

Supplemental Material S3: Reference percentile estimates with 90% confidence intervals (CIs) for ASPEKT method quantitative videofluoroscopy measures by liquid consistency.

	IDDSI Level 0 (Thin)		IDDSI Level 1 (Slightly thick)		IDDSI Level 2 (Mildly thick)		IDDSI Level 3 (Moderately thick)		IDDSI Level 4 (Extremely thick)	
	Estimate	CI	Estimate	CI	Estimate	CI	Estimate	CI	Estimate	CI
Swallow Reaction Time (ms)	-	-	-	-	-	-	-	-	-	-
N	75		77		77		76		77	
Outliers (n)	1		0		0		1		0	
2.5th percentile	-33	(-33, 0)	-66	(-66, 33)	-33	(-66, 33)	-66	(-66, 33)	-66	(-99, -66)
5th percentile	0	(-33, 0)	-33	(-33, 0)	-33	(-33, 0)	-33	(-66, 0)	-66	(-66, -33)
25th percentile	66	(33, 66)	33	(33, 66)	66	(66, 66)	99	(66, 99)	132	(99, 132)
Median (50th percentile)	132		132		165		264		363	
75th percentile	396	(330, 4955)	396	(330, 495)	528	(462, 660)	660	(561, 792)	792	(660, 957)
95th percentile	825	(693, 990)	792	(693, 924)	1089	(891, 1320)	1254	(1089, 1452)	1452	(1254, 1683)
97.5th percentile	957	(792, 1122)	924	(792, 1089)	1287	(1089, 1518)	1452	(1254, 1716)	1683	(1419, 1914)
Hyoid-Burst-to-UES-Opening (ms)	-	-	-	-	-	-	-	-	-	-
N	75		75		77		77		77	
Outliers (n)	2		2		1		0		1	
2.5th percentile	33	(0, 33)	33	(33, 33)	33	(33, 66)	66	(33, 66)	66	(33, 99)
5th percentile	33	(33, 33)	33	(33, 66)	66	(33, 66)	66	(33, 99)	99	(33, 99)

25th percentile	66	(66, 66)	99	(99, 99)	99	(99, 99)	132	(99, 132)	132	(132, 132)
Median (50th percentile)	99		132		132		165		165	
75th percentile	132	(132, 132)	165	(165, 165)	165	(165, 165)	198	(198, 198)	198	(198, 198)
95th percentile	165	(165, 198)	198	(198, 198)	198	(198, 231)	231	(231, 264)	231	(231, 264)
97.5th percentile	198	(165, 198)	198	(198, 231)	231	(198, 231)	264	(231, 264)	264	(231, 264)
UES Opening Duration (ms)	-	-	-	-	-	-	-	-	-	-
N	70		77		77		75		74	
Outliers (n)	6		0		0		2		3	
2.5th percentile	396	(363, 396)	330	(330, 363)	330	(330, 363)	297	(297, 330)	297	(297, 297)
5th percentile	396	(396, 396)	363	(330, 363)	363	(330, 363)	330	(297, 330)	297	(297, 330)
25th percentile	429	(429, 429)	396	(396, 396)	396	(396, 396)	363	(363, 363)	363	(363, 363)
Median (50th percentile)	462		462		462		396		396	
75th percentile	528	(495, 528)	528	(495, 528)	528	(495, 528)	429	(429, 462)	429	(429, 462)
95th percentile	594	(561, 627)	594	(561, 627)	594	(561, 627)	528	(495, 528)	495	(495, 528)
97.5th percentile	627	(594, 660)	627	(594, 627)	627	(594, 660)	528	(528, 561)	528	(495, 528)
Time-to-LVC (ms)	-	-	-	-	-	-	-	-	-	-
N	77		77		77		77		77	
Outliers (n)	0		0		0		0		0	
2.5th percentile	33	(33, 66)	-99	(-198, -66)	-33	(-66, 0)	0	(-66, 33)	33	(33, 66)

