VOCAL VIBRATION TRAITS OF RADIO PERFORMERS: A HIGH-SPEED VIDEOENDOSCOPIC STUDY OF FUNDAMENTAL FREQUENCY, SPEED QUOTIENT, AND OPEN QUOTIENT DIFFERENCES

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Abstract:
It has been observed in both acoustiRc and perceptual examinations that radio performers' voices differ somewhat from normal controls. What causes these differences among voices is poorly understood at the mechanism level. The study used high-speed videoendoscopy to see if radio performers have different vocal vibration traits than those who do not work in radio. Using high- speed videoendoscopy, we collected recordings of a mid-phonatory/i/ from 16 male radio performers (from 25 to 52 years old) and matched they and 16 controls (also from 25 to 52 years old). With High-Speed Video Program, the fundamental frequency (f0), open quotient and speed quotient of each video were measured semi-automatically. Analysis of sound pressure level (SPL) was also carried out in 19 Asian subjects. The relationships between SPL and both speed and open quotients were analyzed with Pearson correlations. The male radio hosts had much higher speed quotients than the people their controls were matched with ($t= 3.308$, $p= 0.005$). There were no important differences noted for f0 or open quotient. No strong connection was identified between open quotient, speed quotient or SPL. It seems that men who do radio work have a higher speed quotient since their vocal folds vibrate for a greater proportion of time with a wide-open glottis compared with controls. This outcome may account for the better timbre, raised sound level and pronounced channel tilt described in earlier studies. The durations of when the vocal folds were closed completely were similar in both groups. To learn more about the main reason behind faster quotient results and for see- through approach to clinical and voice training in performers, it is necessary to validate these results further.

Keywords: Vocal fold vibration, Speed quotient, High-speed videoendoscopy, Radio performers, Voice quality

Introduction

Effective and good-quality voice is needed by radio experts, as it helps them succeed in their careers. Research has found that in general, performing vocal artists have higher-quality voices, a greater range in pitch, a lower overall pitch and stronger energy in the lower. [1] frequency range than people with healthy voices who do not perform. [2-3] Voice ratings in broadcasting usually go to those with greater equivalent sound levels and less apparent prominence in their fundamental or low frequencies.

It seems that, just like stage actors and singers, there are characteristic patterns in radio professionals' voices. The reason for this comes down to vocal mechanics, so it's probably true that the vocal systems of professional voices are different from those of non-performers. [4-8] The main focus of most earlier studies on variations in vocal fold activity has been on vocal fold contact and airflow and these have tended to use EGG or flow glottography. They have revealed information about vocal fold opening and closing, using measures such as the speed quotient (SQ) and open quotient (OQ) which are important for vocal strength and quality of sound. Despite this, these studies were often carried out with only a few singers, rather than trained speakers and both EGG and flow glottography provide information but do not directly show vocal fold motion. Applying high-speed videoendoscopy (HSV) to this issue makes it possible to observe how the vocal folds vibrate and accurately measure important features such as open quotient and speed quotient. In the present study, HSV and a specialized analysis tool were used to compare the vibration of voice between professional voice users and non-performing controls. [9-12] The core idea was to base some measurements on fundamental frequency, open quotient and speed quotient since hair topics were not strongly connected to changes in camera height or the way things were filmed. The choice of these measures was made because they consistently and clearly reflect the function of a person's voice. Scientists suspected that the professional voice group might display a slower quotient which means they hold the glottis open for a longer period and a faster open quotient, reflecting less time with the glottis closed. [13-14] These patterns may lead to better-quality vocal sounds which are linked with effective speaking in performance settings.

