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Differential Diagnosis in Voice Disorders

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Respiratory Therapy I 15321

Overall Purpose

- Provide conceptual framework for voice assessment
- We do not diagnose medical conditions but...
- Our findings may partly reflect medical diagnosis (at times leading to collaborative discussion about Dx)

Diagnosis (Dx)

At Broadest Level: Detective Work

- What's going on in there?
- Does what we're seeing match MD Dx?
- What are likely causes?

Medical diagnosis (MD Dx)

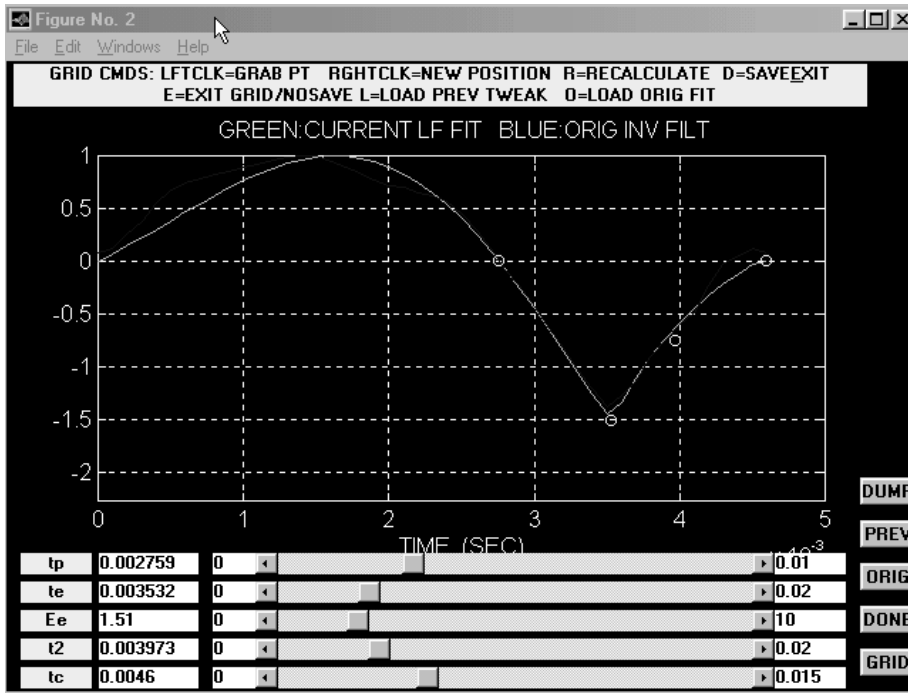
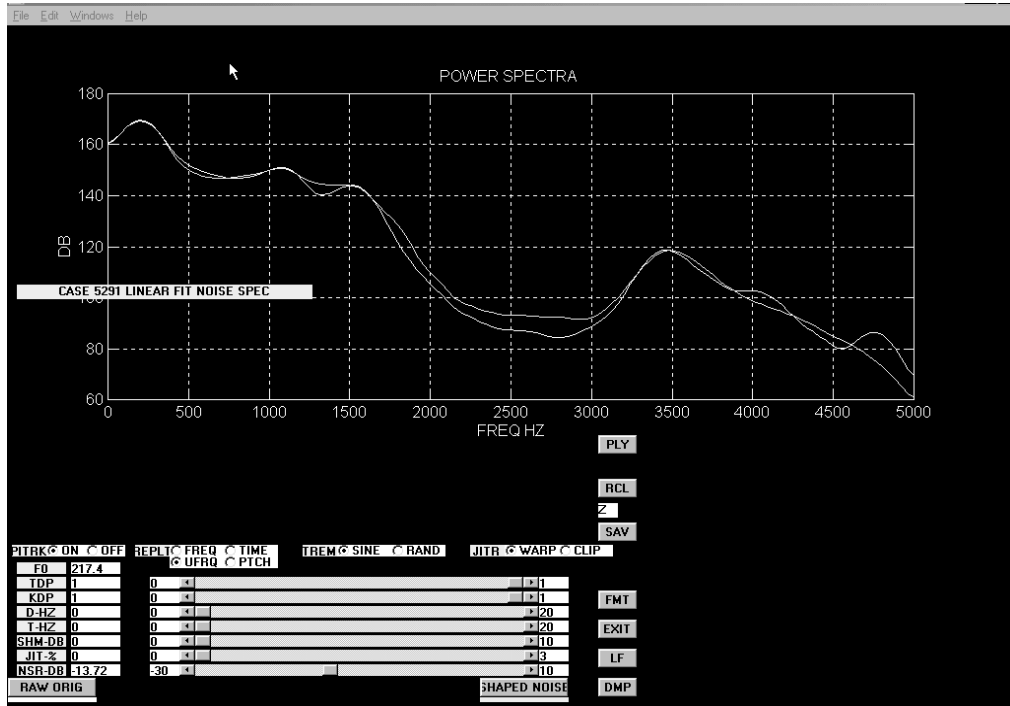
First Question (Before Trying to Figure Out “What” and “Why?”)

- Is there a pathology affecting voice? (MD Dx)
- Is there a voice disorder? (Patient perception)
 - Voice Handicap Index-10
 - Singing Handicap Index
 - Reflux Severity Index
 - Dyspnea Index
- Is voice affected? (Clinician perception; CAPE-V)
- Severity?