5th percentile	66	(33, 66)	-66	(-132, 0)	0	(-33, 33)	33	(-33, 66)	66	(33, 66)
25th percentile	99	(99, 99)	66	(33, 66)	66	(66, 99)	99	(99, 99)	99	(99, 99)
Median (50th percentile)	132		132		132		165		132	
75th percentile	165	(165, 198)	231	(198, 231)	198	(198, 231)	198	(198, 231)	165	(165, 198)
95th percentile	264	(231, 264)	330	(297, 363)	330	(297, 363)	264	(231, 297)	264	(231, 264)
97.5th percentile	264	(231, 297)	363	(330, 429)	363	(297, 396)	297	(264, 297)	264	(264, 297)
LVC Duration (ms)										
N	75	-	73	-	76	-	77	-	74	-
Outliers (n)	0		4		1		0		3	
2.5th percentile	297	(264, 297)	297	(297, 330)	297	(264, 297)	297	(297, 330)	330	(297, 330)
5th percentile	297	(297, 330)	330	(297, 330)	297	(297, 330)	330	(297, 330)	330	(330, 363)
25th percentile	396	(396, 396)	396	(396, 396)	396	(396, 396)	396	(363, 396)	396	(396, 396)
Median (50th percentile)	462		462		462		429		429	
75th percentile	627	(561, 660)	561	(528, 594)	561	(528, 561)	528	(495, 561)	495	(462, 528)
95th percentile	858	(759, 924)	726	(660, 759)	660	(627, 726)	693	(627, 759)	594	(561, 627)
97.5th percentile	924	(825, 1023)	759	(726, 825)	726	(660, 759)	726	(693, 726)	627	(594, 693)
Vallecular Residue [% (C2-4)²]										
N	75	-	77	-	77	-	77	-	77	-
Outliers (n)	1		0		0		0		0	

Minimum										
2.5th percentile	0	(0, 0)	0	(0, 0)	0	(0, 0)	Unable to Estimate		Unable to Estimate	
5th percentile	0	(0, 0)	0	(0, 0)	0	(0, 0)	Unable to Estimate		Unable to Estimate	
25th percentile	0	(0, 0)	0	(0, 0)	0	(0, 0)	Unable to Estimate		Unable to Estimate	
Median (50th percentile)	0.1		0.1		0.1		0		0	
75th percentile	1	(0.5, 0.9)	1	(0.7, 1.3)	1.1	(0.8, 1.4)	0.6	(0.4, 0.8)	0.5	(0.4, 0.6)
95th percentile	1.5	(1.2, 1.8)	2.4	(1.9, 2.8)	2.5	(2, 3)	1.5	(1.2, 1.7)	1.3	(1, 1.5)
97.5th percentile	1.8	(1.5, 2.1)	2.8	(2.2, 3.4)	3	(2.4, 3.6)	1.8	(1.4, 2.1)	1.5	(1.2, 1.8)
Maximum										
% above 0	0.546666 667		0.532467 532		0.597402 597		0.493506 494		0.389610 39	
Pyriiform Sinus Residue [% (C2-4)²]										
N	76	-	77	-	75	-	77	-	77	-
Outliers (n)	0	-	0	-	2	-	0	-	0	-
Minimum										
2.5th percentile	Unable to Estimate		Unable to Estimate		Unable to Estimate		Unable to Estimate		Unable to Estimate	
5th percentile	Unable to Estimate		Unable to Estimate		Unable to Estimate		Unable to Estimate		Unable to Estimate	
25th percentile	Unable to Estimate		Unable to Estimate		Unable to Estimate		Unable to Estimate		Unable to Estimate	
Median (50th percentile)	0		0		0.1		0		0	

