Strategies in Aided Voice Evaluation

By Dennis Colucci, AuD, MA

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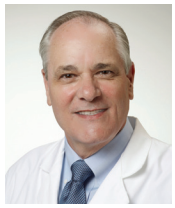
Own-voice complaints from patients after they undergo fitting of new hearing instruments is not uncommon. Some patients eventually adapt after a short period of time, while others require a more in-depth analysis. In some cases, the fitting tools provided by manufacturers can be used to help resolve the issue, but this is not universal. A patient with voice that is too nasal, loud, hollow, reverberant, raspy, or who speaks with a lisp may have a difficult time adjusting, thus increasing the possibility of the patient returning his or her hearing aids or leaving it in the dresser drawer. From the treatment standpoint, some of the issues are related to long-term, own-voice deprivation or having a voice with natural qualities as noted above, while others may be related to overamplification, the use of hearing aids with features like directional microphones or transposition, or occlusion. A simple evaluation of the aided voice can identify abnormal sensations and provide usable evidence to correct the problems. An ear probe microphone could also be used to clarify the acoustic issues, but understanding the patient's voice perceptions can be difficult to ascertain.

Most instances of abnormal voice perception can be corrected by manipulating the gain, output, and compression schemes. However, moderate degrees of occlusion cannot be resolved as easily. The occlusion effect is a result of bone-conducted, low-tone sounds being blocked in the ear canal, increasing the sound pressure as demonstrated by the Real Ear Occlusion Response (REOR). When a patient's hearing is better than 30 to 40 dB in the fundamental voice tone (F0), the voice is heard in the ears or head as a barrel, plugged, loud, or reverberant sensation. The only practical resolution is to properly vent the ear canals. For this reason, the receiver-in-the-canal (RIC) hearing aid is a breakthrough technology.

Since the development of RIC, electronic advances have made feedback control more effective, allowing for greater functional gain and output. However, an open fitting may not provide adequate audibility at 1,000 Hz and below for many hearing losses. In hearing aid fitting and cochlear implantation, preserving the F0 and other low-tone information adds value to the quality of environmental sound and music as well as in individual voice identification and discrimination, especially in background noise (*Hearing Journal.* 2015;68(10):39). Balancing the right amount of occlusion to achieve the desired low-frequency gain is important for the patient to realize functional hearing levels and a more normalized perception of sound.



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THE PROCESS

A quick and simple evaluation with or without real-ear testing can be done using the patient's own voice and a time-tested aided voice evaluation worksheet (can be downloaded from our website: bit.ly/AVEtest). In this process, the patient is asked to repeat speech sounds and identify the location or place of specific phonemes (fricatives, nasals, and front-back vowels) or weighted voiced vs. unvoiced sentences. The patient is also asked to evaluate the sound quality.

When singing, the colloquial chest and the middle and head registers have different frequency ranges based on the vibratory patterns of laryngeal function and associated resonances. The primary energy for a chest register is lower-toned while the head register is higher. This is also true for speech when it is divided into voiced and unvoiced sounds. Throat sounds are lower-pitched, and the unvoiced consonant sounds produced by the teeth, tongue, and lips are high-pitched. With this knowledge, the patient's perceptions of sound location and quality can be evaluated.

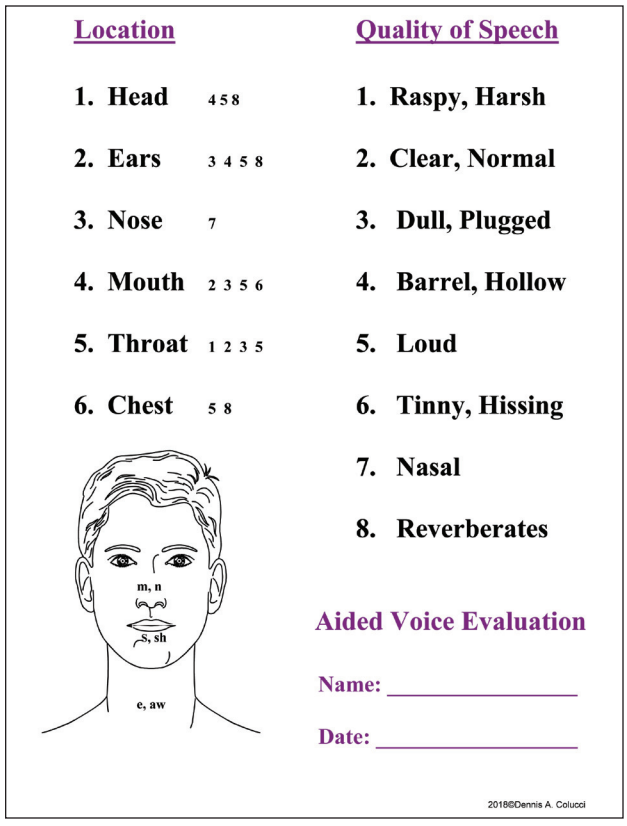

Figure 1. Aided voice evaluation worksheet with location and quality of speech categories. The phonemes /e, aw/, /m, n/, and /s, sh/ are labeled to represent the loci for throat, nasal, and high-frequency mouth sounds. The numbers next to the location column are the quality responses from 39 patients during their binaural fitting process (presented by Dennis Colucci, AuD, at the 2000 American Academy of Audiology annual meeting in San Diego, CA).

THE WORKSHEET

The worksheet is divided into two categories: first, the place or location of own-voice speech and second, common descriptions used by patients when characterizing the quality of aided or unaided speech. The suggested location of the speech samples are noted in the worksheet illustration to guide the evaluation. When patients repeat the speech samples, they are able to identify and judge their own voices. The test phonemes are divided into the following: throat /e/, front vowel /a/, back vowel (as in dot), nose /m/ and /n/, and high-tone mouth sounds /s/ and /sh/. The two lines are also used to test the voiced or nasal tones (Mary had a little lamb) and the high tones (Sally sells sea shells).

THE PROTOCOL

Before starting the test, review the worksheet with the patient. Demonstrate the desired speech sounds starting with /e/. Help patients identify the unaided /e/ as localized to the throat and have them select a perceived sound quality from the chart. In unconcluded ears, the response is typically mouth (4) or throat (5) and clear, normal (2). Aided testing for occlusion starts with the vowels. The procedure is repeated with the hearing aids inserted but turned off. If the patient reports hearing a voice that is loud, barrel-like, or reverberant, and places this sound at the ears or in the head, there is occlusion. To confirm this, slowly pull the hearing aids out of the ears by a few millimeters and have the patient repeat the sounds. If the patient places the sound to either the mouth (4) or throat (5), the occlusion is improved or resolved and the ear mold or dome choice can be modified accordingly. To complete the testing, teach the patient the location of each phoneme and confirm the new sound perception. In more complex cases wherein the patient complains of hearing a nasal or raspy voice or feeling chest vibrations that are not present in unaided conditions, the patient should be subjected to a more complete test.

The primary tone ranges, location, and quality of the patient's voice can reveal overamplification issues in both the high and low tones. Low tones that are overamplified and felt in the chest can also be loud, while hissing or lisping speech requires changes in the high-frequency prescription.

Resolving a patient's own-voice issues is paramount to successful patient management. While there are various strategies to address different issues, the aided voice evaluation outlined here also aims to identify the cause of a patient's complaint, making the process more investigative. Furthermore, extending the low-tone range for various degrees of hearing loss creates a balance between open and occluded ear canals. Finding that best balance improves audibility throughout the patient's hearing range and maximizes brain activity, learning, and memory.