

The spine and carina as a surrogate for target registration in cone-beam CT imaging verification in locally advanced lung cancer radiotherapy

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SUPPLEMENTARY TABLE S1. Spine/target registration analysis in the lateral, longitudinal and vertical directions according to the nodal (N) stage

Spine/target registration deviation according to the nodal (N) stage															
Fraction	LATERAL (mean mm)				p value	LONGITUDINAL (mean mm)				p value	VERTICAL (mean mm)				p value
	N0	N1	N2	N3		N0	N1	N2	N3		N0	N1	N2	N3	
1 st	1.63	0.00	1.13	1.31	0.644	2.83	1.00	2.60	2.94	0.989	1.75	1.00	0.87	1.25	0.418
10 th	1.88	0.00	1.13	1.25	0.446	2.00	3.00	2.00	2.00	0.597	1.63	2.00	2.27	1.13	0.360
15 th	1.63	0.00	1.87	1.13	0.226	2.13	2.00	2.53	2.38	0.975	1.88	3.00	1.27	1.13	0.349
20 th	1.75	0.00	2.00	1.06	0.191	3.38	2.00	2.73	2.44	0.991	1.75	1.00	1.20	0.94	0.832

SUPPLEMENTARY TABLE S2. Carina/target registration analysis in the lateral, longitudinal and vertical directions according to the nodal (N) stage

Carina/target registration deviation according to the nodal (N) stage															
Fraction	LATERAL (mean mm)				p value	LONGITUDINAL (mean mm)				p value	VERTICAL (mean mm)				p value
	N0	N1	N2	N3		N0	N1	N2	N3		N0	N1	N2	N3	
1 st	1.25	0.00	0.73	0.94	0.807	1.38	6.00	1.73	1.81	0.491	2.50	1.00	1.07	1.25	0.291
10 th	1.50	1.00	1.20	0.75	0.578	1.75	5.00	1.67	1.06	0.232	1.75	1.00	1.27	0.63	0.128
15 th	1.38	4.00	1.20	0.63	0.034	2.50	5.00	1.73	0.94	0.025	2.63	2.00	1.20	0.88	0.075
20 th	0.75	2.00	1.73	0.50	0.028	2.75	11.00	2.20	1.25	0.076	2.38	4.00	1.40	0.81	0.034

SUPPLEMENTARY TABLE S3. Impact of the tumour location on the mean set-up deviation difference between spine/target vs. carina/target registration

