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Voice Evaluation Beyond the Basics

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Learner Outcomes

- After this intermediate level course participants will be able to:
  - List essential elements of the voice evaluation
  - Describe various voice evaluation tools
  - Identify research literature which supports the use of various acoustic measures

Introduction

- Overview of voice assessments – a sampler of assessment tools
- In-depth discussion of voice assessments – why and how to use selected acoustic and perceptual voice assessment tools
- Interpretation of assessments – making sense of the data
- Report writing – helpful hints for organizing the information to increase the likelihood that the report will be read and understood
- Summary and Q&A

Introduction

- As a matter of best practice, the Speech-Language Pathologist should consult with the patient's primary care physician, the otolaryngologist and other specialists involved in the patient's care.[1]
- The role of the physician is to identify laryngeal pathologies, render medical diagnoses and suggest appropriate medical management strategies
- The role of the SLP is to assess acoustic voice production and underlying physiology to determine how a voice disorder affects an individual's overall functioning and to make recommendations for intervention with referrals to other specialists as appropriate[2]

Introduction

- ASHA Preferred Practice Patterns for the Profession of Speech-Language Pathology #34 regarding the purpose behind Voice Assessment states:
  - Voice assessment is provided to evaluate vocal structure and function (strengths and weaknesses), including identification of impairments, associated activity and participation limitations, and context barriers and facilitators.[1]
- This is consistent with World Health Organization (WHO) framework to identify and describe :
  - underlying strength and deficits related to a voice disorder or a laryngeal disorder affecting respiration and communication performance;
  - effects of the voice disorder on the individual's activities (capacity and performance in everyday communication contexts) and participation;
  - contextual factors that serve as barriers to or facilitators of successful communication and participation for individuals with voice disorders or laryngeal disorders affecting respiration.[1]

Overview of Voice Assessments

- General Voice Evaluation Protocol [1]
  - Medical Evaluation
  - Complete Case History
  - Perceptual Assessment of Voice
  - Acoustic Analysis of Voice
  - Aerodynamic Assessment
  - Electroglottography
  - Imaging techniques such as stroboscopy and endoscopy
  - Therapeutic Probes

Medical Evaluation

- Physician will take medical history
- Comprehensive examination of the head and neck
- Use of laryngeal visualization procedure to observe the structures within the vocal tract – especially the vocal folds
- Visualization procedures may include:[3]
  - Imaging studies
  - Videostroboscopy
  - Direct (mirror) laryngoscopy

Complete Case History

- Many forms available[4,5]
  - Ideally, the case history interview should include all medical and behavioral information as well as clarification questions
- Gather information regarding:
  - Health history
  - The patient's description of the voice problem
  - Voice symptoms/complaints
  - Cause (if known)
  - Onset
  - Duration
  - Variability
  - Typical voice use
  - Environmental information

Perceptual Assessment of Voice

- CAPE-V [6]
  - A rating scale for the clinician's assessment of the patient's voice disorder
  - Why it is used: Standardized procedure to rate the basic qualities of voice (6 perceptual attributes)
  - How to use: Instructions can be found at:
  - http://www.asha.org/uploadedFiles/members/divs/D3CAPEVprocedures.pdf
  - Form: See Handout 1
  - The degree of each voice attribute is indicated on a 100mm line on which the left end indicates normal and the right end indicates that the voice attribute is severe
  - The ratings should be made after completion of several tasks, including sustained vowels, sentences and spontaneous speech

Perceptual Assessment of Voice

- CAPE-V (cont'd.)
  - The clinician makes a mark on the line corresponding to the perceived severity of the voice attribute measured
  - The clinician should also note whether the voice attribute is consistent or intermittent in the voice sample rated
  - The clinician then measures the distance between the left end of the line and the mark made to indicate severity. The measurement is entered in the Score column as a fraction (___/100).

