**Perturbation**

Perturbation refers to a disturbance in the regularity of the waveform. These disturbances reflect slight changes in the mass, tension, or vibratory characteristics of the vocal folds from one glottic cycle to the next. Perturbation correlates to perceived roughness or harshness.

Instrumental acoustic analysis of pitch and volume during sustained vowel production of /a/ often includes reported measurements of perturbation. An increase in perturbation measures is perceived as hoarseness. Although there is some degree of perturbation in normal voices, there is an increased percent in dysphonic voices.

Clinicians should be cautious in the interpretation of perturbation measure as the type of waveform (signal) varies dependent upon the distortion or aperiodicity of the signal (Titze 1995). Perturbation also varies as a function of pitch. As a result, there is a wide range of “norms” reported in the literature. General definitions and examples of the most frequently reported clinical reference norms and their sources are listed below. Values above these normative measures are seen in dysphonic patients.

**Jitter** is a short-term measure of cycle-to-cycle variation in fundamental frequency detected during a sustained vowel. Jitter is considered a measure of instability from cycle to cycle in the vibratory characteristics of the vocal folds. Average jitter is expressed as a percent of the average fundamental frequency with normal perturbation (variation from cycle to cycle) reported to be less than one percent. Mean absolute jitter represents pitch variations occurring between consecutive pitch periods and is expressed in microseconds.

\[
\text{Jitter} \% = \text{< 1.0}\%
\]

\[
\text{Mean absolute jitter} = 0.4\text{msec}
\]

**Shimmer** is a short-term measure of cycle-to-cycle variation in amplitude detected during a sustained vowel. Shimmer reflects slight changes or irregularity in intensity of the signal. The norm is reported as less than 0.5 dB variation from cycle to cycle and/or less than 5 percent of the average amplitude.

\[
\text{Shimmer in dB} = \text{< 0.5 dB}
\]

\[
\text{Shimmer percent} = \text{< 5 \%}
\]

**Harmonics-to-Noise Ratio (H/N)** is also called signal-to-noise ratio and is a measure of the frequency structure (harmonics) of the voice signal to the noise within that signal. Increased noise in a speech signal results in a lower H/N ratio and is perceived as hoarseness. Therefore, for this measure, any value below the reported norm is seen in dysphonic patients. The norm for harmonics-to-noise may be expressed as a ratio or in decibels. Normative values are greater than 1.0 or greater than 12dB (meaning that the harmonic energy is greater than the energy from noise).

**Harmonics** are defined as multiples of the fundamental frequency.

**Noise** is defined as aperiodic or random distribution of acoustical energy.

\[
\text{H/N} = \text{>12dB}
\]
Protocol for Voice Evaluation

**Purpose:** The purpose of this policy is to describe the procedures used for objective data assessment of voice disordered clients.

**Scope:** The policy applies to all speech-language pathologists involved with the evaluation of voice disorders.

**Procedure**

1. Consult received from physician
2. Case history/speech pathology intake form to be reviewed with the patient
3. Completion of the *Voice Handicap Index* (VHI) by the patient
4. Objective measures will be obtained using the Computerized Speech Lab (CSL), maintaining a sampling rate of 50,000 and a microphone-to-mouth distance less than 10cm (optimal 3-4cm) at a 45-90 degree angle from the mouth for sustained productions to reduce airflow noise/breath contamination (as recommended by the Summary Statement Workshop on Acoustic Voice Analysis, NCVS 1994).

**Sustained Phonation**

/a/ = (3-4 second sample) at modal pitch and comfortable loudness
- Analyze via MDVP (Multi-Dimensional Voice Program) to include all parameters and radial graph.
- Report fundamental frequency, jitter %, shimmer (in dB), and H/N ratio. Use Baken and Orlikoff norms (1992).
- Assess jitter on high /i/ and low /u/ vowel productions to assess source-vocal tract interactions. (Jitter reliability is high for type 1 signals only. Use all parameters [visual graph/MDVP] for type 2 & 3 signals.)

**Speech Samples**

a) Counting 1-10
b) All-voiced sentence: “Where are you going?”
c) Voice onset/offset: “The blue spot is on the key.”
- Analyze via RTP (Real Time Pitch) protocol for habitual pitch.
- Report fundamental frequency and amplitude.
- Use tasks b) and c) to assess adductory control.

**Pitch Range**

Instruct the patient to move from a comfortable pitch to the lowest and then to the highest.
- Analyze via RTP protocol for pitch range.