	Fraction	Tumour location	Spine/target Deviation (mm)					Carina/target Deviation (mm)					Deviation difference (mm)	p
			M	SD	ME	Min	Max	M	SD	ME	Min	Max		
LAT	1 st	Central.	0.71	0.92	0.00	0.00	3.00	0.65	1.17	0.00	0.00	4.00	0.06	0.705
		Perifer.	1.77	1.97	1.00	0.00	7.00	1.14	1.58	1.00	0.00	7.00	0.64	0.058
	10 th	Central.	0.76	0.75	1.00	0.00	2.00	0.53	0.51	1.00	0.00	1.00	0.24	0.206
		Perifer.	1.77	1.31	2.00	0.00	5.00	1.55	1.30	1.00	0.00	5.00	0.23	0.355
	15 th	Central.	1.47	1.33	1.00	0.00	4.00	0.71	0.69	1.00	0.00	2.00	0.76	0.012
		Perifer.	1.55	1.06	2.00	0.00	4.00	1.41	1.18	1.00	0.00	4.00	0.14	0.581
20 th	Central.	1.94	1.60	2.00	0.00	6.00	1.00	1.17	1.00	0.00	4.00	0.94	0.048	
	Perifer.	1.27	1.24	1.00	0.00	4.00	1.14	1.17	1.00	0.00	4.00	0.14	0.722	
LONG	1 st	Central.	1.18	1.85	0.00	0.00	7.00	1.65	2.60	1.00	0.00	11.00	-0.47	0.258
		Perifer.	3.91	3.16	2.50	0.00	10.00	2.00	2.89	1.00	0.00	11.00	1.91	0.034
	10 th	Central.	1.53	1.01	2.00	0.00	3.00	1.18	2.04	0.00	0.00	8.00	0.35	0.270
		Perifer.	2.41	2.09	2.00	0.00	8.00	1.86	1.55	1.00	0.00	5.00	0.55	0.178
	15 th	Central.	2.59	2.35	2.00	0.00	10.00	1.00	1.06	1.00	0.00	3.00	1.59	0.010
		Perifer.	2.32	2.50	1.50	0.00	9.00	2.23	1.80	2.00	0.00	6.00	0.09	0.715
20 th	Central.	2.29	1.45	2.00	0.00	6.00	0.94	1.25	1.00	0.00	5.00	1.35	0.011	
	Perifer.	3.14	2.42	3.00	0.00	11.00	3.14	3.11	2.50	0.00	11.00	0.00	0.943	
VRT	1 st	Central.	1.12	1.45	1.00	0.00	5.00	1.06	1.48	0.00	0.00	5.00	0.06	0.892
		Perifer.	1.32	1.59	1.00	0.00	6.00	1.77	1.51	1.50	0.00	5.00	-0.45	0.102
	10 th	Central.	1.41	2.60	1.00	0.00	11.00	0.82	0.81	1.00	0.00	2.00	0.59	0.257
		Perifer.	1.86	1.17	2.00	0.00	5.00	1.32	1.21	1.00	0.00	4.00	0.55	0.116
	15 th	Central.	1.35	1.58	1.00	0.00	5.00	0.88	0.99	0.00	0.00	2.00	0.47	0.263
		Perifer.	1.45	1.34	1.00	0.00	6.00	1.77	1.74	1.00	0.00	8.00	-0.32	0.208
20 th	Central.	1.29	1.40	1.00	0.00	5.00	0.88	1.11	1.00	0.00	4.00	0.41	0.396	
	Perifer.	1.09	1.38	1.00	0.00	5.00	1.82	1.50	1.50	0.00	5.00	-0.73	0.055	
LAT	All measurements	Central.	1.22	0.73	1.25	0.25	2.50	0.72	0.54	0.75	0.00	1.75	0.50	0.003
		Perifer.	1.59	0.97	1.25	0.00	4.00	1.31	0.84	1.38	0.25	3.75	0.28	0.157
LONG	All measurements	Central.	1.90	1.02	2.00	0.50	3.75	1.19	1.18	0.75	0.00	4.25	0.71	0.003
		Perifer.	2.94	1.83	2.50	0.75	8.00	2.31	1.79	1.75	0.50	6.75	0.64	0.092
VRT	All measurements	Central.	1.29	1.22	0.75	0.25	4.75	0.91	0.76	0.50	0.00	2.75	0.38	0.083
		Perifer.	1.43	0.94	1.25	0.00	4.00	1.67	1.15	1.50	0.50	5.25	-0.24	0.190

LAT = lateral; LONG = longitudinal; ME = median; M = mean; SD = standard deviation; target = primary tumour and lymph nodes; VRT = vertical

SUPPLEMENTARY TABLE S4. Impact of N0 vs. N1-3 stage on the mean set-up deviation difference between the spine/target vs. carina/target registration