Perceptual Assessment of Voice

- Voice Handicap Index(VHI)[7]
  - A rating scale of the patient's assessment of their voice disorder
  - One of the most frequently used Quality of Life (QOL) instruments specific to voice
- Why it is used:
  - This measure can be used to assess the functional, emotional, and psychosocial consequences of voice disorders and the impact of an individuals' voice disorder upon life activities.
- How to use it: The patient completes the form
  - Instructions and form can be found at:

http://oregon.providence.org/~/media/files/providence%20or%20migrated%20pdfs/patients%20toolkit/rehabvoicehandicapindex.pdf

Scoring guidelines can be found in the Jacobson et al. article cited above

Perceptual Assessment of Voice

- VHI-10
  - 10 item representation of the 30 item VHI
  - Studies have indicated that the VHI-10 is highly correlated with the original VHI and other self-reporting questionnaires[8,9]
- Voice Related Quality of Life (V-RQOL)[10, 11]
  - This is a 10-item patient questionnaire that asks patients to rate their quality of life in the context of their voice disorder. This scale can be found at:
  - http://utahhealthsciences.net/upload/186/2705_voice-quiz%20v-rqol.pdf

Acoustic Analysis of Voice

- Fundamental frequency (Fo)
  - Directly related to vocal fold vibratory rate (Hz)
  - Purpose is to estimate appropriateness of frequency to patient's age and sex when compared to normative data [3]
  - Provides quantitative data to provide objective information about vocal behavior at baseline and at various measurement intervals
  - Requires instrumentation to measure
- Intensity
  - Mean intensity correlates with the perception of vocal loudness [12]
  - Mean intensity vs. dynamic range
  - Requires instrumentation to measure

Acoustic Analysis of Voice

- Variability measures
  - Jitter – Cycle to cycle variability in frequency (%)
  - Used to measure frequency stability in sustained vowels
  - Requires instrumentation to measure
  - Shimmer – Cycle to cycle variability in amplitude in sustained vowels (dB)
  - Used to measure stability of amplitude
  - Requires instrumentation to measure
- Jitter and Shimmer should be interpreted in combination with other instrumental and perceptual data [13]
- Caution: Jitter and Shimmer may not be meaningful measures for severely dysphonic voices

Acoustic Analysis of Voice

- Vocal Noise Measures
  - Measurement of ratio of harmonic to noise energy in voice (dB)
  - An objective index of breathiness, roughness or hoarseness in the voice
  - Requires instrumentation to measure
  - Harmonics to Noise Ratio (HNR)
  - Noise to Harmonics Ratio (NHR)
  - Signal to Noise Ratio (SNR)
  - Dysphonic voices are characterized by low HNR or SNR and high NHR

Acoustic Measures of Voice

- Helpful Tools
  - Pentax Medical – Visi-Pitch IV, Sona-speech II, CSL – These instruments vary greatly in price range with Sona-speech II (software) being the most economical
  - PRAAT (Free!) http://www.fon.hum.uva.nl/praat/
  - Audacity (Free!) https://sourceforge.net/projects/audacity/
  - University College London (UCL) http://www.phon.ucl.ac.uk/resource/software-windows.php
    - Free programs include: WASP, RTSPECT and RTPITCH
  - Virtual Piano (Free!) http://virtualpiano.net/

Acoustic Measures of Voice

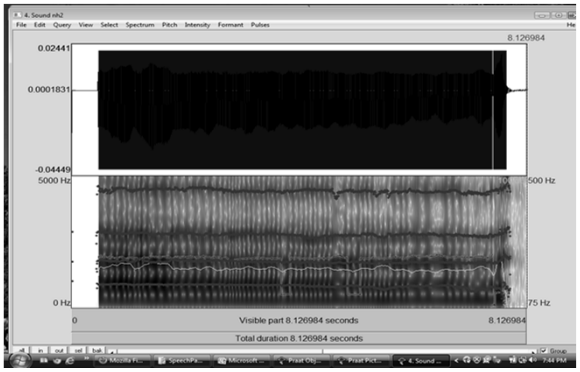
- Helpful Tools
  - Sound Level Meters – Many available in a wide range of prices
  - External USB Sound card – Very helpful for clean acoustic analysis of voice on laptop or desktop computers – Many sources (Sound Blaster, Insten, Audio Technica)
  - Microphone – buy the best you can afford – Cardioid microphones are best at recording sound that is in front of the mic and are more forgiving with regard to ambient noise conditions. Omnidirectional microphones record sound from all around the subject and can be used when recording voice in a quiet environment (sound booth)

