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'Why Can I Not Hit My Notes?' A Case Series on the Need for Multi-Parametric Voice Assessment Protocol for Singers

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Abstract

The ability to configure the vocal tract to enhance and attain the most efficient and economical vocal range and vocal modulations is of paramount importance to singers. This ability to sing in the desired voice may be affected by multiple organic or functional factors/ etiologies. Hence, when a singer consults a Speech Language Pathologist/ Voice therapist, there is a need to perform a multi-parametric assessment of voice to identify the cause of vocal symptoms and to design an individualized therapy plan. This case series includes 5 trained singers who consulted a voice therapist with the major complaint of inability to sing in the desired vocal range, intermittent change in voice quality, or strain while singing. The multi-parametric assessment protocol comprised of a detailed case history, visualization of vocal folds, an array of acoustic evaluations, and clinician-rated and self-rated perceptual tests. The findings of the assessment were compared with the normative of these tests. The assessment protocol helped to identify 2 singers with organic lesions while the other 3 had changes in their vocal range due to hormonal variations, aging, and post-COVID. Inappropriate vocal and non-vocal habits were identified. The perceived effect of the voice change ranged from mild to severe. The findings of the assessment formed the baseline for the individualized treatment plan. Administering a multi-parametric voice assessment protocol enables singers and voice therapists to identify and intervene in various etiologies that limit the vocal range or affect the vocal quality, and thus prevent any secondary voice disorders.

Keywords : Vocal range, Vocal symptoms, Voice Assessment Protocol, Voice Therapy, Vocal Hygiene program

Research Paper

Introduction

Voice gives uniqueness to a person's identity and for a singer, it is an asset. Humans have adapted the function of the vocal tract to produce musical tones of varying pitch and loudness for singing. This adaptation of the vocal tract function for singing must be in the most efficient and economical pattern or else it may result in adverse vocal symptoms. Indian classical singing encompasses certain techniques to achieve the desired vocal output during singing (Mohan). The singers are generally trained for many years with long hours of vocal practice each day, follow a modified lifestyle, and have long durations of performances. Their vocal range may range from 2 to 2.5 octaves (Arunachalam et al. 128.e1).

The prevalence of voice disorders in professional singers is generally high due to multiple intrinsic and extrinsic factors that affect their professional lives, and in turn, affect their personal lives (Devadas et al. 303.e1; Pestana et al. 722). They were also reported to have high levels of stress and psychological consequences of their voice disorders (Nair et al. 161). These voice disorders, if identified at an early stage, can be treated and also prevent the onset of compensatory voice problems. In the study by Arunachalam et al. (128.e1), the most common conditions reported by Carnatic singers were laryngopharyngeal reflux (LPR), muscle tension dysphonia (MTD), and chronic laryngitis.

The most reported vocal symptoms are change in voice, difficulty hitting higher notes, and vocal fatigue with a reduction in the Maximum Phonation Time (MPT) and deviations in acoustics and perceptual parameters of voice (Arunachalam et al. 128.e1). Older singers were reported to have significant differences in terms of MPT, maximum fundamental frequency (F0), and Dysphonia Severity Index (DSI) (Maruthy and Ravibabu 65).

In the clinical practice, we may come across singers whose chief complaint is "I cannot sing the desired pitch/ note" with no change in the quality of voice. As they belong to the category of elite voice users, even a slight change in voice can hinder their professional functioning drastically. In such cases, though communication is not affected, singers may feel stressed and handicapped, especially during performances (Primov-Fever et al. 586.e1). This difficulty to hit the right notes or transition between voice registers may be due to faulty singing techniques which need to be rectified by vocal training and practice. However, if there is an underlying voice disorder that needs to be medically or therapeutically managed, the singer must consult an Otolaryngologist or a voice therapist at the earliest before the onset of compensatory/secondary voice problems.

An evidence-based management plan can be implemented only if the etiology and the associated factors are identified. To achieve this outcome, a multiparametric assessment has always been recommended in the literature. In the cases where singing in a particular range or transitioning from one register to another is the only chief complaint with consecutive vocal fatigue, multiparametric assessment needs to be carried out as a gross deviation may not be evident on perceptual evaluation. Hence, the current case series was planned to document how a multiparametric voice assessment protocol helps in identifying underlying etiologies and factors that may lead to difficulty in singing the desired notes, and how voice therapists can plan therapy based on these findings.

