNonUniformityNormalized	0.852	0.794
glrlm_GrayLevelVariance	0.839	0.906
glrlm_HighGrayLevelRunEmphasis	0.644	0.855
glrlm_LongRunEmphasis	0.955	0.849
glrlm_LongRunHighGrayLevelEmphasis	0.960	0.841
glrlm_LongRunLowGrayLevelEmphasis	0.909	0.739
glrlm_LowGrayLevelRunEmphasis	0.742	0.876
glrlm_RunEntropy	0.838	0.884
glrlm_RunLengthNonUniformity	0.995	0.999
glrlm_RunLengthNonUniformityNormalized	0.954	0.963
glrlm_RunPercentage	0.952	0.956
glrlm_RunVariance	0.953	0.846

Table S5 (*continued*)

Table S5 (*continued*)

	Primaries (ICC)	Nodes (ICC)
glrlm_ShortRunEmphasis	0.953	0.955
glrlm_ShortRunHighGrayLevelEmphasis	0.708	0.878
glrlm_ShortRunLowGrayLevelEmphasis	0.767	0.896
glszm_GrayLevelNonUniformity	0.993	0.996
glszm_GrayLevelNonUniformityNormalized	0.787	0.758
glszm_GrayLevelVariance	0.820	0.763
glszm_HighGrayLevelZoneEmphasis	0.813	0.787
glszm_LargeAreaEmphasis	0.973	0.995
glszm_LargeAreaHighGrayLevelEmphasis	0.986	0.997
glszm_LargeAreaLowGrayLevelEmphasis	0.953	0.990
glszm_LowGrayLevelZoneEmphasis	0.820	0.726
glszm_SizeZoneNonUniformity	0.983	0.996
glszm_SizeZoneNonUniformityNormalized	0.678	0.777
glszm_SmallAreaEmphasis	0.642	0.793
glszm_SmallAreaHighGrayLevelEmphasis	0.792	0.756
glszm_SmallAreaLowGrayLevelEmphasis	0.808	0.596
glszm_ZoneEntropy	0.836	0.915
glszm_ZonePercentage	0.932	0.961
glszm_ZoneVariance	0.973	0.995
gldm_DependenceEntropy	0.688	0.890
gldm_DependenceNonUniformity	0.995	0.999
gldm_DependenceNonUniformityNormalized	0.958	0.953
gldm_DependenceVariance	0.948	0.890
gldm_GrayLevelNonUniformity	0.986	0.997
gldm_GrayLevelVariance	0.835	0.915
gldm_HighGrayLevelEmphasis	0.623	0.849
gldm_LargeDependenceEmphasis	0.941	0.926
gldm_LargeDependenceHighGrayLevelEmphasis	0.940	0.858
gldm_LargeDependenceLowGrayLevelEmphasis	0.871	0.652
gldm_LowGrayLevelEmphasis	0.733	0.881
gldm_SmallDependenceEmphasis	0.942	0.962
gldm_SmallDependenceHighGrayLevelEmphasis	0.832	0.944
gldm_SmallDependenceLowGrayLevelEmphasis	0.924	0.875

Table S6 Frequency of features selected for models in the parallel ensemble schema for the fused model predicting local failure of primaries

Feature	Frequency of selection (# of models)	Percent (% of models)
Site_Primary	125	100.0%
Smoking_Status	125	100.0%
p16	125	100.0%
Chemo	125	100.0%
T_Stage	125	100.0%
N_Stage	125	100.0%
Delta_original_shape_Maximum3DDiameter	87	69.6%
CT1_original_gldm_DependenceVariance	81	64.8%
CT1_original_glszm_SizeZoneNonUniformity	80	64.0%
CT1_original_glszm_LargeAreaEmphasis	47	37.6%
CT1_original_shape_SurfaceVolumeRatio	44	35.2%
CT1_original_shape_Sphericity	41	32.8%
CT1_original_glszm_SmallAreaHighGrayLevelEmphasis	37	29.6%
Delta_original_shape_MajorAxisLength	34	27.2%
CT1_original_glszm_ZoneEntropy	33	26.4%
Delta_original_glrlm_GrayLevelNonUniformity	29	23.2%
Delta_original_gldm_GrayLevelNonUniformity	28	22.4%
CT1_original_gldm_DependenceEntropy	26	20.8%
CT1_original_glszm_SmallAreaLowGrayLevelEmphasis	25	20.0%
Delta_original_glszm_LargeAreaEmphasis	24	19.2%
Delta_original_shape_Maximum2DDiameterSlice	24	19.2%
CT1_original_glszm_HighGrayLevelZoneEmphasis	23	18.4%
CT1_original_gldm_LargeDependenceEmphasis	22	17.6%
Delta_original_shape_VoxelVolume	21	16.8%
CT1_original_glszm_LargeAreaLowGrayLevelEmphasis	21	16.8%
Delta_original_shape_Elongation	20	16.0%
CT1_original_gldm_SmallDependenceHighGrayLevelEmphasis	20	16.0%
Delta_original_glszm_SizeZoneNonUniformity	17	13.6%
Delta_original_shape_MinorAxisLength	16	12.8%
CT1_original_gldm_GrayLevelNonUniformity	16	12.8%
Delta_original_glszm_LargeAreaLowGrayLevelEmphasis	16	12.8%
Delta_original_glszm_LargeAreaHighGrayLevelEmphasis	15	12.0%
Delta_original_glszm_ZoneVariance	15	12.0%
CT1_original_firstorder_TotalEnergy	15	12.0%
Delta_original_shape_SurfaceArea	14	11.2%