Acoustic Measures of Voice

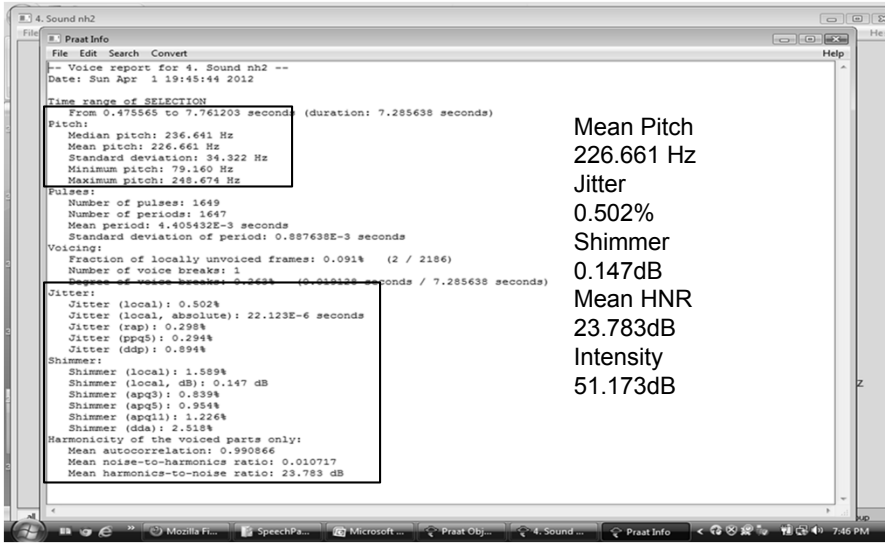
- Optimal Recording Procedures
  - Quiet environment (≤ 50dB)
  - Use a good quality microphone
  - If using a computer, use a good quality USB sound card to filter out “machine noise”
  - Keep mouth to microphone distance constant within and between samples (3-4cm)
  - Place microphone 45° off center to avoid aerodynamic noise

Acoustic Analysis of Voice

- Example: Use of PRAAT
  - Acoustic Information yielded from “Voice Report” in the “Pulses” pulldown menu and “Get Intensity” in the “Intensity” pulldown menu



Acoustic Analysis of Voice



Mean Pitch
226.661 Hz
Jitter
0.502%
Shimmer
0.147dB
Mean HNR
23.783dB
Intensity
51.173dB

Aerodynamic Assessment

- Aerodynamic measures assess a person's ability to regulate the flow of air through the larynx [3] and may include:
  - Lung volumes and capacities (spirometry)
    - Tidal volume
    - Inspiratory reserve volume
    - Expiratory reserve volume
    - Residual Volume
  - Air pressure (PAS, Aerophone II)
  - Measures of airflow and laryngeal resistance (Glottal Enterprises)
- These measures can only be obtained with the use of specialized equipment

Aerodynamic Assessment

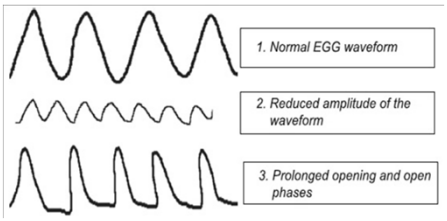
- Maximum Phonation Performance [14]
  - Voice Range Profile – Assessment of lowest and highest intensities as lowest and highest frequencies (i.e. range from softest and lowest pitch to loudest and lowest pitch to softest and highest pitch to loudest and highest pitch)
  - Maximum Phonation Time – Assessment of vocal fold function and respiratory support for sustained vowels

