Physiologic Approaches to Voice Therapy

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Goals for the Session

• Understand the rationale behind and use of physiologic voice therapy
• Identify cases where physiologic voice therapy is appropriate
• Identify and begin to develop expertise in voice therapy methods supported by the evidence

Case 1

• 42 year old female
• 3rd grade teacher
• Mother of 3
• c/o progressive hoarseness, reduction in pitch, vocal fatigue, difficulty projecting the voice
• Cyclic pattern
• Interfering with ability to perform job requirements
Case 1

- Perceptual Evaluation – mod dysphonia
  - Hoarseness
  - Breathiness
  - Reduced pitch
- Acoustic Evaluation
  - Reduced fo and fo range
  - Reduced SPL
  - Increased noise to harmonics ratio
- Voice Handicap Index (VHI) = 50
  (mod impairment)

Case 1 – Strobe

Case 1

- Findings
- Management Ideas....

Case 2

- 78 year old male
- Retired auctioneer
- Married, grandfather of 5
- c/o weak voice, breathiness, reduced loudness, runs out of air when talking
- Reports reducing social interactions due to his voice limitations

Case 2 - Strobe

Case 2

- Auditory Perceptual – Mild to moderate dysphonia
  - Reduced loudness
  - Breathiness
- Acoustic
  - Increased Fo
  - Reduced SPL
  - Increased Noise to Harmonics Ratio
- VHI = 59, Moderate impairment (social and functional impact)
Case 2

- Findings
- Management Ideas....

Case 3

- 55 year old female
- Sudden onset of voice change
- c/o weak voice
  - Monopitch
  - Breathiness
  - Inability to control the voice
  - Inconsistent “strangling” on water
  - Difficulty breathing during exertion
  - Inhalatory stridor

Case 3

- Auditory Perceptual – Moderate-severe dysphonia
  - Reduced loudness
  - Increased pitch
  - Frequent breaths; few syllables per breath
  - Inconsistent diplophonia
- Acoustic
  - Decreased SPL
  - Increased Fo
  - Increased NHR, increased jitter and shimmer
- VHI = 64, Moderate impairment (social and functional impact)

Case 3 – Strobe

Case 3

- Findings
- Management Ideas

Commonalities?

- Complaints
- Auditory Perceptual Findings
- Functional Impact
- Stroboscopy
- Treatment Goals?
- Treatment Methods?
What is Physiologic Voice Therapy?

- Based on expanded knowledge of vocal function as evaluated through objective voice assessment / measurement
- Improve the relationship / balance among:
  - (1) respiratory support
  - (2) laryngeal muscle strength, control and stamina,
  - (3) supraglottic modification of the laryngeal tone/resonance
- Treat the voice holistically; single training focus

What is Physiologic Voice Therapy?

- Presented by Colton and Casper (1990) and Stemple, Glaze, and Gerdeman (1993)
- Modification of underlying physiology of the voice producing mechanisms: respiration, phonation, resonance

Subsystems of Voice Production

- Requires balance among the 3

Disruption in 1 may perturb the other 2

Foundations of Physiologic Voice Therapy

- Many voice disorders (pathologically-based or functional) share the same underlying physiology
- Examples:
  - LOSS OF NORMAL PHYSIOLOGICAL BALANCE
  - Many voice disorders will respond to a shared approach
  - RESTORATION OF PHYSIOLOGIC BALANCE

Voice Disorder

- Same pathology /problem may lead to different responses
- Example – Unilat. VF Paralysis
  - Response 1 - Overwork the system (increase supraglottic effort to improve sound, function)
  - Response 2 - Underuse the system (decrease effort and enter/falsetto to achieve better approximation)
Foundations of Physiologic Voice Therapy

<table>
<thead>
<tr>
<th>Resonance</th>
<th>Phonation</th>
<th>Respiration</th>
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Treatment
- Treatment is focused on returning the system to normal (more normal) patterns of production
- Applicable across a variety of diagnoses because all share the same goal...restored balance

Physiologic Therapy Approaches
Therefore...
- May consider all 3 of our cases have the same basic concern:
  - Lack of glottic closure
  - Leading to inefficient use of the glottal / phonation system
  - Possible compensatory patterns
- All 3 share the same need:
  - Obtaining the most efficient use of the system
  - Elimination of compensatory patterns

