The Relationship between Relative Fundamental Frequency and a Kinematic Estimate of Laryngeal Stiffness in Healthy Adults

Objective: The purpose of this study was to examine the relationship between an acoustic measure, relative fundamental frequency (RFF), and a kinematic estimate of laryngeal stiffness during self-modulated effort in healthy speakers, to assist in validating RFF as a quantitative indicator of laryngeal tension.

Method: Twelve healthy adults produced repetitions of /i/ while varying their self-perceived vocal effort during simultaneous acoustic and nasal-endoscopic recordings. The acoustic measure of RFF was determined from the last ten voicing cycles before the voiceless obstruent (RFF offset) and the first ten voicing cycles of the following vowel (RFF onset). A kinematic estimate of laryngeal stiffness was determined for the gross vocal fold adductory gestures during re-voicing. A kinematic stiffness ratio was calculated by normalizing the maximum angular velocity by the maximum value of the glottic angle during the voiceless obstruent.

Results: A linear mixed effect model found that the RFF offset cycle 10 and first RFF onset cycle 1 were significant predictors of the kinematic stiffness ratios. The model accounted for 52% of the variance in the kinematic data. Individual relationships between RFF and kinematic stiffness ratios varied across subjects, but correlations were generally higher for RFF offset, with 83% of participants exhibiting at least a moderate negative linear relationship ($r = -0.5$ to -0.91), while only 40% of participants exhibited at least a moderate relationship during onset analyses ($r = -0.53$ to -0.79).

Conclusion: RFF significantly predicted kinematic estimates of laryngeal stiffness in healthy speakers and has the potential to be a useful clinical indicator of laryngeal tension. Further research is needed in individuals with tension-based voice disorders to determine its utility as a clinical tool.

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