Electroglottography (EGG)

- A noninvasive method of obtaining information about vocal fold contact across time[14]
  - A small electrical current is passed between electrodes placed on the thyroid laminae
  - The waveform that is generated represents summary information about vocal fold contact over time

15

16



Imaging Techniques

- Stroboscopy and Endoscopy [17]
  - Purposes: To provide the clinician with a detailed view of vocal fold structure at rest and during vibration
  - To provide the clinician with information regarding vocal fold closure patterns, tension, tone and status of the mucosal layer
  - To provide the clinician with information regarding the nature and extent of vocal pathology as it relates to the patient's dysphonia
- Equipment Needed
  - Microphone or EGG
  - Endoscope (flexible or rigid)
  - Light source
  - Videostroboscopy requires a camera and video monitor

Imaging Techniques

- Stroboscopy and Endoscopy
  - Vocal fold parameters studied
    - Symmetry of movement
    - Amplitude
    - Periodicity
    - Mucosal wave
    - Vocal fold closure

Imaging Techniques

- Specialized Knowledge and Skills Required [18]
  - Knowledge and Skills for Speech-Language Pathologists With Respect to Vocal Tract Visualization and Imaging
  - It is required that individuals who practice independently in this area hold the Certificate of Clinical Competence in Speech-Language Pathology and abide by the ASHA Code of Ethics, including Principle of Ethics II Rule B, which states: “Individuals shall engage in only those aspects of the professions that are within the scope of their competence, considering their level of education, training, and experience” (ASHA, 2003). ASHA Certification in speech-language pathology is necessary, but meeting certification requirements is not sufficient to qualify a person to perform the specific clinical procedure(s) discussed in this document.

Therapeutic Probes

- Shifting tone focus
- Easy onset
- Hard glottal onset
- Breath support
- Postural adjustment
- Laryngeal manipulation
- Increase loudness
- Decrease loudness
- Increase fundamental frequency
- Decrease fundamental frequency
- Boone's 25 Facilitating Approaches [3]
- Stimulability and level of cueing

Interpretation of Assessments

- Various formats available
  - http://www.asha.org/uploadedFiles/slp/healthcare/AATVoiceEvaluation.pdf
  - Interpretation of Voice Assessment results should be based on comparison to published normative data when available or provision of skilled observations of anatomical, physiological or behavioral attributes

Interpretation of Assessments

- Normative data available for:
  - Fundamental frequency (Mean 125Hz for males, 225Hz for females)
  - Pitch range (2-3 octaves depending on vocal experience)
  - Maximum Phonation Time (20-25 seconds adults, elderly 13-15 sec.)
  - Intensity (70-80dB, range 50-115dB)
  - Jitter (< 1% local)
  - Shimmer (<.5dB local)
  - HNR (≥ 12dB Mean harmonic-to-noise ratio)
  - Aerodynamic measures (Can be found in Reference 4)

Report Writing

- Helpful Hints
  - Give narrative description of patient history and present complaint using short sentences quoting the patient's statements when giving description of the present complaint.
  - Compare data to any available norms
  - If the report is a follow-up assessment, include data from the previous or baseline assessment
  - Post data in tables (See Below)

Acoustic Results	**Mean Fo**	**HNR**	**Jitter**	**Shimmer**	**MPT**	**Intensity**
Sustained Vowel /a/						
Connected Speech						
Reading						
Norms		>12dB	< 1%	<.5dB	20-25 sec	70-80dB

Summary

- Physicians, SLPs and others involved in the care and training of the voice may be involved in the voice care team
- Results from all quantitative and qualitative measures should be used to determine voice diagnosis
- Many helpful tools are available to assist the SLP with acoustic and perceptual voice measurement
- SLP should follow consistent procedures when measuring voice parameters
- Voice evaluation results should be presented in a clear, simple format
    - Questions?

THANK YOU!

- Thank you for taking the time to take part in this seminar today. Please feel free to contact me with any questions that you may have regarding this topic.

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