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The Ease and Effects of Oral Rinsing in the Acoustic Parameters of Voice in Carnatic Female Singers: A Warm-Up Protocol

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Abstract

Background: Vocal hygiene and vocal warm-up exercises are commonly used practices in the rehabilitation for professional voice users. Throat gargling and oral rinsing influence maintaining overall vocal hygiene, immediate humidification on vocal folds, and oral rinsing is considered as one of the warm-up exercises, as stated in Ayurvedic practices by the name "Gandusha." Practicing this has benefits of improving the strength of mandible, giving more strength and power to voice, along with preventing dryness of throat and mouth, but no scientific evidence to prove the same.

Objective: To investigate the immediate effects of oral rinsing on acoustic characteristics of voice among female singers.

Method: Total of 19 female Carnatic singers with age range of 18 to 25 years with minimum 2 years of singing experience participated in the study. Participants were given maximum of 240mL of normal mineral water with no electrolytes added, were instructed to comfortably oral rinse for 2 minutes, by puffing their cheeks and feeling the pressure on all the articulators. Phonation samples were collected before and immediately after the task.

Results: The mean values of pre and post of jitter, shimmer and SAPQ values were decreased, with slight increase in f0, SPPQ; and no changes in NHR. No difference was seen in LTAS and CPP values.

Conclusion: In view of the better objective evidence for oral rinsing, as well as the ease of this act, authors suggest oral rinsing to be considered as one of the warm-up exercises during voice rehabilitation in professional voice users.

Keywords: Gandusha; Oral-rinsing; Vocal warm-up; Carnatic female singers.

Introduction

Warm-up exercises are required for many physical activities to function effectively. The vocal warm-up exercises play a major role in voice production. An effective vocal warm-up exercise should include stretching the muscles, maintaining adequate breath, and preparing the articulators and resonators [1], all of which relaxes the vocal folds, in turn reducing the laryngeal muscle tension [2]. There are many vocal warm-up exercises listed in the literature that are effective in bringing down the tension and rigidity of the muscles. They are yawning, breathing, gliding from low to high pitch and high to a low pitch, humming, chant talk, jaw relaxation, and laryngeal massage. Other forms of vocal warm-up exercises mentioned in the literature are semi-occluded vocal tract exercises, wherein the constriction or narrowing of the vocal tract at the level of articulators or beyond makes the vocal tract shorter, thereby decreasing the glottal resistance and increasing the airflow [3-5]. With the warm-up exercises of sustaining vowels and gliding of pitches from low to high and high to low in commercial singers, positive effects on acoustical parameters of voice along with self-perception of good voice quality and phonatory effort were seen (Fantini et al., 2017) [4]. Similarly, improved aerodynamic and glottal resistance were found in long-

duration straw phonation against short duration in healthy normal individuals [6]. There was considerable change in acoustic as well as perceptual characteristics with improved self-perceptions after vocal warm-up exercises such as lip trills, tongue trills, and voiced fricative sounds [7].

Singers often adopt some warm-up exercises in order to increase the vocal performance and the quality of voice during singing (Cook-cunningham & Grady, 2017). Some of the professional voice users routinely use vocal warm down exercises such as relaxed humming, easy cooing the 'u' vowel, and massaging the head and neck region to release excessive muscle contraction exhibited during the rehearsal of vocally demanding roles [8]. Despite positive objective results after vocal warm-up exercises, the same has not been appreciated in the self-perception measures by few professional voice users. In one of the vocalist's pilot survey, 25.6% of the participants reported voice problems despite vocal warm-up exercises [9]. A vocal warm-up study done to investigate its effect on vocal fatigue failed to reveal any significant changes in the phonation threshold pressure and self-perceived phonatory effort in participants with chronic vocal fatigue [10].

Apart from these traditional warm-up exercises, gargling and oral rinsing are also considered for relaxing or prepping the muscles for further activities. The throat gargling and oral rinsing have an effect on maintaining overall vocal hygiene, immediate humidification on vocal folds, and gargling is considered as one of the warm-up exercises [11-14]. The oral rinsing action is restricted to the oral cavity by stimulating the active articulators during the process, possibly giving a warm-up effect for the buccinators muscle, tongue, soft uvula, and lips. By filling the fluid in oral cavity completely, makes it impossible for gargling. This technique called "Gandusha" has been mentioned in ancient literature of Ayurvedic practices for good health [15]. The benefits of practicing this technique in a daily routine had mentioned that it improves the strength of mandible, gives more strength and power to voice, along with preventing dryness of throat and mouth [16]. Till date, there is no scientific evidence on the effects of oral rinsing on vocal characteristics. Since this is simple technique and can be practiced as a daily routine regime, the current study is planned in this direction. Singers will be the reliable target population since they can be aware of the subtle change in their voice quality and most of them rely on self-perception. Hence the current study is aimed at investigating the immediate effects of oral rinsing in professional voice users i.e., singers. The objective of the study is to investigate the changes in the acoustical characteristics of voice due to oral rinsing.