			Spine/target Deviation (mm)					Carina/target Deviation (mm)					Deviation difference (mm)	p
	Fraction	N stage	M	SD	ME	Min	Max	M	SD	ME	Min	Max		
LAT	1 st	0	1.63	2.26	1.00	0.00	7.00	1.25	2.38	0.50	0.00	7.00	0.38	0.083
		1-3	1.19	1.51	1.00	0.00	6.00	0.81	1.09	0.50	0.00	4.00	0.38	0.175
	10 th	0	1.88	1.81	1.50	0.00	5.00	1.50	1.60	1.00	0.00	5.00	0.38	0.257
		1-3	1.16	0.99	1.00	0.00	4.00	0.97	1.00	1.00	0.00	5.00	0.19	0.289
	15 th	0	1.63	0.52	2.00	1.00	2.00	1.38	1.19	1.00	0.00	4.00	0.25	0.480
		1-3	1.44	1.29	1.00	0.00	4.00	1.00	1.02	1.00	0.00	4.00	0.44	0.062
	20 th	0	1.75	1.04	2.00	0.00	3.00	0.75	0.71	1.00	0.00	2.00	1.00	0.050
		1-3	1.47	1.52	1.00	0.00	6.00	1.13	1.24	1.00	0.00	4.00	0.34	0.442
LONG	1 st	0	2.38	2.62	1.00	0.00	7.00	1.38	1.69	1.00	0.00	4.00	1.00	0.273
		1-3	2.72	3.08	1.50	0.00	10.00	1.91	2.93	1.00	0.00	11.00	0.81	0.234
	10 th	0	2.00	2.78	1.00	0.00	8.00	1.75	1.58	1.50	0.00	4.00	0.25	0.786
		1-3	2.03	1.40	2.00	0.00	6.00	1.47	1.85	1.00	0.00	8.00	0.56	0.039
	15 th	0	2.13	1.96	1.50	0.00	6.00	2.50	1.07	3.00	1.00	4.00	-0.38	0.567
		1-3	2.44	2.53	2.00	0.00	10.00	1.44	1.68	1.00	0.00	6.00	1.00	0.085
	20 th	0	3.38	3.62	2.00	0.00	11.00	2.75	3.45	1.00	0.00	9.00	0.63	0.673
		1-3	2.56	1.50	2.00	0.00	6.00	2.00	2.46	1.00	0.00	11.00	0.56	0.120
VRT	1 st	0	1.75	1.28	2.00	0.00	3.00	2.50	1.85	2.50	0.00	5.00	-0.75	0.285
		1-3	1.06	1.54	0.50	0.00	6.00	1.16	1.32	1.00	0.00	5.00	-0.09	0.675
	10 th	0	1.63	0.74	1.50	1.00	3.00	1.75	1.49	1.00	0.00	4.00	-0.13	0.705
		1-3	1.69	2.09	1.50	0.00	11.00	0.94	0.88	1.00	0.00	3.00	0.75	0.020
	15 th	0	1.88	1.89	1.00	0.00	6.00	2.63	2.39	2.00	1.00	8.00	-0.75	0.180
		1-3	1.25	1.30	1.00	0.00	5.00	1.06	1.01	1.00	0.00	4.00	0.19	0.554
	20 th	0	1.75	1.83	1.50	0.00	5.00	2.38	1.51	2.50	0.00	5.00	-0.63	0.180
		1-3	1.06	1.22	1.00	0.00	5.00	1.19	1.28	1.00	0.00	4.00	-0.13	0.626
LAT	All measurements	0	1.72	0.84	1.50	1.00	3.50	1.22	1.10	0.88	0.25	3.75	0.50	0.034
		1-3	1.31	0.91	1.25	0.00	4.00	0.98	0.70	0.75	0.00	2.25	0.34	0.023
LONG	All measurements	0	2.47	2.31	1.88	0.75	8.00	2.09	1.35	1.75	0.50	5.00	0.38	0.496
		1-3	2.44	1.42	2.13	0.50	6.00	1.70	1.71	1.13	0.00	6.75	0.73	0.003
VRT	All measurements	0	1.75	1.19	1.50	0.50	4.00	2.31	1.49	1.75	1.25	5.25	-0.56	0.073
		1-3	1.27	1.00	1.00	0.00	4.75	1.09	0.74	1.00	0.00	2.75	0.18	0.256

LAT = lateral; LONG = longitudinal; ME = median; M = mean; SD = standard deviation; target = primary tumour and lymph nodes; VRT = vertical

SUPPLEMENTARY TABLE S5. Impact of N0 vs. N2 vs. N3 stage on the mean set-up deviation difference between the spine/target vs. carina/target registration