Method

The present case series comprises of 5 cases of female professional singers trained in Hindustani Sangeet for more than 3 years (Mohan). Their primary complaint was difficulty in attaining desirable pitch, or perceptual change in vocal range, with or without other voice changes. A multiparametric voice assessment protocol was used in these cases to identify the etiology/cause of vocal symptoms. The multiparametric voice assessment protocol comprised of –

1. Case history–to collect information regarding the vocal symptoms, associated factors and medical conditions, vocal and non-vocal habits.
2. Videolaryndostroboscopy (VSL)–a procedure to assess the structure and function of the larynx, to assess the mucosal waves.
3. GRBAS rating scale–scale to rate perceptual parameters of vocal quality by the clinician.
4. Singing Voice Handicap Index 10 (SVHI)–questionnaire for self-perceived vocal handicap by singers.
5. Maximum Phonation Time (MPT)–subjective aerodynamic evaluation of breath support for phonation.
6. Multidimensional Voice Program (MDVP)–to assess the acoustic parameters of voice and compare with the pre-established normative for sustained phonation of vowels.
7. Voice Range profile (VRP)–to determine the frequency range and the energy range attainable for singing.
8. Participants were also instructed to sing a song in which they perceived difficulty in singing/ transitioning to higher or lower pitches. The sample was recorded. Postural misalignment of the head, neck, and torso, breathing pattern, and external muscle tension were also noted.

The data from the tests and questionnaires in the protocol was compiled for each participant to identify the etiology and the severity of deviation of vocal parameters from the normative. Based on the results of the assessment, an individualized treatment plan was structured for each participant. The outcomes of the treatment provided are beyond the scope of this case series.

Result

The brief findings of each case evaluated in this series along with the recommended treatment plan are documented below and in Tables 1, 2, and 3. The most common vocal habits, leading to vocal overload, which were reported by them were continuous and long hours of vocal practice and vocal performance, additional vocal abuse at home, vocal misuse trying to imitate the singing range of other singers, and inadequate vocal warm-up before performance. The adverse non-vocal habits that were reported by them were inadequate hydration, excessive intake of caffeine, throat clearing, not using noise cancellation earplugs, over-the-counter medications which can lead to dehydration, intermittent fasting, eating spicy/ oily food before performance, and inadequate sleep.

Case 1: 34-year-old female singer, who reported the complaint of inability to sing in high notes and vocal fatigue during her performance for 3 months. The

participant has a vocal practice session of 3 to 4 hours per day at a stretch and each stage performance of at least 3 hours. The symptoms subsided with rest but were becoming more frequent. She has predisposing non-vocal habits. On VLS, bilateral early-forming vocal nodules, LPRD-related changes, and Type II MTD, with smooth mucosal waves were observed.

The perceptual voice was mildly harsh, strained, and asthenic with a rating of G1R1B0A1S1. MPT was 10 sec, with shallow thoracic breathing. SVHI-10 score was 20, indicative of vocal handicap. On MDVP, perturbation and noise measures were elevated. Based on the findings, the treatment plan included a vocal hygiene program, modified voice rest, breath support exercises, Vocal Function exercises (VFE), and medical management for LPRD. She was also educated regarding her singing range using the VRP findings along with modifications in posture and breathing pattern during singing.

Case 2: 60-year-old female singer with a major complaint of difficulty in transitioning to higher and lower pitches while singing, with frequent vocal fatigue for 1 year. She has practice sessions of 1 hour at least thrice a week and performances once per month for 1-2 hours. There are no significant factors related to vocal or non-vocal habits. She is hypertensive and under medication.

On VLS, signs of prebylaryngis with Type I MTD were observed. G1R1B0A0S1 rating was given indicative of perceptually mild harsh and strained voice with vocal instability. MPT was 21 sec which was adequate for speech but not for sustained singing. She has good posture and breathing patterns while singing. Vocal handicap was indicated by the SVHI-10 score of 24. On MDVP, only vFo was slightly elevated with lower F0. The treatment plan for this case included voice naps, breath support and breath hold exercises, VFE, and singing in the vocal range indicated by the VRP findings.

Case 3: 45-year-old female singer, reported complaints of pitch breaks while singing and strain in her voice for past 6 months. She reported singing sessions everyday for 1-2 hours with no adequate vocal warm-up or cool-down, poor vocal and non-vocal habits. She also reported variations in menstrual cycles for past 6- 8 months.

On VLS, there was thickening of the vocal folds with reduced amplitude of mucosal waves and Type II MTD. Voice was perceptually unstable, strained, and mildly harsh with a rating of G1R1B0A0S1. MPT was 13, with shallow thoracic breathing, and SVHI-10 score was 21, indicative of vocal handicap. Her posture was observed to be leaning toward left side during singing. On MDVP, all the perturbation and noise parameters were elevated. The treatment plan recommended for this case was vocal hygiene program, breath support exercises, Resonant voice therapy (RVT), singing practice based on the findings of VRP, and Gynecological consultation (given premenopausal changes).

