

Effect of vocal intensity and fundamental frequency on cepstral peak prominence in women with and without voice disorders

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Introduction

Cepstrum-based voice measures, such as smoothed cepstral peak prominence (CPPS), have been recently recommend for voice assessment to objectively describe overall dysphonia [1]. However, in vocally healthy adults, cepstral measures were influenced by voice sound pressure level (SPL) changes [2, 3]. Since it is unclear if similar effects hold in adults with voice disorders and how these interact with natural fundamental frequency (f_0) changes, this study examines voice SPL and f_0 effects on CPPS in women with vocal hyperfunction and vocally healthy controls.

Methods

In a retrospective matched case-control study, 58 female voice patients 18–61 years of age (mean 27, SD 12.4) were paired with 58 vocally healthy women according to approximate age and occupation. The patient group comprised women diagnosed with phonotraumatic vocal hyperfunction associated with vocal fold nodules ($n=39$) or polyps ($n=5$), or non-phonotraumatic vocal hyperfunction associated with primary muscle tension dysphonia ($n=14$). All participants sustained the vowel /a/ at “soft”, “comfortable”, and “loud” conditions, and acoustic voice recordings were obtained at 10 cm distance. Voice SPL, f_0 , and CPPS (dB) were computed from the acoustic voice recordings using Praat [4]. The effects of loudness condition, measured voice SPL, and f_0 on CPPS were investigated with linear mixed models. Pairwise correlations among voice SPL, f_0 , and CPPS were assessed using multiple regression analysis.

Results

Results (Figure 1) show that increasing voice SPL correlated significantly ($p<.001$) with higher CPPS in both patient ($r2=.54$) and normative control groups ($r2=.45$). f_0 had statistically significant effects on CPPS ($p<.001$), with a weak relation for the patient ($r2=.02$) and control groups ($r2=.05$).

Discussion

While CPPS was moderately affected by the individual’s voice SPL in women with and without voice disorders, the effects of f_0 were considerably weaker. The direct relationship between CPPS and SPL in sustained vowels may be explained by a stronger harmonic source with increasing SPL. SPL related effects may be also present in connected speech samples of voice disordered adults, and also multiparametric indices incorporating CPPS [3]. Therefore, it is recommended to control for voice SPL variations in clinical assessments. This may be done by applying SPL-corrected values for CPPS or by taking care to elicit similar voice SPL levels throughout a patient’s stage of treatment for robust CPPS comparisons. Other potentially confounding factors such as sex, age, and voice training status should be investigated in the future on patients across a larger spectrum of voice disorders.

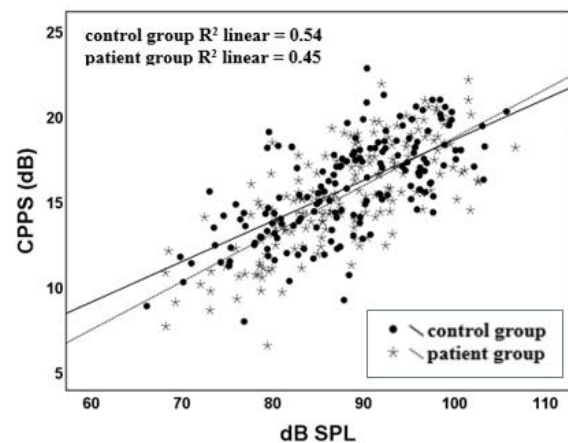


Figure 1: Relation between CPPS and voice SPL (dB SPL @10 cm). CPPS strongly increased with rising voice SPL in both the patient and control groups.

References

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