75th percentile	<i>Unable to Estimate</i>		0.6	(0.4, 0.9)	0.4	(0.3, 0.5)	0.5	(0.3, 0.7)	<i>Unable to Estimate</i>
95th percentile	1.6	(1.2, 2)	1.6	(1.1, 2.1)	0.9	(0.8, 1.1)	1.2	(0.8, 1.6)	<i>Unable to Estimate</i>
97.5th percentile	1.9	(1.5, 2.4)	1.9	(1.2, 2.6)	1.1	(0.9, 1.2)	1.4	(1, 2)	<i>Unable to Estimate</i>
Maximum									
% above 0	0.315789 474		0.376623 377		0.533333 333		0.376623 377		0.324675 325
Other Pharyngeal Residue									
[% (C2-4)²]	-	-	-	-	-	-	-	-	-
N	75		77		77		76		75
Outliers (n)	0		0		0		0		0
Minimum	0		0		0		0		0
2.5th percentile	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>		0	(0, 0)	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>
5th percentile	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>		0	(0, 0)	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>
25th percentile	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>		0	(0, 0)	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>
Median (50th percentile)	0		0		0		0		0
75th percentile	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>		0.6	(0.46, 0.74)	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>
95th percentile	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>		1.48	(1.2, 1.76)	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>
97.5th percentile	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>		1.77	(1.43, 2.13)	<i>Unable to Estimate</i>		<i>Unable to Estimate</i>
Maximum	1.3		2.2		2.4		5.05		5.85
% above 0	20%		29%		39%		29%		19%

Total Residue [% (C2-4)²]	-	-	-	-	-	-	-	-	-	
N	73		72		73		70		74	
Outliers (n)	2		5		4		6		1	
2.5th percentile	0	(0, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)
5th percentile	0	(0, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)
25th percentile	0	(0, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)
Median (50th percentile)	0.1		0.2		0.3		0.2		0.1	
75th percentile	1	(1, 1.8)	1.2	(0.9, 1.5)	1.7	(1.2, 2.1)	0.7	(0.6, 0.9)	1.2	(0.9, 1.5)
95th percentile	3.2	(2.6, 3.8)	2.7	(2.3, 3.2)	3.7	(3.1, 4.3)	1.5	(1.3, 1.8)	2.9	(2.3, 3.5)
97.5th percentile	3.8	(3.2, 4.5)	3.2	(2.6, 3.7)	4.3	(3.7, 5)	1.8	(1.5, 2)	3.4	(2.8, 4)
Maximum UES Diameter [% (C2-4)]	-	-	-	-	-	-	-	-	-	
N	75		76		76		77		76	
Outliers (n)	1		1		1		0		1	
2.5th percentile	9.4	(7.8, 363)	9.2	(8, 10.4)	9.2	(7.9, 10.4)	7.9	(7, 8.8)	8.9	(7.7, 330)
5th percentile	11.1	(9.7, 12.7)	10.4	(9.3, 11.5)	10.7	(9.4, 11.9)	8.8	(8, 9.7)	330	(9, 11.2)
25th percentile	17	(16, 561)	14.8	(14.3, 15.1)	15.4	(21.2, 23.6)	12.2	(11.9, 12.7)	13.8	(13.4, 14.2)
Median (50th percentile)	20.5		18.9		18.6		495		16.4	
75th percentile	24	(23.2, 25.9)	23.1	(21.7, 24.5)	22.4	(21.2, 23.6)	18.7	(17.6, 19.9)	19.5	(18.5, 20.5)
95th percentile	30.2	(28.7, 32.1)	29.2	(27.5, 31.3)	27.9	(26.4, 29.4)	24.1	(22.5, 25.8)	24	(22.8, 25.2)