Method

The Institutional Ethical Committee approved the protocol of pretest-posttest study design, which included 19 singers. All the participants were females within the age range of 18 to 25 years (mean age: 21.36 ± 1.6 years). They were Carnatic classical singers with singing experience of more than 2 years. Participants with the use of substances that may affect normal vocal function and larynx mucosa such as tobacco, caffeine, alcohol, and medications were excluded from the study. Since this was a preliminary study, only female participants were included to maintain homogeneity.

Instrumentation: Following are the instruments and software used in the study

- Pre and post voice recording was done using Computerized Speech Lab (CSL Kay Pentax 4150) system. For acoustic analysis and extraction of the parameters like Fundamental frequency (f0), Jitter (%), Shimmer (%), Smoothened pitch perturbation quotient (SPPQ), Amplitude perturbation quotient (SAPQ), Noise to harmonic ratio (NHR), the Multidimensional Voice Program (MDVP), a module of CSL was used. CSL was also used to analyze long term average spectrum (LTAS) by extracting the highest peak between 0-2kHz and its respective intensity [17]. A steady state sustained phonation of /a/ for 5secs was obtained for analyzing the acoustic characteristics in MDVP and pitch gliding for LTAS.

- For the same phonation samples, the cepstral analysis was carried out using a z-tool (speech tool program software) given by Hillenbrand [18].

Procedure: The study involved oral rinsing activity as vocal warm-up exercise. Participants were instructed to puff their cheeks and feel the pressure at cheek muscles and on soft palate along with movement of the tongue in all possible degrees of freedom keeping water inside the mouth, allowing the movement towards the base of the tongue without swallowing the water. The participants were given a maximum of 8ounce (240mL) of normal mineral water with no electrolytes added, at room temperature, and were instructed to comfortably oral rinse for 2 minutes, with break as and when required to avoid muscle fatigue/ strain. Voice recordings were done before and immediately after the activity to note the immediate effects. The stimulus of sustained phonation of the vowel /a/ for a minimum of 8 seconds and pitch gliding task from low to high pitch at their comfortable loudness were collected from all the participants in a quiet room using CSL system with audio Neutrik unidirectional microphone. The sampling frequency of 50 kHz was used with 16-bit digit audio signal recording. The loudness aspect of every participant was ensured and monitored by maintaining the mouth to microphone distance constant at 30cms in line with suggestions by investigators [19]. Comparison between pre and post oral rinsing measures was done.

Results

Raw data were entered into SPSS version 17 software for statistical analysis. Mean, and Standard deviation were obtained for the entire data. For the parameters such as fundamental frequency, CPP, LTAS, with the data having normal distribution, paired t-test was conducted to evaluate the significant difference between pre and post oral rinsing activity. And for the data which did not follow normal distribution, Wilcoxon Signed Rank tests were conducted to check for the significant group difference.

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Mean values and standard deviation of the acoustical parameters are listed in Table 1, for before and after the oral rinsing activity. Changes were observed in the mean scores of a few parameters but, Paired t-test and Wilcoxon Sign Rank test failed to indicate any significant difference in the pre and post values.

Table 1: Mean, Standard deviation and p-value of acoustic parameters for all the participants before and after Oral Rinsing activity.

	Oral Rinsing				
	Pre		Post		p-value
	Mean	STD	Mean	STD	
Fo (Hz)	226	19.8	248	20.6	0.530*
Jitter (%)	0.82	0.18	0.63	0.39	0.100
Shimmer (%)	3.46	0.05	2.45	0.5	0.320
SPPQ (%)	0.35	0.27	0.49	0.36	0.112
SAPQ (%)	5.35	0.96	2.20	0.66	0.708
NHR	0.08	0.07	0.08	0.06	0.095
CPP (dB)	17.45	2.25	16.91	2.42	0.122*
LTAS (Hz)	2937.9	346	3050.5	371	0.527*
LTAS (dB)	18.49	5.9	19.43	5.1	0.124*

Note: *indicates p-value obtained from parametric test.