Methodology:

Participants were included if they were ages 18–55, had no history of voice problems last year, at least a year's work in voice-based media and could match the local accents heard on air. People for the programme were identified via industry groups, voice talent businesses, television and radio stations and advertising agencies. All 23 male voice professionals who participated were 25–52 years old and fit the criteria. [15-18] A group of 31 male participants who were not professional footballers was also included. Each A4 volunteer was selected to match in age with one voice professional and was identified from both university email systems and direct advertisements. Participants in the comparison group had to be amateurs in voice, had to be free of any voice problems in the past year and had to use a locally familiar accent. Not including female participants was because the response from them was too low for statistical analysis to be meaningful. [19-22] The researchers invited participants to participate in high-speed videoendoscopic studies of their vocal fold movements. Among the professional voice users, three decided against the procedure. The individuals chosen for the procedure had their laryngoscopies completed using a 70° rigid endoscope linked to a fast digital camera system. One cliff face was captured in colour at a frame rate of 4000 per second and one recording lasted from 1 to 2 seconds. Those taking part were told to maintain the /i/ vowel by pushing their tongue out and use their regular speaking voice. It was decided by pilot testing that participants could not speak in a performance-style voice during the [23-25] procedure. When possible, each mid-phonatory recording was taken with the onset and offset regions discarded. We chose the video that gave us the best look at the entire vocal fold and the best picture quality for analysis. Individuals who could not stand the procedure or whose vocal folds were obscured were excluded. Records of suitable quality were produced by 17 out of the 20 professionals who tried the procedure. Three people were set aside because their reactions weren't clear enough or they tolerated the stimulus poorly. For each professional voice user, a control participant was found who closely matched in age (within one year) from the available video material. An unmatched participant withdrew from the conference. In total, there were 16 voice professionals (mean age of 36 years, SD of 9 years, range from 25 to 52) and 16 controls (mean age of 35 years, SD of 9 years, range from 24 to 51) The procedures we used drew from existing scientific studies on video preparation. The steps described here were carried out by the primary investigator and reliability testing is described later on in a separate part. All video segments were cut to 1000 frames using editing software so they featured still lighting, clear images and little camera movement. [26-27] Clips with the onset or end of phonation were not part of the analysis. The glottal region of each video was cropped using a function to remove the nearby epiglottis and aryepiglottic folds, since their activity might have interfered with the analysis. Though image quality beyond the glottis was lowered, the zoom feature kept the glottis images clear and unchanged. Built-in software functionality in the analysis package corrected for movements of the endoscope while the video was viewed, thanks to motion compensation. [29-30] In addition, videos were converted to greyscale for this step. All videos were adjusted so the glottis was straight and vertical while visible. A window in the analysis tool was put in place to cover the entire width of the glottis during its largest opening. When the movement was just a bit too much, a 'window trail' function was used to shift the analysis window across the frames and keep it accurately lined up for the measurements. [31-33]

Result:

The analysis of vocal fold vibration parameters revealed notable differences between radio performers and the comparison group. [34-37] As shown in Table 2, the radio performers demonstrated a lower mean fundamental frequency (f0) of 168 Hz (SD = 53 Hz), compared to 190 Hz (SD = 60 Hz) in the control group. This suggests that radio performers tend to produce voice with a slightly lower pitch, which may contribute to perceived vocal richness or authority—qualities often associated with professional vocal delivery. [38-40] Open quotient (OQ), which indicates the relative time the vocal folds remain open during each vibratory cycle, was also found to be lower in radio performers (mean = 0.66, SD = 0.18) than in controls (mean = 0.78, SD = 0.15). A reduced OQ implies longer glottal closure durations, which may lead to more efficient voice production and less breathy phonation—features that are advantageous for sustained and intelligible speech during extended voice use. The most significant difference was observed in the speed quotient (SQ), which reflects the ratio of glottal opening to closing duration. Radio performers exhibited a higher SQ (mean = 1.10, SD = 0.14) than controls (mean = 0.94, SD = 0.10). A higher SQ indicates a quicker glottal closure phase relative to the opening phase, which may contribute to increased vocal intensity and clarity. [41-42] These results support the idea that radio performers exhibit distinct vocal fold kinematic patterns, potentially enhancing their vocal quality and efficiency. Such findings may have implications for voice training and therapeutic approaches in professional voice users