Physiologic Approaches to Tx
- May simplify approaches to Tx planning
- Address underlying physiology of voice production rather than specific symptoms
- May use 1 or a combo of physiologic approaches
- Used with the understanding that other areas may need to be addressed (eg, emotions, hygiene, etc)

Examples of Physiologic Methods
- Vocal Function Exercises
- Resonant Voice Therapy
- Manual Therapy / Laryngeal Massage
- Accent Method
- Lee Silverman Voice Treatment (for select populations only)

Physiologic Therapy: Evidence
- Evidence
  - Physiologic / theoretical evidence
  - Clinical evidence
    - Majority, well-controlled group studies
    - 5 methods have lines of evidence emerging

Questions? Comments?
Physiologic: Clinical Evidence

• Accent Method
  – Based upon use of pulsed abdominal breaths to facilitate glottal closure
  – Uses principle of Bernoulli effect
  – Builds new respiratory / voice pattern from basic syllable intonations through conversation
  – Evidence: Smith & Thyme (1976); Kotby et al. (1991); Fex et al. (1994); Bassiouny (2001)

• Vocal Function Exercises
  – Series of 4 systematic exercises for the intrinsic laryngeal muscles
  – To “strengthen” and increase the flexibility of the laryngeal muscles, improve balance among subsystems
  – Evidence: Stemple et al. (1994); Sabol et al. (1995); Roy et al. (2001); Gilliván-Murphy et al. (2006); Bell et al. (2007); Pasa, et al. (2007); Gorman et al. (2008); Nguyen et al. (2009)

• Resonant Voice Therapy
  – Based on work of Lessac
  – Voice produced in “mask” of face is most efficient form of voice
  – Systematically builds resonant / front-focused voice from basic phonatory gestures through conversation
  – Lessac-Madsen Resonant Voice Therapy
  – Evidence: Verdolini-Marston et al. (1995); Chen et al. (2003); Roy et al. (2003); Bell et al. (2007)

• Manual Laryngeal Musculoskeletal Reduction Technique
  – First proposed Aronson; Current name – Roy
  – Systematic digital manipulation of laryngeal complex to return larynx to relaxed, normalized posture
  – Evidence: Roy and Leeper (1993); Roy et al. (1997); Van Lierde et al. (2004)

• Lee Silverman Voice Treatment
  – Ramig
  – Originally designed for PD
  – Now known effective with other disorders
  – Premise – Increase effort (“Loud”) speech to enhance fx of respiratory, phonatory, resonance, and articulatory systems
  – Evidence: Ramig et al. (1995) Ramig et al. (1996); Ramig, Sapir, Countryman et al. (2001); Ramig, Sapir, Fox et al. (2001)

Other Orientations to Therapy

• Hygiene
  – Examples: Hydration, Elimination of abuses

• Symptomatic
  – Examples: Chewing, Raising pitch, Chant talk, Yawn-Sigh

• Psychogenic
  – Examples: Counseling, Identifying the underlying cause
Vocal Hygiene Evidence

- Few large scale studies support the therapeutic benefit of general hygiene education as a stand alone Tx
  - Hygiene should be used only as an adjunct to direct forms of treatment.
- Hygiene may *insulate* from further voice decline
- Growing support for use of hydration
- Future work
  - Monitor / quantify compliance
  - Increase number of studies on disordered populations

Symptomatic Evidence

- One line of promising work - Biofeedback
- Future Directions
  - Potential examination of theoretical bases of the methods
  - More rigorous research designs

Psychogenic Evidence

- Limited systematic study of this form of therapy
- Form of therapy often used in combo with other methods; hard to investigate

Evidence: Overall Conclusions

- Physiologic methods possess strongest support
- Efficacy of hygiene training inconclusive
- Limited evidence for symptomatic therapy
- Lack of evidence for psychogenic approaches

Planning the Physiologic Voice Therapy Program

Physiologic Therapy: Sample Sequence

Patient Education
Vocal Hygiene
Vocal Function Exercise Program
Resonant Voice Therapy

*VFE Training
*Initiation of Home Practice
*RVT Training
*Continue home practice of VFEs and build practice of RVT

Vocal Function Exercises: Building the Physiologic Foundation

Vocal Function Exercises

- A series of systematic voice manipulations, similar in theory to physical therapy for the vocal folds, designed to strengthen and coordinate the laryngeal musculature, and to improve the efficiency of the relationship among airflow, vocal fold vibration, and supraglottic treatment of phonation