Table S6 (*continued*)

Table S6 (*continued*)

Feature	Frequency of selection (# of models)	Percent (% of models)
Delta_original_shape_LeastAxisLength	14	11.2%
Delta_original_glrlm_RunLengthNonUniformityNormalized	13	10.4%
CT1_original_glszm_GrayLevelNonUniformity	13	10.4%
CT1_original_glszm_GrayLevelVariance	13	10.4%
CT1_original_gldm_SmallDependenceEmphasis	12	9.6%
CT1_original_glrlm_RunVariance	11	8.8%
CT1_original_gldm_LargeDependenceHighGrayLevelEmphasis	11	8.8%
CT1_original_gldm_DependenceNonUniformity	11	8.8%
Delta_original_shape_Maximum2DDiameterColumn	10	8.0%
Delta_original_gldm_DependenceNonUniformityNormalized	10	8.0%
CT1_original_glszm_LowGrayLevelZoneEmphasis	10	8.0%
CT1_original_firstorder_Entropy	9	7.2%
CT1_original_gldm_SmallDependenceLowGrayLevelEmphasis	9	7.2%
CT1_original_glrlm_ShortRunHighGrayLevelEmphasis	8	6.4%
CT1_original_glszm_SmallAreaEmphasis	8	6.4%
CT1_original_glszm_ZonePercentage	8	6.4%
CT1_original_glcm_Imc2	7	5.6%
Delta_original_glrlm_RunLengthNonUniformity	7	5.6%
CT1_original_gldm_HighGrayLevelEmphasis	7	5.6%
CT1_original_glszm_LargeAreaHighGrayLevelEmphasis	6	4.8%
CT1_original_glszm_GrayLevelNonUniformityNormalized	6	4.8%
CT1_original_shape_Flatness	6	4.8%
CT1_original_gldm_DependenceNonUniformityNormalized	6	4.8%
CT1_original_gldm_LargeDependenceLowGrayLevelEmphasis	6	4.8%
Delta_original_glrlm_RunPercentage	6	4.8%
CT1_original_firstorder_10Percentile	5	4.0%
CT1_original_glrlm_RunPercentage	5	4.0%
CT1_original_glrlm_RunEntropy	5	4.0%
CT1_original_glszm_SizeZoneNonUniformityNormalized	5	4.0%
Delta_original_glszm_GrayLevelNonUniformity	5	4.0%
CT1_original_glcm_ClusterTendency	5	4.0%
CT1_original_glszm_ZoneVariance	5	4.0%
CT1_original_gldm_LowGrayLevelEmphasis	4	3.2%
Delta_original_shape_Maximum2DDiameterRow	4	3.2%

Table S6 (*continued*)