Case 4: 38-year-old female singer with major complaints of difficulty in pitch transition, difficulty singing loudly, vocal fatigue, and change in voice quality since 4-5 months. She has singing practice of 1-2 hours daily with occasional performances of 2-3 hours per month and is a singing teacher at a school. Poor vocal and non-vocal habits with no significant medical history.

On VLS, bilateral vocal nodules were seen with reduced amplitude of mucosal wave, and Type III MTD. Voice was perceptually mildly hoarse and strained with rating of G1R1B1A0S1. She had an MPT of 16 sec which was adequate for speaking but less for sustained singing, with shorter breathing cycles and slightly slouched posture. The SVHI-10 score is 22, indicative of vocal handicap. On MDVP, frequency perturbation measures and SPI are elevated. Based on the findings, the treatment plan included vocal hygiene program, modified voice rest, breath support and breath control exercises, VFE, postural modification, and follow-up VLS after 1 month to determine the need for surgery.

Case 5: 30-year-old female singer, reported with chief complaint of difficulty in sustaining higher notes, breathlessness during sustained speaking and singing, difficulty in loud phonation, and vocal fatigue. Onset of breathing and voice problems are reported to be immediate post-COVID-19 infection. She is currently unable to practice or perform singing.

On VLS, Type III MTD was noted. On sustained phonation, voice is perceived as unstable, mildly harsh, weak, and strained with a rating of G1R1B1A1S1. MPT is only 7 sec with shallow thoracic breathing. On SVHI-10, a score of 20 indicated vocal handicap. On MDVP, perturbation, and noise measures are elevated. As seen on VRP, she has good pitch range but poor energy range. Treatment plan for her included vocal hygiene program, breath support and breath control exercises, VFE and Semi-occluded vocal tract exercises (SOVTE), and recommendation to consult Respiratory medicine.

Table 1: Perceptual measures of voice					
	Probable etiology	**GRBAS**	**MPT (sec)**	**SVHI-10**	**Quality of voice**
Case 1	Vocal nodule	G1R1B0A1S1	10	20	Mildly harsh, strained, and weak
Case 2	Presbyphonia	G1R1B0A0S1	21	24	Vocal instability, mildly harsh and strained
Case 3	Hormonal variations	G1R1B0A0S1	13	21	Vocal instability, mildly harsh and strained
Case 4	Vocal nodule	G1R1B1A0S1	16	22	Mildly hoarse and strained
Case 5	Post COVID-19 infection	G1R1B1A1S1	7	20	Vocal instability, mildly harsh, weak, and strained

Table 2: Acoustic measures on Multidimensional Voice Program (MDVP). (Values in bold with * are deviant from normative)										
	F0 (Hz)	**Jitt (%)**	**RAP (%)**	**PPQ (%)**	**vF0 (%)**	**ShdB (dB)**	**APQ (%)**	**vAm (%)**	**NHR**	**SPI**
Case 1	224.452	1.843*	1.118*	1.095*	1.567*	0.216*	1.761	15.228	0.148*	14.911*
Case 2	186.995	19.967	0.212	0.205	1.128*	0.112	0.966	7.061	0.067	11.999
Case 3	264.220	2.910*	1.756*	1.734*	2.367*	0.250*	1.995*	27.006*	0.135*	55.182*
Case 4	227.674	1.695*	1.044*	0.957*	1.465*	0.145	1.131	7.142	0.076	50.095*
Case 5	212.421	2.597*	1.549*	1.496*	2.157*	0.326*	2.236*	9.400	0.137*	13.177*

Table 3: Voice range profile (VRP) parameters									
	Minimum F0 (Hz)	**Maximum F0 (Hz)**	**F0 range (Hz)**	**Minimum F0 (Semitone)**	**Maximum F0 (Semitone)**	**F0 range (Semitone)**	**Minimum energy (dBSPL)**	**Maximum energy (dBSPL)**	**Energy range (dBSPL)**
Case 1	138.59	554.37	415.78	C#3	C#5	24	87	122	35
Case 2	138.59	880.00	741.41	C#3	A5	32	55	103	48
Case 3	123.47	987.77	864.30	B2	B5	36	59	115	56
Case 4	130.81	698.46	567.65	C3	F5	29	70	121	51
Case 5	58.27	830.61	772.34	A#1	G#5	46	55	85	30

Discussion

A well-taken case history is an integral part of voice assessment. In all the participants, the common symptoms were inability to sing at desired notes, difficulty in transitioning between vocal registers, and vocal fatigue. Identifying the vocal habits (like vocal abuse or misuse) and non-vocal habits (like hydration) in these cases assisted in planning the individualized vocal hygiene program to eliminate or alleviate the effects of these habits on the vocal mechanism (Van Wyk et al. 111.e29; Boominathan et al. 47).