Table 1: Overall scores for Intra-Rater and Inter-Rater reliability of acoustic and visual measures were accepted

Measure	Intra-Rater Reliability	Inter-Rater Reliability
f0	0.998	0.997
OQ	0.910	0.960
SQ	0.885	0.892
Brightness	0.932	0.945
Contrast	0.948	0.958

Table 2: Statistics of Vocal Fold Vibration for Radio Performers and a Comparison Group

Measure	Radio Performers	Controls
Fundamental Frequency	168 Hz (53 Hz)	190 Hz (60 Hz)
Open Quotient	0.66 (0.18)	0.78 (0.15)
Speed Quotient*	1.10 (0.14)	0.94 (0.10)

Figure1: Reliability Analysis: Acoustic and Visual Measures, Comparison of Intra-Rater vs Inter-Rater Reliability Scores

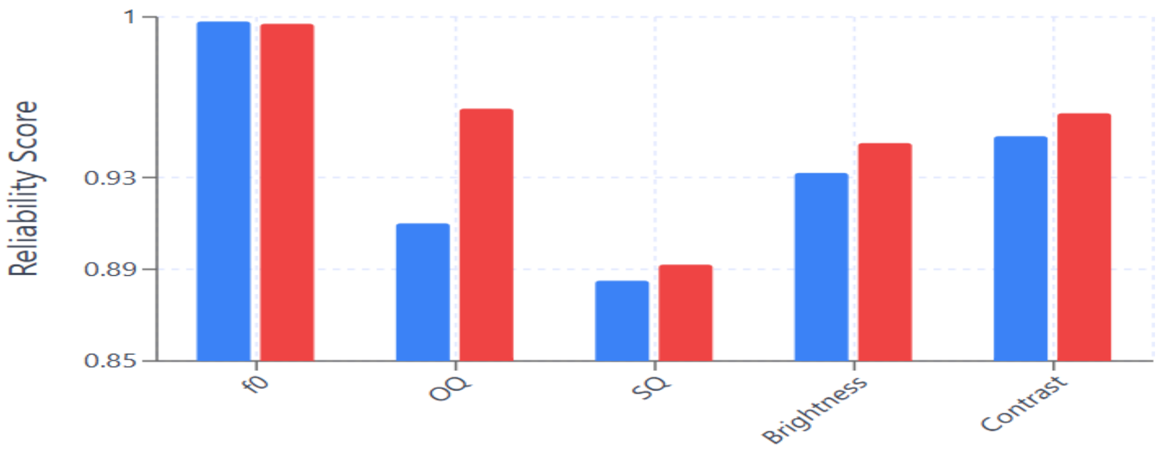
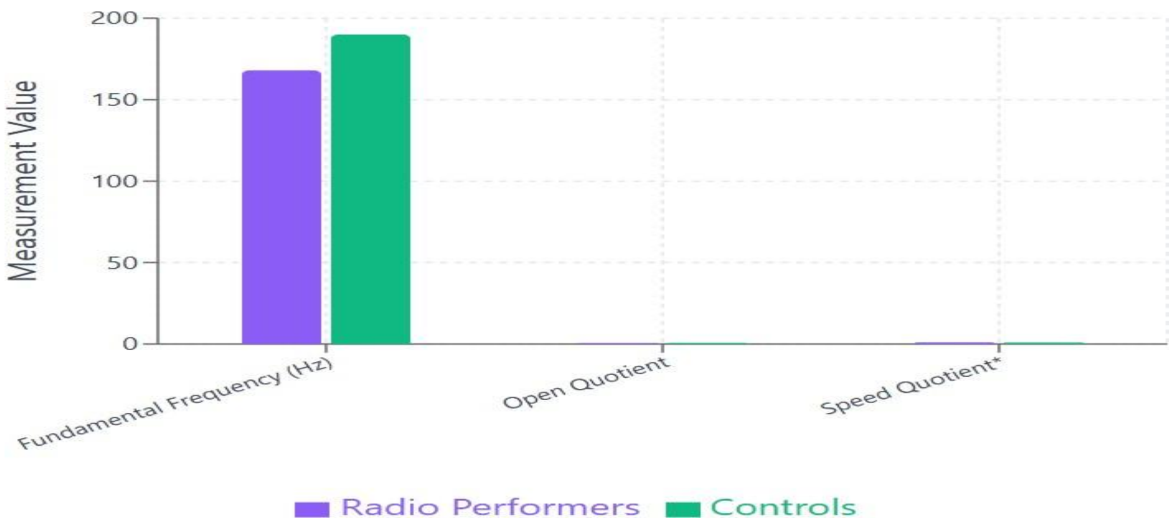