Feature	Frequency of selection (# of models)	Percent (% of models)
CT1_original_firstorder_Maximum	4	3.2%
Delta_original_shape_Flatness	3	2.4%
CT1_original_shape_Maximum2DDiameterRow	3	2.4%
Delta_original_shape_MeshVolume	3	2.4%
CT1_original_firstorder_Skewness	3	2.4%
Delta_original_glrlm_LongRunEmphasis	3	2.4%
Delta_original_gldm_DependenceNonUniformity	3	2.4%
CT1_original_shape_VoxelVolume	3	2.4%
CT1_original_glcm_SumEntropy	3	2.4%
Delta_original_glrlm_ShortRunEmphasis	3	2.4%
CT1_original_glrlm_GrayLevelVariance	2	1.6%
CT1_original_firstorder_Minimum	2	1.6%
Delta_original_shape_SurfaceVolumeRatio	2	1.6%
CT1_original_glrlm_LongRunHighGrayLevelEmphasis	2	1.6%
CT1_original_shape_SurfaceArea	2	1.6%
Delta_original_glrlm_RunVariance	1	0.8%
CT1_original_glcm_SumSquares	1	0.8%
CT1_original_shape_MajorAxisLength	1	0.8%
CT1_original_glcm_ClusterProminence	1	0.8%
CT1_original_firstorder_Range	1	0.8%
CT1_original_glrlm_RunLengthNonUniformity	1	0.8%
CT1_original_glrlm_ShortRunLowGrayLevelEmphasis	1	0.8%
CT1_original_firstorder_Mean	1	0.8%
Delta_original_shape_Sphericity	1	0.8%
CT1_original_firstorder_MeanAbsoluteDeviation	1	0.8%
CT1_original_firstorder_Uniformity	1	0.8%
CT1_original_shape_Maximum3DDiameter	1	0.8%
CT1_original_glcm_InverseVariance	1	0.8%
CT1_original_firstorder_Energy	1	0.8%
CT1_original_glcm_Id	1	0.8%

Features with a frequency of selection of 0 were excluded from the below chart. Note that all clinical features were included based on prior knowledge, resulting in 100% inclusion in all models using clinical features.

Table S7 Frequency of features selected for models in the parallel ensemble schema for the fused model predicting local failure of nodes

Feature	Frequency of selection (# of models)	Percent (% of models)
Site_Primary	125	100.0%
Smoking_Status	125	100.0%
p16	125	100.0%
Chemo	125	100.0%
T_Stage	125	100.0%
N_Stage	125	100.0%
Delta_original_shape_Sphericity	101	80.8%
CT1_original_glcm_Correlation	86	68.8%
CT1_original_glrlm_LongRunHighGrayLevelEmphasis	81	64.8%
CT1_original_gldm_LargeDependenceLowGrayLevelEmphasis	48	38.4%
CT1_original_glrlm_RunEntropy	45	36.0%
CT1_original_glszm_LargeAreaLowGrayLevelEmphasis	43	34.4%
CT1_original_firstorder_TotalEnergy	38	30.4%
CT1_original_glrlm_RunVariance	34	27.2%
CT1_original_gldm_SmallDependenceLowGrayLevelEmphasis	32	25.6%
CT1_original_glcm_Id	30	24.0%
CT1_original_glrlm_GrayLevelNonUniformity	29	23.2%
CT1_original_glszm_GrayLevelNonUniformityNormalized	29	23.2%
CT1_original_glszm_SizeZoneNonUniformity	27	21.6%
CT1_original_glszm_ZoneEntropy	27	21.6%
CT1_original_glcm_InverseVariance	27	21.6%
CT1_original_glcm_MaximumProbability	27	21.6%
Delta_original_glcm_Id	26	20.8%
Delta_original_firstorder_Energy	26	20.8%
Delta_original_glcm_Idm	26	20.8%
CT1_original_glrlm_LongRunLowGrayLevelEmphasis	26	20.8%
Delta_original_shape_Maximum2DDiameterRow	22	17.6%
Delta_original_shape_Elongation	21	16.8%
Delta_original_firstorder_TotalEnergy	20	16.0%
CT1_original_shape_Flatness	20	16.0%
CT1_original_glszm_GrayLevelNonUniformity	17	13.6%
CT1_original_gldm_GrayLevelNonUniformity	17	13.6%
CT1_original_gldm_DependenceEntropy	17	13.6%
Delta_original_glcm_DifferenceEntropy	15	12.0%

Table S7 (*continued*)

Table S7 (*continued*)