Table 1 shows the mean values of pre and post oral rinsing for the acoustical parameters f0, jitter, shimmer, SAPQ, SPPQ, NHR, along with CPP and LTAS. The mean values of pre and post for oral rinsing activity of jitter, shimmer and SAPQ values were decreased, with slight increase in f0, SPPQ; and no changes in NHR. No difference was seen in LTAS and CPP values.

Discussion

The main aim of the current study was to investigate the acoustical changes of voice immediately after performing the oral rinsing exercise among singers. It is established that the muscles should be stimulated to perform any activity optimally. The agonist and antagonist muscles are responsible for the proper maintenance of length-tension and balance. These muscles stretch and contract against one another depending on the activity and maintain the tension and balance between them [20]. For any physical activity, warm-up exercises are reported to be effective to keep the muscles in action for a better performance. The tissues and muscles respond actively and favorably once they undergo warm-up activities owing to improved blood circulation to specific tissues of the muscles, along with the temperature maintenance required for the activity. Voice production also follows the same trend. The prolonged usage of voice leads to vocal fatigue, and warm-up exercises prevent vocal fatigue or damage [21].

In the current study, the oral rinsing with water was considered as the warm-up exercise, since it involves stimulating the active articulators and resonators like buccinators, mandible, tongue, uvula and rest of the passive articulators, which may relax the muscles. Even though oral rinsing activity does not target the laryngeal muscles directly, it was intended to see if this activity results in any acoustic changes in voice, in line with some warm-up exercises like lip/tongue trills mentioned in the literature. The acoustical parameters such as frequency and amplitude perturbation measures indicate the regularity or periodicity of the vocal folds in terms of pitch and loudness [22], for the sustained phonation of vowel stimuli. Through LTAS, maximum energy and highest frequency range was obtained using pitch glide sample, with the participants producing the maximum frequencies/ range [23]. CPP is the measure of harmonic configuration and an indicator of breathiness in the voice, which was obtained through sustained phonation of the vowel [24,25]. The results indicated increased mean values for f0, SAPQ, and NHR; no change in shimmer; and decreased mean scores for jitter and SPPQ. However, the inferential statistics showed no significant difference. The reduction in the mean CPP value among the participants of oral rinsing group indicates breathy voice quality, which failed to reach significant statistical value.

The effort required for oral rinsing is different compared to any other warm-up activities. During rinsing, the majority of the active articulators participate and stimulate the muscles along with passive articulators. Moreover, there is no tension in the laryngeal area or strain in the neck. With oral rinsing, the mean scores of pitches and amplitude perturbation parameters such as jitter, shimmer, and SAPQ had decreased in post values showing a favorable change in the voice quality by decreasing the variation in pitch and amplitude. The resonators of the vocal tract help in achieving good harmonics, which would have contributed to reduced perturbation measures. During the oral rinsing process, the complete closure of the vocal tract at the anterior end makes vocal tract shorter, thereby increasing the impedance of the vocal

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tract. The subglottic pressure increases owing to the closure at one end of the vocal tract, and the airflow balances between the subglottic and supraglottic region along with the controlled exhalation. Along with this, the puffing of cheeks and movement of the tongue inside the oral cavity during rinsing stimulates the resonators and articulators, which helps in relaxing the tongue, cheeks, mandible, posterior portion of the oral cavity, and to some extent the pharyngeal muscles too [26-28]. Since the head posture is normal with no involvement of vocal folds during this activity, oral rinsing serves as an easy and simple vocal warm-up exercise. The lack of significant difference could be due to the small sample size. Moreover, the targeted acoustical measures may not be the true reflection of the benefit derived from oral rinsing; the ease of phonation, self-perception of voice, and vocal preparedness can be assessment protocols in the upcoming studies. Further research can be conducted with a greater number of participants, in both the genders, as well as on different professional voice users, by varying the duration of rinsing activity.

Conclusion

This was a preliminary study to investigate the efficacy of oral rinsing as a warm-up exercise among singers. The results showed no significant difference in pre and post values on acoustical parameters, though the mean differences were favorable. In view of the better objective evidence for oral rinsing, as well as the ease of this act, authors suggest oral rinsing to be considered as one of the warm-up exercises during voice rehabilitation in professional voice users. More probes are essential for larger participants, involving other professional voice users too.

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