Vocal Function Exercises

- Long sustained tones
- Maximal pitch glides
- Efficient posturing of the voice producing mechanism to permit maximum output with minimal effort

Vocal Function Exercises

- A series of systematic voice manipulations
- Similar in theory to physical therapy
- Designed to strengthen and coordinate the laryngeal musculature
- Designed to improve the efficiency of the relationship among airflow, vocal fold vibration, and supraglottic treatment of phonation

Vocal Function Exercises

- Consider the knee
- Made of multiple cartilages, muscles, and connective tissue
- A jointed system
- May become injured, weakened, or imbalanced in its function
Vocal Function Exercises

• Rehabilitation for injuries of the knee
  – rest to reduce edema
  – appropriate supports, casts, bracings, and wraps as needed
  – ambulatory devices
  – systematic exercise
  – Return to previous activities

Vocal Function Exercises

• Consider the larynx
  • Made of multiple cartilages, muscles, and connective tissue
  • A jointed system
  • May become injured, weakened, or imbalanced in its function

Vocal Function Exercises

• How are disorders / injuries of the larynx typically treated?
  – Sometimes voice rest / modified use
  – Sometimes hygiene counseling
  – Supports (mics, etc)
  – Treatment of symptoms
    • Meds, Behavioral Therapy
  – Return to previous activity

Vocal Function Exercises

• Systematic vocal exercise to rehabilitate the laryngeal complex itself – the muscles, cartilages, joints, etc.
• Vocal functions exercises were designed to offer this systematic exercise

What is missing?

Direct Systematic Exercises

• Restrengthening and coordinating the laryngeal musculature
• Enhancing the relationship of the three subsystems of voice production

Phase 1: Model Development

• RLN of anesthetized rats (N = 32) were fitted with custom-made nerve cuff electrodes
Phase 1: Model Development

- Experimental group (n = 16)
  - Stimulation twice daily for 7 days
  - Stimulation twice daily for 14 days
- Control group (n = 16)
  - No stimulation for 7 days
  - No stimulation for 14 days

Animals tolerated well
- 1 animal lost – sick upon arrival
- 1 animal lost during surgery

Animal model of ILM exercise established

Phase 2: Initial Examination of the Effects of ILM Exercise

- 1 day post last training session, rats anesthetized and killed
  - TA muscle dissected and fixed for analysis
  - Performed histologic & biochemical assays

Preliminary Findings

- The right (stimulated) side was significantly smaller than the left (unstimulated) side  (true change vs. normal variability)
  - This suggests that nerve stimulation may simulate endurance training which decreases muscle size

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<thead>
<tr>
<th></th>
<th>M</th>
<th>SD</th>
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<tbody>
<tr>
<td>Control Right</td>
<td>333.56</td>
<td>66.35</td>
</tr>
<tr>
<td>Nerve Stimulation Right</td>
<td>360.25</td>
<td>90.75</td>
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- Increased # of NMJs with exercise

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<tr>
<td>Nerve Stimulation Right</td>
<td>55</td>
<td>28.60</td>
</tr>
<tr>
<td>Control Right</td>
<td>49.8</td>
<td>19.41</td>
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- Possible increase in mitochondria with exercise

Preliminary Findings
Future Directions

- Complete analysis from this pilot study
- Repeat aspects of the study with additional assays
- Consider other intrinsic laryngeal muscles
- Vary the “exercise” program – frequency, duration, stimulation rate, etc
- Potential for exercise to affect diseased, paralytic, or aged vocal folds

Four Steps of VFEs

- Warm up
- Stretching Exercise
- Contracting Exercise
- Adductory Strengthening Exercise

Vocal Function Exercises - Manner of Production

- Posture
- Breathing
- Placement
- Onset
- Muscle Engagement

Vocal Function Exercises - Manner of Production

- Resonance
- Phonation
- Respiration

Vocal Function Exercises

1. (Warm-up) Sustain the vowel /i/ for as long as possible on the musical note (F)

   “F” above middle (C) for females

   “F” below middle (C) for males

Vocal Function Exercises

- Exercise 1 Goal
  - Goal based upon the patient’s personal anatomy & physiology
  - Know that efficient voice production has a flow rate of 80-200 liters / second
    - Below 80 – limiting the air flow through the system
    - Above 200 – allowing excessive air through the system
**Vocal Function Exercise**

