

Supplemental Material S1. Operational definitions of temporal measures.

Component	Definition
Global oral transit time (gOTT, seconds)	The interval between the frame showing onset of manipulation of the bolus by the tongue in the oral cavity and the head of the bolus reaching the angle of the ramus of the mandible
Stage transition duration (STD, seconds)	The interval between the frame showing the head of the bolus reaching the angle of the ramus of the mandible and the frame showing onset of anterior-superior hyoid movement, associated with a swallow (Robbins, Hamilton, Lof, & Kempster, 1992)
Initiation of laryngeal closure (ILC, seconds)	The interval between the frame showing the head of the bolus reaching the angle of the ramus of the mandible to the frame showing contact of the arytenoids with base of the epiglottis (Rademaker, Pauloski, Logemann, & Shanahan, 1994; Robbins et al., 1992)
Laryngeal vestibule closure-reaction time (LVCrt, seconds)	The interval between the frame showing onset of anterior-superior hyoid movement, associated with a swallow and the frame showing contact of the arytenoids with base of the epiglottis (Macrae, Anderson, & Humbert, 2014)
Laryngeal closure duration (LCD, seconds)	The interval from the frame showing contact of the arytenoids with base of the epiglottis (airway closure) to the last frame showing this contact has discontinued (airway opening) (Rademaker, Pauloski, Colangelo, & Logemann, 1998)
Pharyngeal response time (PRT, seconds)	The interval from the frame showing onset of initiation of laryngeal elevation to the frame showing the tail of the bolus passing into the upper oesophageal sphincter (UOS) (Rademaker et al., 1998)
Pharyngeal transit time (PTT, seconds)	The interval from the frame showing the head of the bolus reaching the angle of the ramus of the mandible to the frame showing the tail of the bolus passing into the UOS (Power et al., 2006)
Upper oesophageal sphincter duration (UOSD, seconds)	The interval from first opening of the UOS (as signified by a column of air at the top of the narrowest part of the UOS or of contrast entering the narrowest part of the UOS) to the frame showing the tail of the bolus passing into the UOS (Kendall, McKenzie, Leonard, Gonçalves, & Walker, 2000; Power et al., 2006)

Initiation of pharyngeal swallow (IPS, range 0-4) (Martin-Harris et al., 2008)	Location of bolus head when initiation of pharyngeal swallow is triggered. 0: bolus head at posterior angle of ramus; 1: bolus head in valleculae; 2: bolus head at posterior laryngeal surface of epiglottis; 3: bolus head in pyriforms; 4: no visible initiation at any location
Bolus transport (BT, range 0-4) (Martin-Harris et al., 2008)	Pattern of bolus transport through oral cavity and lingual movement. 0: brisk tongue motion; 1: delayed initiation of tongue motion; 2: slowed tongue motion; 3: repetitive/ disorganized tongue motion; 4: minimal to no tongue motion.
Oral residue (OR, range 0-4) (Martin-Harris et al., 2008)	Residue in oral cavity. 0: complete oral clearance; 1: trace residue lining oral structures; 2: residue collection on oral structures; 3: majority of bolus remaining; 4: minimal to no clearance.
Pharyngeal residue (PR, range 0-4) (Martin-Harris et al., 2008)	Residue in pharynx. 0: complete pharyngeal clearance; 1: trace residue within or on pharyngeal structures; 2: collection of residue within or on pharyngeal structures; 3: majority of contrast within or on pharyngeal structures; 4: minimal to no pharyngeal clearance.

REFERENCES

- Kendall, K. A., McKenzie, S., Leonard, R. J., Gonçalves, M. I., & Walker, A. (2000). Timing of events in normal swallowing: a videofluoroscopic study. *Dysphagia*, 15(2), 74-83.
- Macrae, P., Anderson, C., & Humbert, I. (2014). Mechanisms of airway protection during chin-down swallowing. *J Speech Lang Hear Res*, 57(4), 1251-1258.
- Martin-Harris, B., Brodsky, M. B., Michel, Y., Castell, D. O., Schleicher, M., Sandidge, J., et al. (2008). MBS measurement tool for swallow impairment--MBSImp: establishing a standard. *Dysphagia*, 23(4), 392-405.
- Power, M. L., Fraser, C. H., Hobson, A., Singh, S., Tyrrell, P., Nicholson, D. A., et al. (2006). Evaluating oral stimulation as a treatment for dysphagia after stroke. *Dysphagia*, 21(1), 49-55.
- Rademaker, A. W., Pauloski, B. R., Colangelo, L. A., & Logemann, J. A. (1998). Age and volume effects on liquid swallowing function in normal women. *J Speech Lang Hear Res*, 41(2), 275-284.
- Rademaker, A. W., Pauloski, B. R., Logemann, J. A., & Shanahan, T. K. (1994). Oropharyngeal swallow efficiency as a representative measure of swallowing function. *J Speech Hear Res*, 37(2), 314-325.
- Robbins, J., Hamilton, J. W., Lof, G. L., & Kempster, G. B. (1992). Oropharyngeal swallowing in normal adults of different ages. *Gastroenterology*, 103(3), 823-829.