			Spine/target Deviation (mm)					Carina/target Deviation (mm)					Deviation difference (mm)	P
	Fraction	N stage	M	SD	ME	Min	Max	M	SD	ME	Min	Max		
LAT	1 st	0	1.63	2.26	1.00	0.00	7.00	1.25	2.38	0.50	0.00	7.00	0.38	0.083
		2	1.13	1.46	1.00	0.00	5.00	0.73	0.80	1.00	0.00	3.00	0.40	0.197
		3	1.31	1.62	1.00	0.00	6.00	0.94	1.34	0.00	0.00	4.00	0.38	0.518
	10 th	0	1.88	1.81	1.50	0.00	5.00	1.50	1.60	1.00	0.00	5.00	0.38	0.257
		2	1.13	1.13	1.00	0.00	4.00	1.20	1.21	1.00	0.00	5.00	-0.07	0.792
		3	1.25	0.86	1.00	0.00	3.00	0.75	0.77	1.00	0.00	2.00	0.50	0.046
	15 th	0	1.63	0.52	2.00	1.00	2.00	1.38	1.19	1.00	0.00	4.00	0.25	0.480
		2	1.87	1.51	1.00	0.00	4.00	1.20	0.68	1.00	0.00	2.00	0.67	0.085
		3	1.13	0.96	1.00	0.00	3.00	0.63	0.96	0.00	0.00	3.00	0.50	0.084
	20 th	0	1.75	1.04	2.00	0.00	3.00	0.75	0.71	1.00	0.00	2.00	1.00	0.050
		2	2.00	1.81	2.00	0.00	6.00	1.73	1.39	2.00	0.00	4.00	0.27	0.662
		3	1.06	1.06	1.00	0.00	4.00	0.50	0.73	0.00	0.00	2.00	0.56	0.071
LONG	1 st	0	2.38	2.62	1.00	0.00	7.00	1.38	1.69	1.00	0.00	4.00	1.00	0.273
		2	2.60	2.87	2.00	0.00	9.00	1.73	2.76	1.00	0.00	11.00	0.87	0.371
		3	2.94	3.42	1.00	0.00	10.00	1.81	3.08	1.00	0.00	11.00	1.13	0.261
	10 th	0	2.00	2.78	1.00	0.00	8.00	1.75	1.58	1.50	0.00	4.00	0.25	0.786
		2	2.00	1.25	2.00	0.00	5.00	1.67	2.09	1.00	0.00	8.00	0.33	0.345
		3	2.00	1.59	2.00	0.00	6.00	1.06	1.39	1.00	0.00	4.00	0.94	0.007
	15 th	0	2.13	1.96	1.50	0.00	6.00	2.50	1.07	3.00	1.00	4.00	-0.38	0.567
		2	2.53	2.85	1.00	0.00	10.00	1.73	1.87	1.00	0.00	6.00	0.80	0.341
		3	2.38	2.36	2.00	0.00	9.00	0.94	1.18	1.00	0.00	4.00	1.44	0.062
	20 th	0	3.38	3.62	2.00	0.00	11.00	2.75	3.45	1.00	0.00	9.00	0.63	0.673
		2	2.73	1.75	2.00	1.00	6.00	2.20	1.82	1.00	0.00	6.00	0.53	0.329
		3	2.44	1.31	2.50	0.00	5.00	1.25	1.84	0.50	0.00	6.00	1.19	0.062
VRT	1 st	0	1.75	1.28	2.00	0.00	3.00	2.50	1.85	2.50	0.00	5.00	-0.75	0.285
		2	0.87	0.92	1.00	0.00	3.00	1.07	1.03	1.00	0.00	3.00	-0.20	0.414
		3	1.25	2.02	0.00	0.00	6.00	1.25	1.61	0.50	0.00	5.00	0.00	1.000
	10 th	0	1.63	0.74	1.50	1.00	3.00	1.75	1.49	1.00	0.00	4.00	-0.13	0.705
		2	2.27	2.74	2.00	0.00	11.00	1.27	0.96	1.00	0.00	3.00	1.00	0.136
		3	1.13	1.15	1.00	0.00	4.00	0.63	0.72	0.50	0.00	2.00	0.50	0.084
	15 th	0	1.88	1.89	1.00	0.00	6.00	2.63	2.39	2.00	1.00	8.00	-0.75	0.063
		2	1.27	1.33	1.00	0.00	5.00	1.20	1.08	1.00	0.00	4.00	0.07	0.829
		3	1.13	1.26	1.00	0.00	5.00	0.88	0.96	1.00	0.00	3.00	0.25	0.726
	20 th	0	1.75	1.83	1.50	0.00	5.00	2.38	1.51	2.50	0.00	5.00	-0.63	0.180
		2	1.20	1.52	1.00	0.00	5.00	1.40	1.40	1.00	0.00	4.00	-0.20	0.607
		3	0.94	0.93	1.00	0.00	3.00	0.81	0.91	1.00	0.00	3.00	0.13	0.581
LAT	All measurements	0	1.72	0.84	1.50	1.00	3.50	1.22	1.10	0.88	0.25	3.75	0.50	0.034
		2	1.53	1.01	1.25	0.00	4.00	1.22	0.67	1.25	0.00	2.25	0.32	0.270
		3	1.19	0.76	1.13	0.25	2.50	0.70	0.64	0.50	0.00	2.25	0.48	0.002
LONG	All measurements	0	2.47	2.31	1.88	0.75	8.00	2.09	1.35	1.75	0.50	5.00	0.38	0.496
		2	2.47	1.38	2.25	0.50	5.50	1.83	1.61	1.25	0.25	6.00	0.63	0.013
		3	2.44	1.54	2.25	0.50	6.00	1.27	1.30	0.75	0.00	4.75	1.17	0.015
VRT	All measurements	0	1.75	1.19	1.50	0.50	4.00	2.31	1.49	1.75	1.25	5.25	-0.56	0.073
		2	1.40	1.18	1.00	0.25	4.75	1.23	0.79	1.00	0.00	2.75	0.17	0.555
		3	1.11	0.84	0.88	0.00	2.75	0.89	0.67	0.50	0.00	2.25	0.22	0.220

LAT = lateral; LONG = longitudinal; ME = median; M = mean; SD = standard deviation; target = primary tumour and lymph nodes; VRT = vertical