- **Exercise 1**
  - Calculate goal in 1 of 2 ways
  - **Method 1**
    - Determine patient’s expiratory volume
    - Divide by 80 (most efficient system)
    - Obtain # seconds patient should sustain tone
  - **Method 2**
    - Sustain lightest /s/ possible for as long as possible

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**Exercise 1 - Rationale**

- Contracting laryngeal adductors and cricothyroid
- Warming up the muscles
- As patient works to increase duration, they are improving their ability to valve the exhaled air
  - When reach target – producing tone with most efficient balance of 3 subsystems

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**Vocal Function Exercises**

- **Exercise 1**
  - Monitor for:
    - Tone focus
    - Breathing, Onset of tone (top of breath)
    - Posture
  - **Expectations**
    - Poor control early on
    - Voice breaks
    - Loss of focus

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**Exercise 2**

- **Rationale**
  - Stretches the VF
  - Slow, controlled contraction of the CT
- **Expectations**
  - Difficulty maintaining tone focus
  - Voice breaks

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**Vocal Function Exercises**

2. (Stretching) Glide from your lowest note to your highest note on the word “knoll”, “whoop”, tongue trill, lip trill
   Goal = no voice breaks

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3. (contracting) Glide from a comfortable high note to your lowest note on the word “knoll”, “boom”, tongue trill, lip trill
   Goal = no voice breaks
Vocal Function Exercises

• Exercise 3
  – Rationale
    • Slow, controlled contraction of the TA
  – Expectations
    • Difficulty maintaining tone focus
    • Voice breaks

Vocal Function Exercises

4. (Power) Sustain the musical notes (C-D-E-F-G) for as long as possible on the word “old” without the /d/.

Middle (C) females
Octave below middle (C) males

• Goal same as for exercise 1

Vocal Function Exercises

• Exercise 4
  – Rationale
    • Adductory Strengthening Exercise
    • Sustained contraction of adductors (IA, LCA)

Vocal Function Exercises

Pitch Modifications

• G A B C D E F G A B C

• G A B C D E F G A B C

• G A B C D E F G A B C

Vocal Function Exercises

- notes are matched to a pitch pipe, audio CD, key board, piano
- daily record is charted by the patient
- estimated time of completion 8-10 weeks
- some patients experience minor laryngeal aching the first few days of exercise
Vocal Function Exercises

- All exercises are done 2 x each, 2 x per day
- All exercises are done as softly as possible, but engaged
- Quality of tone is monitored for breaks, wavering, and breathiness
- Extreme care is taken to teach the production in a forward tone focus without tension
- Attention is paid to the glottal onset of the tone to assure an easy onset without breathiness
- Appropriate breathing technique is assured

Explanation to the Patient

- Admit that it seems silly
- Compare it to workout program, physical therapy, weight lifting, etc. – Show the anatomy
- Stress the necessity of systematic exercise without breaks
- Explain that the times do not increase due to increased lung capacity

Advantages for the Patient

- Easily understood, reasonable model
- Systematic, permits plotting of progress
- Patient must attend to the voice at least 2 times per day
- Involves doing something positive as opposed to the “don’t do’s”

Vocal Function Exercises

- Maintenance Schedule
  - Full program 2 x each 2 x per day
  - Full program 2 x each 1 x per day
  - Full program 1 x each 1 x per day
  - Exercise 4 2 x each 1 x per day
  - Exercise 4 1 x each 1 x per day
  - Exercise 4 1 x each 3 x per week
  - Exercise 4 1 x each 1 x per week
  - Each taper involves approximately 1 week

Resonant Voice Therapy: Generalizing the Balanced Voice

Resonant Voice Therapy

- Lessac (1965)
  - The well-placed voice yields optimal functioning of respiratory, phonatory, and resonance systems
- Titze (2003)
  - RV maximum transfer of power through the vocal tract from glottis to lips and ultimately to the listener
  - Proper energy conversion at the vocal folds results in excellent propagation of sound -- vibrations of the glottal tone can extend into the facial regions
Resonant Voice Therapy

- RV produced with vocal folds barely separated
- Berry (2001)
  - Glottic configuration observed in RV produces maximum transfer of sound through vocal tract
  - Implications: Glottal configuration for RV is most efficient use of the system

Resonant Voice Therapy

- Voice production involving oral vibratory sensations, usually on the anterior alveolar ridge or higher in the face
- In the context of easy phonation
- Where resonant voice is a continuum of oral sensations and easy phonation builds from basic speech gestures through conversational speech

Resonant Voice Therapy

- Fundamental perceptual target is focused, oral vibratory sensations in the context of easy phonation.
- The singular training focus (resonance) is expected to affect multiple levels of physiology (breathing and laryngeal).
- Large numbers of repetitions are used, in varying speech contexts.
- Training is strongly goal (results) driven, involving a dogged insistence upon the greatest possible precision in the achievement of the perceptual tasks.