97.5th percentile	32.1	(30.5, 34.1)	31.2	(29.4, 33.3)	29.7	(28, 31.5)	25.9	(24.1, 27.7)	25.5	(24, 26.9)
Pharyngeal Area at Maximum										
Pharyngeal Constriction [% (C2-4)²]			-	-	-	-	-	-	-	-
N	69		67		76		70		75	
Outliers (n)	7		10		1		7		2	
2.5th percentile	0	(NaN, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)
5th percentile	0	(NaN, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)	0	(0, 0)
25th percentile	0	(0, 0.2)	0.1	(0.1, 0.5)	0.2	(0.1, 0.5)	0	(0, 0.1)	0	(0, 0)
Median (50th percentile)	0.7		0.7		1.2		0.4		0.2	
75th percentile	2	(1.3, 2)	1.7	(1.3, 2)	3	(2.5, 3.6)	1.1	(0.8, 1.4)	1.2	(0.9, 1.5)
95th percentile	3	(2.6, 3.5)	3.1	(2.6, 3.5)	5.7	(4.8, 6.6)	2.1	(1.8, 2.4)	2.6	(2.2, 3)
97.5th percentile	3.5	(3, 3.9)	3.5	(3.0, 4.0)	6.5	(5.6, 7.4)	2.4	(2.1, 2.7)	3.1	(2.6, 3.6)
Pharyngeal Area at Rest [% (C2-4)²]										
	-	-	-	-	-	-	-	-	-	-
N	66		70		69		70		70	
Outliers (n)	0		2		1		2		0	
2.5th percentile	36.3	(33.5, 39.2)	36.4	(33.6, 39.2)	33	(29.7, 36.4)	35.7	(32.9, 38.5)	35.7	(32.4, 38.4)
5th percentile	39.1	(36.3, 41.6)	39.5	(36.6, 42.6)	36.7	(33.2, 40.1)	38.6	(35.7, 41.1)	38.4	(35.6, 41.1)
25th percentile	50	(48.2, 50.8)	50.3	(49.4, 51.6)	49.6	(48.1, 51.2)	49.1	(47.9, 50)	48.6	(47.3, 49.6)
Median (50th percentile)	59.1		60.5		58.9		59.1		57.5	

75th percentile	74	(69.6, 79.9)	71	(67.9, 74.6)	71.5	(67.4, 75.8)	71.5	(67.7, 75.4)	73.7	(68.9, 79.3)
95th percentile	96.8	(88.5, 105.1)	86.5	(81.4, 91.1)	89.8	(84.3, 95.6)	89.8	(84.2, 95.9)	97.2	(87.6, 106.4)
97.5th percentile	104.2	(95.5, 114.3)	91.6	(86.5, 97.2)	95.9	(90, 102.2)	95.8	(89.3, 102)	105	(94.6, 116.1)
Peak Hyoid										
Position - X [% (C2-4)]										
N	71	-	72	-	72	-	69	-	70	-
Outliers (n)	0	-	0	-	0	-	0	-	0	-
2.5th percentile	122	(120, 125)	119	(116, 121)	121	(119, 126)	120	(118, 122)	120	(118, 124)
5th percentile	125	(122, 128)	122	(119, 124)	124	(122, 128)	123	(120, 125)	123	(120, 127)
25th percentile	134	(133, 135)	132	(130, 133)	134	(133, 137)	132	(131, 133)	134	(133, 135)
Median (50th percentile)	142	-	141	-	143	-	140	-	143	-
75th percentile	156	(151, 160)	154	(150, 159)	155	(151, 159)	152	(148, 156)	154	(151, 158)
95th percentile	176	(169, 183)	174	(166, 182)	173	(167, 180)	170	(164, 177)	171	(166, 178)
97.5th percentile	182	(174, 191)	181	(173, 190)	179	(171, 187)	176	(169, 183)	177	(171, 184)
Peak Hyoid										
Position - Y [% (C2-4)]										
N	70	-	72	-	71	-	67	-	69	-
Outliers (n)	1	-	0	-	1	-	2	-	1	-
2.5th percentile	40	(32, 48)	39	(31, 46)	52	(45, 58)	47	(41, 53)	42	(33, 50)

N	71		71		70		69		70	
Outliers (n)	0		1		2		1		0	
2.5th percentile	71	(65, 79)	67	(63, 72)	73	(69, 77)	61	(54, 67)	67	(63, 71)
5th percentile	79	(71, 85)	73	(68, 77)	78	(73, 82)	67	(61, 74)	71	(68, 75)
25th percentile	103	(100, 105)	94	(92, 96)	96	(94, 98)	89	(87, 91)	89	(87, 91)
Median (50th percentile)	122		113		114		104		105	
75th percentile	142	(136, 149)	146	(135, 156)	139	(131, 148)	122	(115, 128)	138	(128, 148)
95th percentile	171	(161, 180)	193	(180, 208)	176	(166, 188)	148	(140, 157)	187	(171, 202)
97.5th percentile	180	(170, 191)	209	(195, 227)	189	(175, 202)	157	(148, 166)	203	(186, 221)

ms = milliseconds; LVC = Laryngeal Vestibule Closure; UES = Upper Esophageal Sphincter