Feature	Frequency of selection (# of models)	Percent (% of models)
CT1_original_glrlm_LongRunEmphasis	13	10.4%
CT1_original_glcm_JointEnergy	13	10.4%
CT1_original_glszm_SmallAreaLowGrayLevelEmphasis	12	9.6%
Delta_original_glcm_DifferenceAverage	12	9.6%
CT1_original_gldm_LowGrayLevelEmphasis	12	9.6%
CT1_original_firstorder_InterquartileRange	12	9.6%
CT1_original_shape_Maximum3DDiameter	11	8.8%
CT1_original_glszm_LargeAreaEmphasis	10	8.0%
CT1_original_glszm_ZonePercentage	10	8.0%
CT1_original_glrlm_LowGrayLevelRunEmphasis	10	8.0%
CT1_original_glszm_HighGrayLevelZoneEmphasis	10	8.0%
CT1_original_gldm_LargeDependenceHighGrayLevelEmphasis	10	8.0%
CT1_original_firstorder_RobustMeanAbsoluteDeviation	10	8.0%
CT1_original_shape_VoxelVolume	9	7.2%
CT1_original_glszm_LowGrayLevelZoneEmphasis	9	7.2%
Delta_original_shape_Maximum2DDiameterColumn	9	7.2%
CT1_original_firstorder_Energy	8	6.4%
CT1_original_shape_SurfaceArea	8	6.4%
CT1_original_glszm_SizeZoneNonUniformityNormalized	8	6.4%
CT1_original_shape_MeshVolume	8	6.4%
CT1_original_glszm_GrayLevelVariance	7	5.6%
CT1_original_gldm_SmallDependenceHighGrayLevelEmphasis	7	5.6%
CT1_original_glszm_SmallAreaHighGrayLevelEmphasis	7	5.6%
CT1_original_glszm_SmallAreaEmphasis	7	5.6%
CT1_original_firstorder_Skewness	7	5.6%
CT1_original_gldm_SmallDependenceEmphasis	7	5.6%
Delta_original_shape_LeastAxisLength	6	4.8%
Delta_original_glrlm_GrayLevelNonUniformity	6	4.8%
CT1_original_gldm_DependenceNonUniformityNormalized	5	4.0%
CT1_original_firstorder_Minimum	5	4.0%
CT1_original_glszm_LargeAreaHighGrayLevelEmphasis	5	4.0%
Delta_original_shape_Flatness	5	4.0%
Delta_original_glrlm_ShortRunEmphasis	4	3.2%
CT1_original_shape_MinorAxisLength	4	3.2%

Table S7 (*continued*)

Table S7 (*continued*)

Feature	Frequency of selection (# of models)	Percent (% of models)
Delta_original_glcm_ClusterTendency	3	2.4%
Delta_original_shape_MeshVolume	3	2.4%
CT1_original_glrlm_RunLengthNonUniformity	3	2.4%
Delta_original_glcm_Contrast	3	2.4%
CT1_original_gldm_DependenceVariance	3	2.4%
CT1_original_glrlm_RunPercentage	3	2.4%
CT1_original_shape_LeastAxisLength	2	1.6%
Delta_original_shape_MinorAxisLength	2	1.6%
CT1_original_gldm_DependenceNonUniformity	2	1.6%
Delta_original_shape_SurfaceVolumeRatio	2	1.6%
CT1_original_glcm_Idn	2	1.6%
Delta_original_glrlm_RunLengthNonUniformityNormalized	2	1.6%
CT1_original_glcm_ClusterShade	2	1.6%
CT1_original_glrlm_ShortRunHighGrayLevelEmphasis	2	1.6%
Delta_original_glcm_DifferenceVariance	2	1.6%
CT1_original_shape_SurfaceVolumeRatio	2	1.6%
CT1_original_glszm_ZoneVariance	2	1.6%
CT1_original_shape_Maximum2DDiameterSlice	2	1.6%
CT1_original_glcm_Idm	2	1.6%
Delta_original_shape_MajorAxisLength	2	1.6%
Delta_original_shape_Maximum3DDiameter	2	1.6%
CT1_original_firstorder_10Percentile	1	0.8%
Delta_original_glszm_LargeAreaLowGrayLevelEmphasis	1	0.8%
Delta_original_shape_Maximum2DDiameterSlice	1	0.8%
Delta_original_glcm_ClusterShade	1	0.8%
Delta_original_glszm_SizeZoneNonUniformity	1	0.8%
Delta_original_glrlm_RunLengthNonUniformity	1	0.8%
CT1_original_gldm_GrayLevelVariance	1	0.8%
CT1_original_shape_Maximum2DDiameterRow	1	0.8%
Delta_original_gldm_GrayLevelNonUniformity	1	0.8%
Delta_original_shape_VoxelVolume	1	0.8%

Features with a frequency of selection of 0 were excluded from the below chart. Note that all clinical features were included based on prior knowledge, resulting in 100% inclusion in all models using clinical features.