In this case series, observing the participant's posture, breathing pattern and any evident muscle tension during the analysis of sustained phonation and singing provided essential co-relation with the documented MPT, VLS finding of MTD and served as the factors that can be modified to improve the functioning of the respiratory and phonatory systems. Inadequate breath support and compensatory muscle tension, either to sustain the voicing or to sing beyond the comfortable vocal range can have severe long-term effects leading to symptoms like vocal fatigue, reduced vocal range, or genesis of organic lesions (Kwok and Eslick 58).

VLS is an essential procedure to determine the presence of organic lesions or alterations in the structure and function of the vocal folds (Kwok and Eslick 58). One of the major findings on VLS in all the cases in this series is MTD of varying types which has been evidenced to be a major factor in singing-related difficulties.

VRP Singers who were trained in Hindustani classical singing for more than 36 months were reported to have a significant impact on stabilizing their base note and

widening their vocal range (Mohan). However, there should be consistent vocal practice to maintain this vocal range and have an efficient and economical use of the vocal mechanism while singing. Self-awareness of own vocal range was not present in some of the cases in this series as they tried to imitate the vocal range of other professional singers or in the range of the musical instruments. The addition of VRP in the assessment protocol is a necessity for these performing artists as it gives them a real-time feedback on what comfortable vocal range they can achieve, especially with added information on energy range and musical notes. VRP thus served as a tool for training these singers in the subsequent therapy sessions.

Acoustic analysis using software like MDVP helped to provide comprehensive information regarding the extent of deviation in the acoustic parameters and assisted the voice therapist in co-relating the symptoms reported by the participant with the VLS findings and the perceptual voice evaluation using GRBAS. Frequency perturbation and noise measures were the most common groups of acoustic parameters that were deviant from the normative. GRBAS rating in all 5 cases was mild dysphonia with either strain or asthenia and varying voice quality. This scale provides a quick and comprehensive perceptual rating of voice and acts as a monitoring tool during therapy.

As seen in literature, singers being elite voice users have more handicapping effects with even slight change in voice and this can be documented using the SVHI-10 to analyze the baseline of vocal handicap and the reduction in the self-perceived handicap as therapy progresses. In the present case series, all the participants had SVHI-10 scores above the normative value of 19.5 indicating vocal handicap (Cohen et al. 1864).

Vocal nodules have been the most common benign lesion with reported symptoms of vocal fatigue and range impairment (Kwok and Eslick 58). In Case 1 and Case 4, the multiparametric assessment helped to identify the presence of the nodule, its extent and form, thus helping in decision making, especially in terms of phonosurgery and the expected prognosis with voice therapy.

As documented in the study by Maruthy and Ravibabu (65), there are changes in the acoustic characteristics of voice as well as in the smooth and efficient mechanism of the respiratory and phonatory subsystems which can be attributed to the onset of atrophy and other changes related to presbylaryngis which are also evident in Case 2 in this study.

Hormonal variations have a significant impact on the vocal mechanism and thus lead to disruptions in the singing voice with a change in voice quality (Lã and Ardura 438.e1). In Case 3, symptoms of premenopause reported in case history were co-related with the findings on VLS and the changes in acoustic parameters, and hence the management plan also included a gynecological referral.

As seen in Case 5, deviations in pulmonic airstream control during sustained phonation were reported in COVID infected participants, resulting in sporadic and unintended disruptions (Bartl-Pokorny et al. 4377). The most common symptoms documented in participants recovering from COVID were dysphonia and asthenic voice, with significantly lower MPT (Yasien et al. 4485). Moreover, these singers were found to have an increased level of stress due to multiple intrinsic and environmental factors during the pandemic (Primov-Fever et al. 586.e1)

Management of voice problems should be individualized with appropriate referrals for medical management and evidence-based voice therapy to get the most effective outcome (Ropero Rendón et al. 1069). In the present study, based on the case history, individualized vocal hygiene program was designed. Based on the findings of the multiparametric assessment, and the ease of the participant, voice therapy plan was chalked for each individual with use of appropriate visual and auditory feedback tools like VRP, MDVP, and voice recorders.

The current case series focused on implementing a multiparametric voice assessment protocol comprising tests and procedures, which provide add-on information for assessment of singers who perceived difficulty in pitch control and transition without any significant change in voice while taking into consideration both the clinician's and patient's perspectives. This comprehensive assessment provided essential information in identifying individual specific etiology, associated factors, and severity of the voice disorder, and compiling these findings for individualized therapy plans that targeted managing the etiology or the symptoms to have more efficient and balanced vocal mechanism for singing.