**Maximum Phonation Time (MPT):** average of two trials on sustained /a/

**S/Z Ratio**

sustained /s/ maximum duration
sustained /z/ maximum duration

**Reading:** Rainbow Passage
assessment of breath support patterns during running speech and WPM (if appropriate)

5. Write report and attach all pertinent acoustic measures. Include diagnostic impressions (including ICD-9) and recommendations.

Proposed by Sandra Kasper Schwartz (Presbyterian Voice Center, University of Pennsylvania Health System June 2003)
LOWER MOTOR NEURON (LMN) LESIONS (result in flaccid or hypotonic muscles)

- Bulbar palsy
- Myasthenia Gravis

**Bulbar palsy**

**Etiology**
Bulbar palsy may result from brainstem CVA, viral infection, tumor, or trauma to the cranial nerves (motor units).

**Effects on speech and voice production**
The resulting speech deficit is characterized as *flaccid dysarthria*. Speech therapy should focus on oral (lingual/labial) strengthening and articulatory precision.

Vocal characteristics associated with bulbar palsy include a breathy/weak vocal quality with any combination of the following: hypernasality, monotone, monoloudness, and use of short phrases. There is a possibility of vocal fold paresis/paralysis that may be bilateral or unilateral, causing inspiratory stridor (noise on inhalation).

**Treatment**

*Improved respiratory support for voicing*
- diaphragmatic breathing (page 104)
- breath support and control of airflow (pages 105-106)
- phrasing practice (pages 107)
- sentences of increased length (page 108)

*Increasing volume and variations of loudness*
- use of background noise to encourage use of louder speech
- compare soft and loud productions

*Improved adduction/hypofunction*
- adduction exercises (pages 101-102)
- pitch glides for improved medial closure—Have the patient produce a low-pitched and then high-pitched hum using /a/ or /i/.
- pitch scales from lower to higher pitches (e.g., sing a scale).

**Myasthenia Gravis**

**Etiology**
Myasthenia Gravis may result from brainstem CVA, viral infection, tumor, or trauma to the cranial nerves (motor units).
Adduction Exercises

Target: vocal fold (VF) adduction

Goal: to improve medial glottal closure through the use of tension

Background: Adduction exercises are most often used in hypofunctional voice disorders (e.g., presbylarynx) and neurologic vocal conditions (e.g., vocal fold paralysis) that result in reduced vocal fold adduction and/or reduced volume.

These exercises use pushing and/or pulling during phonation, resulting in increased vocal fold closure and increased subglottic air pressure. Use this increased pressure to produce a louder vocal tone.

Clinical Note: Take care not to strain the laryngeal or cervical muscles during these exercises. In addition, do not do these exercises if the vocal folds are inflamed or a hyperfunctional pathology is present, as in the case of vocal fold nodules or hemorrhage.

Adduction Exercise 1

1. Sit in a straight back chair and clasp your hands in front of your chest.

2. Take a deep breath.

3. Try to pull your hands apart while holding a steady “ahhh” for 10 seconds.
Example Treatment Plan for Hypofunctional Disorders
(e.g., VF Paralysis, Presbylarynx)

Voice Therapy—Plan of Treatment

Patient:

Physician:

Diagnosis: ICD-9:

Recommendation: ______ sessions of voice therapy

Goals
1. To improve overall laryngeal functioning for voice production, breathing, and/or swallowing.
2. To improve and maintain appropriate medial glottal closure upon phonation

Objectives
1. The patient will learn techniques to improve vocal hygiene and maximize functioning without vocal hyperfunction/abuse.
2. The patient will engage in vocal exercises/practice to improve utilization of airflow during speech.
3. The patient will learn diaphragmatic breathing techniques and methods of easy airflow release.
4. The patient will engage in easy adduction exercises to improve medial glottal closure.
5. The patient will improve self-monitoring of vocal quality, onset of phonation, pitch, volume and laryngeal tension.
6. The patient will learn adaptive strategies utilizing head and neck positioning as needed to improve glottal closure.

Progress
Progress will be measured by patient’s ability to sustain phonation (MPT) and ability to achieve and maintain vocal parameters, including airflow measures that are WNL for patient’s age and sex. Symptoms of dysphagia/aspiration (if present) will be reduced. Improvement of medial glottal closure will be assessed through visualization.

______________ ____________________
Speech-Language Pathologist Date