Basic RVT Training Maneuvers

- Stretches and Breathing Warm-Ups
  - Shoulders
  - Neck
  - Jaw
  - Floor of Mouth
  - Lips
  - Tongue
  - Pharynx

Basic Training Gesture for RT
(Step 1 for all stages of RT)

- Holm-molm-molm-molm-molm…..As a sigh
- Extreme forward focus is required with appropriate breath support
- Make the connection from the abdominal muscles to the lips
- Patient should feel very relaxed at the end of this gesture

RT Hierarchy: Stage 1 “All Voiced”

1. molm-molm-molm….. (sustained pitch) ____ note
   - vary the rate only
   - discover the vibrations; experiment with broad and narrow vibrations
RT Hierarchy: Stage 1 “All Voiced”

2. molm-molm-molm…..
   • slow-fast-slow
   • soft-loud-soft on ____ note
3. molm-molm-molm….. as speech
   • use non-linguistic phrase
   • vary the rate, pitch, and loudness
   • make the connection from the abdominal muscles to the lips

4. Chant the following voiced phrases on the musical note ____
   • Mary made me mad.
   • My mother made marmalade.
   • My merry mom made marmalade.
   • My mom may marry Marv.
   • My merry mom may marry Marv.
   • Marv made my mother merry.
5. Over-inflect these phrases as speech

RT Hierarchy: STAGE 2 “Voice-Voiceless Contrasts”

Basic Training Gesture
1. mamapapa….. vary the rate on ____ note
2. mamapapa…..
   • slow-fast-slow
   • soft-loud-soft on ____ note
3. mamapapa….. As speech
   • use non-linguistic phrases
   • vary the rate, pitch, and loudness
   • make the connection from the abdominal muscles to the lips

4. Chant the following voiced/voiceless phrases on the musical note ____
   – Mom may put Paul on the moon.
   – Mom told Tom to copy my manner.
   – My manner made Pete and Paul mad.
   – Mom may move Polly’s movie to ten.
   – My movie made Tim and Tom sad.
5. Over-inflect these phrases as speech

RT Hierarchy: STAGE 3 “ANY PHRASE”

Basic Training Gesture
- Produce the following phrases in sequence as follows:
  – First, chant the phrase on the note____, (no breath)
  – Then over-inflect it with extreme forward focus, and
  – Then finally repeat it as natural speech with a forward focus.
- Note: Each individual phrase should be produced following this 3-step sequence before moving onto the next phrase.

- All the girls were laughing.
- Get there before they close.
- Did you hear what she said?
- Come in and close the door.
- Are you going tonight?
- Put everything away.
- Come whenever you can.
- We heard that yesterday.
- The player broke his leg.
- The children went swimming.
RT Hierarchy Stage 4  
“Paragraph Reading”  
- read a paragraph with phrase markers  
- separate each phrase only by the natural inhalation of air  
- exaggerate focus and then repeat with a more normal speech/voice production  
- repeat the above without phrase markers

RT Hierarchy Stage 5  
“Controlled Conversation”  
- practice forward speech placement in conversation  
- do not permit glottal attacks, glottal fry, etc.

RT Hierarchy Stage 6  
“Environmental Manipulations”  
- simulate actual speaking environments  
- use tapes of background noise  
- go to noisy cafeteria

RT Hierarchy Stage 7  
“Emotional Manipulations”  
- use materials and topics that increasingly engage and challenge the patient

RT Home Exercises  
- The critical portion of each exercise for each week is tape recorded as a home exercise example.  
- 15-20 minute home sessions, two times per day with “minis” as needed  
  1. Stretches  
  2. Basic RV gesture  
  3. Selected level of hierarchy

Physiologic Therapy:  
Sample Sequence

<table>
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<th>Patient Education</th>
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<th>Resonant Voice Therapy</th>
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