References

1. Arunachalam, Ravikumar, et al. "Clinical Voice Analysis of Carnatic Singers." Journal of Voice, vol. 28, no. 1, Jan. 2014, p. 128.e1-128.e9.doi.org/10.1016/j.jvoice.2013.08.003.

2. Bartl-Pokorny, Katrin D., et al. "The Voice of COVID-19: Acoustic Correlates of Infection in Sustained Vowels." The Journal of the Acoustical Society of America, vol. 149, no. 6, June 2021, pp. 4377–83. doi.org/10.1121/10.0005194.
3. Boominathan, Prakash, et al. "Vocal Abuse and Vocal Hygiene Practices Among Different Level Professional Voice Users in India: A Survey." Asia Pacific Journal of Speech, Language and Hearing, vol. 11, no. 1, Mar. 2008, pp. 47–53. doi.org/10.1179/136132808805297322.
4. Cohen, Seth M., et al. "Development and Validation of the Singing Voice Handicap10." The Laryngoscope, vol. 119, no. 9, Sept. 2009, pp. 1864–69. doi.org/10.1002/lary.20580.
5. Devadas, Usha, et al. "Prevalence of and Risk Factors for Self-Reported Voice Problems Among Carnatic Singers." Journal of Voice, vol. 34, no. 2, Mar. 2020, p. 303.e1-303.e15. doi.org/10.1016/j.jvoice.2018.09.013.
6. Kwok, Michelle, and Guy D. Eslick. "The Impact of Vocal and Laryngeal Pathologies Among Professional Singers: A Meta-Analysis." Journal of Voice, vol. 33, no. 1, Jan. 2019, pp. 58–65. doi.org/10.1016/j.jvoice.2017.09.002.
7. Lã, Filipa M. B., and Diego Ardura. "What Voice-Related Metrics Change With Menopause? A Systematic Review and Meta-Analysis Study." Journal of Voice, vol. 36, no. 3, May 2022, p. 438.e1-438.e17. doi.org/10.1016/j.jvoice.2020.06.012.
8. Maruthy, Santosh, and Preethi Ravibabu. "Comparison of Dysphonia Severity Index Between Younger and Older Carnatic Classical Singers and Nonsingers." Journal of Voice, vol. 29, no. 1, Jan. 2015, pp. 65–70. doi.org/10.1016/j.jvoice.2014.05.001.
9. Nair, Raveena M., et al. "Knowledge, Attitude and Practices Towards Vocal Health Care Amongst Indian Carnatic Singers." Journal of Voice, Aug. 2021, pp. 161-169. doi.org/10.1016/j.jvoice.2021.07.004.
10. Pestana, Pedro Melo, et al. "Prevalence of Voice Disorders in Singers: Systematic Review and Meta-Analysis." Journal of Voice, vol. 31, no. 6, Nov. 2017, pp. 722–27. doi.org/10.1016/j.jvoice.2017.02.010.
11. Primov-Fever, Adi, et al. "Songbirds Must Sing: How Artistic Voice Users Perceive Their Voice in Times of COVID-19." Journal of Voice, vol. 36, no. 4, July 2022, p. 586.e1-586.e5. doi.org/10.1016/j.jvoice.2020.07.030.
12. Ropero Rendón, Maria Del Mar, et al. "Efficacy of Phonosurgery, Logopedic Voice Treatment and Vocal Pedagogy in Common Voice Problems of Singers." Advances in Therapy, vol. 35, no. 7, July 2018, pp. 1069–86. doi.org/10.1007/s12325-018-0725-x.
13. Sangeetha, Mohan. "Effect of Hindustani Vocal Training on Voice Measures." International Conference on Studies in Humanities and Social Sciences (ICSHSS'15) July 29-30, 2015 Phuket (Thailand), International Centre of Economics, Humanities and Management, 2015.
14. Van Wyk, Liezl, et al. "The Effect of Hydration on the Voice Quality of Future Professional Vocal Performers." Journal of Voice, vol. 31, no. 1, Jan. 2017, p. 111.e29-111.e36. doi.org/10.1016/j.jvoice.2016.01.002.
15. Yasien, Dalia G., et al. "Phonatory Function and Characteristics of Voice in Recovering COVID-19 Survivors." European Archives of Oto-Rhino-Laryngology, vol. 279, no. 9, Sept. 2022, pp. 4485–90. doi.org/10.1007/s00405-022-07419-2.