

ARE HYOID BONE KINEMATICS ASSOCIATED WITH SWALLOWING SAFETY?

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Introduction:

Hyoid movement is commonly evaluated in videofluoroscopic swallowing studies (VFSS), **but the link between hyoid movement and swallowing safety remains unclear.**

Research Questions:

Question 1: Do swallows with atypical hyoid kinematics have a significantly increased risk of:

- Penetration-Aspiration (PAS)
- Incomplete laryngeal vestibule closure (LVC)
- Late LVC?

Question 2: Does the combination of abnormal hyoid kinematics and delayed or incomplete LVC significantly increase the risk of penetration-aspiration?

Methods:

Participants:

- 305 adults (152 male)
- At-risk for non-congenital, nonsurgical, and non-oncological oropharyngeal dysphagia
- Mean age = 72 (range 28-100)

Data Collection:

- VFSS protocol of 6 thin liquid barium natural cup sips (20% w/v) captured at 30 images per second.

Methods:

VFSS Rating Procedure:

Blinded duplicate ratings were completed by trained raters to determine:

Swallowing Safety:

- PAS score (Rosenbek et. al, 1996)

LVC parameters:

- LVC integrity (complete vs. partial/incomplete)
- Time-to-LVC (the interval between onset of the hyoid burst and the first frame of LVC)

Hyoid kinematic parameters:

- Hyoid XY peak position and Hyoid XY Speed were derived using frame-by-frame tracking (10 frames prior to hyoid burst onset to rest)
- Values were normalized to a C2-C4 scalar.

Data Processing

Swallowing parameters were categorized as *typical* (i.e. within the healthy interquartile range) or *atypical* (<25%ile or >75%ile) based on published reference values (Steele et al., 2019; Smaoui et al., 2020).

Table 1. Published healthy reference values

Parameter	Reference Thresholds for Atypical Values
PAS Score	3 or higher
Time-to-LVC	> 198 ms
LVC integrity	partial or incomplete
Hyoid XY peak position	< 162%(C2-4)
Hyoid XY speed	< 96%(C2-4)/s

Statistical Analyses and Results:

Odds ratios were computed to determine the associations between atypical values for hyoid parameters and atypical values for PAS and LVC measures. The dataset was comprised of 1682 swallows.

Question 1: Significantly increased odds of PAS ≥ 3, incomplete LVC, and prolonged time-to-LVC were seen on swallows with reduced hyoid XY peak position or reduced hyoid XY speed (see Figure 1).

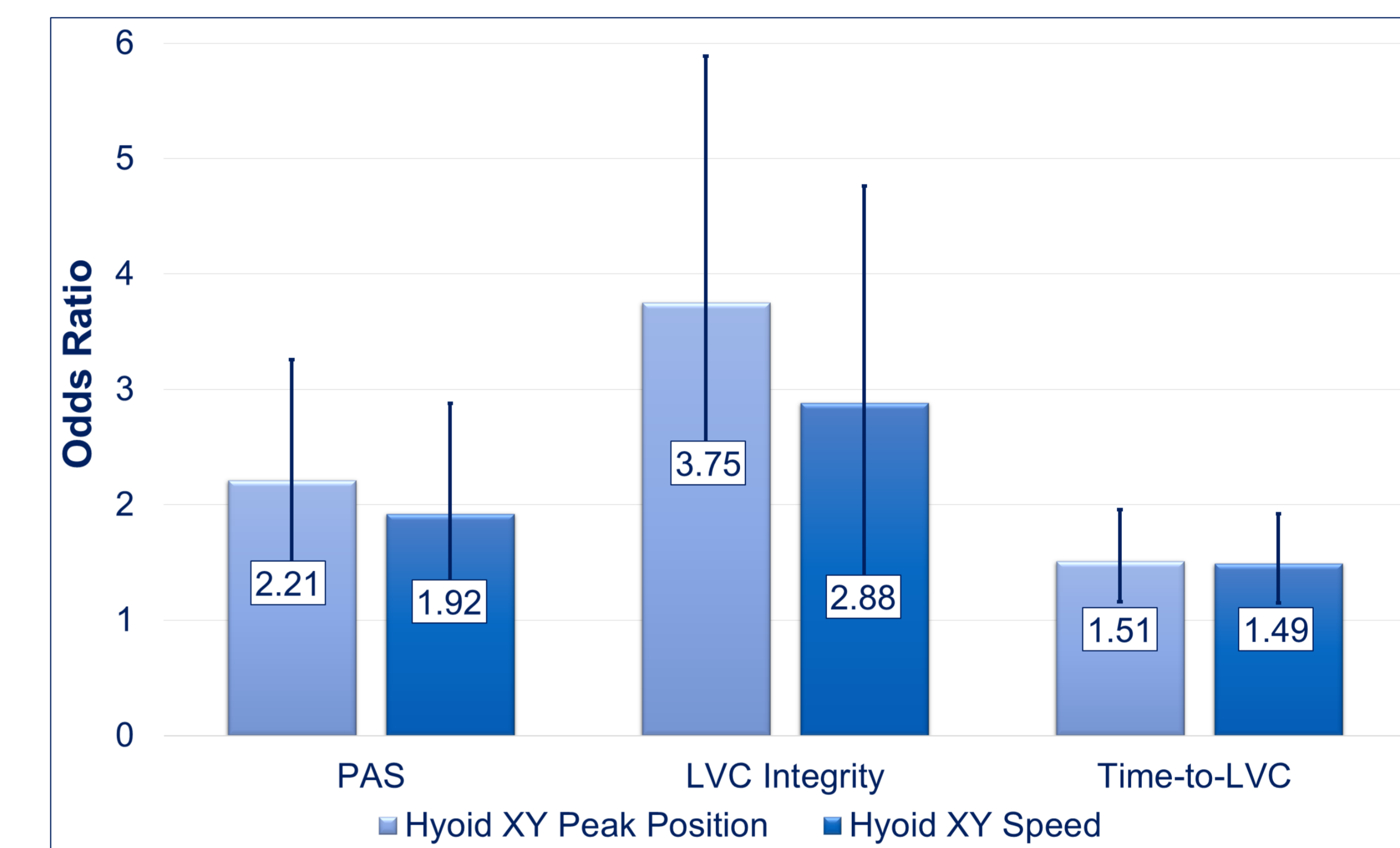


Figure 1. Odds of Atypical PAS and LVC parameters given reduced Hyoid Peak XY Position or Speed

Question 2: The odds of PAS ≥ 3 were increased 10.9-fold on swallows where there was co-occurrence of reduced hyoid XY peak position, reduced hyoid XY speed, incomplete LVC and atypical prolonged time-to-LVC.

Conclusions:

- These results corroborate previous studies suggesting links between hyoid movement and swallowing safety.
- Reductions in hyoid XY peak position and speed were highly predictive of PAS ≥ 3** in this heterogeneous sample of adults with risk for oropharyngeal dysphagia.