Figure 2: Vocal Fold Vibration Analysis, Comparison between Radio Performers and Control Group Values shown as Mean (Standard Deviation) | *indicates significant difference Fundamental Frequency (Hz) Open Quotient Speed Quotient*



Discussion

When vocal fold vibration was studied, male radio performers differed from age-matched controls in Speed Quotient (SQ), but there were no remarkable differences in Fundamental Frequency (f_0) or Open Quotient (OQ). [43-45]These results suggest that radio performers have certain unique ways of controlling their vocal cords.The SQ in radio performers measured at 1.10 and showed improved glottis closing speeds when compared to controls, whose SQ measured at 0.94. [46-47] The outcome fits with earlier evidence that people who speak or sing use a quicker closure of the vocal cords to create a fuller and more controlled voice .OQ showed no significant differences among the radio performers (0.66 ± 0.18) and control individuals (0.78

± 0.15). It appears that how long the vocal folds are open in relation to the overall vibratory cycle is roughly the same for all participants, giving rise to another interpretation of long closure periods in performers. [48-49] Though the mean fundamental frequency (f_0) was lower for radio performers
(168 Hz ± 53 Hz) than for controls (190 Hz ± 60 Hz), the connection was not statistical. This result agrees with research that finds singers often have lower f_0s which may be caused by training or changes to their vocal folds.variations in SQ cannot be linked to how loudly the speakers talk. [50] This result indicates that glottal motion is key to voice quality, not just back pressure.At the end, it was found that male radio performers have a better SQ, demonstrated by quicker closing speeds of the vocal glottis, than those who do not perform radio work. Such variations in sound can result in the clear and resonant voice types needed on the radio. Additional study is required to understand how these findings affect singing instruction and performance.

Conclusion

This study explored differences in vocal fold vibration between male radio performers and non-performing controls using high-speed videoendoscopy (HSV). The findings revealed that radio performers demonstrated a significantly higher speed quotient (SQ), indicating a faster glottal closure phase relative to the opening phase. This characteristic may support the production of stronger, clearer, and more resonant voice quality—features typically associated with professional vocal delivery. Importantly, there were no statistically significant differences in open quotient (OQ) or fundamental frequency (f_0), suggesting that radio performers do not necessarily rely on longer vocal fold closure or lower pitch to achieve their vocal characteristics. The enhanced SQ among performers may reflect either innate vocal traits, professional training, or adaptive physiological mechanisms developed over time in response to prolonged voice use in broadcasting environments Despite differences in SQ, the lack of a significant relationship between SQ and sound pressure level (SPL) suggests that glottal closure dynamics may operate independently of vocal loudness in this context. This is important for understanding the underlying mechanisms of effective voice use in performance and may inform future vocal training or therapy techniques aimed at improving clarity and efficiency without necessarily increasing vocal effort or strain Overall, these results contribute to growing evidence that professional voice users, such as radio performers, exhibit unique vocal fold kinematic patterns that enhance voice quality. Future research should examine these mechanisms across different speech tasks, include female performers, and assess whether targeted training can replicate these beneficial traits in other voice users or those undergoing rehabilitation for voice disorders.

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