Consensus Auditory Perceptual Evaluation of Voice (CAPE-V)

First Question: Voice Quality

- Voice Quality?
 - Currently Consensus Auditory-Perceptual Evaluation of Voice (ASHA standard of practice)
 - Problems:
 - Reliability remains poor (not surprising; voice quality judged against unstable internal referent)
 - Possible solutions:
 - Paired comparisons (make reference point external; hold constant other speaker factors)
 - Link to a set of instrumented parameters vetted for voice quality (most promising, Kreiman et al., forthcoming)



First Question: Enter Results on Profiles Sheet

		Poor			Normal	Superior
General Vocal Fitness Index						
Voice Handicap Index – 10						
		40			11	
Singing Voice Handicap Index						
		144		8.9	8.4	7.9
			144	8.9	8.4	
Vocal Fatigue Index						
	Factor 1	44		9.74	5.16	0.58
	Factor 2					
Reflux Symptom Index						
		45			13	
Dyspnea Index						
		40			10	

First Question: Enter Results on Profiles Sheet

		Poor			Normal	Superior
Voice Quality						
	Overall severity (mm)	72	35	9	0	
	Roughness (mm)	72	35	9	0	
	Breathiness (mm)	72	35	9	0	
	Strain (mm)	72	35	9	0	
	Pitch (mm)	72	35	9	0	
	Loudness (mm)	72	35	9	0	
	Nasality	Severe	Moderate	Mild	Normal	
	Other (specify)	Severe	Moderate	Mild	Normal	

Millimeters (mm)

First Question: Enter Results on Profiles Sheet

		Poor			Normal	Superior		
Physiological Index								
Intrinsic Muscle Strength And Flexibility/Joint Integrity								
	Ad/abductors							
	L-DDK rate (z-score)	-2.0	-1.5	-1.0	0	+1.0	+1.5	+2.0
	L-DDK strength (ordinal)	Severe	Moderate	Mild	Normal	Superior		
	L-DDK consistency (ordinal)	Severe	Moderate	Mild	Normal	Superior		
Mucosal Function								
	S:Z ratio (Z-score) ³	+/-2.0	+/-1.5	+/-1.0	0			
Respiratory								
	S-prolongation (Z-score)	-2.0	-1.5	-1.0	0	+1.0	+1.5	+2.0

Laryngeal diadochokinetic (L-DDK)
Standard scores (Z-score)

First Question: Enter Results on Profiles Sheet

		Poor			Normal	Superior		
Acoustic Index								
Frequency								
	Average in speech (Hz)							
Intensity								
	Average speech (dB) (3 ft)	50/80	55/75	60/70	65			

Hertz (Hz)
Decibel (dB)
Feet (ft)

Second Question: Likely Causes

- Direct (e.g., vocal fold nodules)
- Indirect (e.g., high VF impact stress in phonation, due to strong adduction/high PS/especially at high pitches; dehydration; inflammatory exposures)
- Case history
 - Onset factors
 - Maintaining, exacerbating, and improving factors
 - Mucosal health factors
 - Reflux Dx or Sx
 - Hydration (systemic or surface)
 - Environmental inflammatory exposures

Vocal fold (VF)
Subglottal pressure (PS)
Symptom (Sx)

Second Question: Likely Causes

- Mucosal health factors
 - Reflux Dx or Sx
 - Hydration (systemic or surface)
 - Environmental inflammatory exposures
- Voice use factors
- Observations
 - Likely causes (e.g., pressed voice; high PS)
 - Baseline values
- Largely neurological
 - RLN (ad/abductory; VF shortening)
 - SLN (VF elongation)
- May be mechanical
 - Subluxation (rare; noted by history)
 - Arthritis

Recurrent laryngeal nerve (RLN)
Superior laryngeal nerve (SLN)

Second Question: Likely Causes Structure

- Largely mucosal
 - Added mass (e.g., lumps/bumps, membranous versus cartilaginous)
 - Loss of mass (e.g., atrophy, sulcus)

First Question: Enter Results on Profiles Sheet

		Poor		Normal	Superior
General Vocal Fitness Index					
Voice Handicap Index – 10					
		40		11	
Singing Voice Handicap Index					
		144	8.9	8.4	7.9
		144	8.9	8.4	
Vocal Fatigue Index					
	Factor 1	44	9.74	5.16	0.58
	Factor 2				
Reflux Symptom Index					
		45		13	
Dyspnea Index					
		40		10	

Looks for Pattern (Think BDAE)

		Poor			Normal	Superior	
Voice Quality							
	Overall Severity (mm)	72	35	9	0		
	Roughness (mm)	72	35	9	0		
	Breathiness (mm)	72	35	9	0		
	Strain (mm)	72	35	9	0		
	Pitch (mm)	72	35	9	0		
	Loudness (mm)	72	35	9	0		
	Nasality	Severe	Moderate	Mild	Normal		
	Other (specify)	Severe	Moderate	Mild	Normal		

Boston Diagnostic Aphasia Examination (BDAE)

Looks for Pattern (Think BDAE)

		Poor			Normal	Superior		
Physiological Index								
Intrinsic Muscle Strength And Flexibility/Joint Integrity								
	Ad/abductors							
	L-DDK rate (Z-score)	-2.0	-1.5	-1.0	0	+1.0	+1.5	+2.0
	L-DDK strength (ordinal)	severe	moderate	mild	normal	Superior		
	L-DDK consistency (ordinal)	severe	moderate	mild	normal	Superior		
Mucosal function								
	S:Z ratio (Z-score) ³	+/-2.0	+/-1.5	+/-1.0	0			
Respiratory								
	S-prolongation (Z-score)	-2.0	-1.5	-1.0	0	+1.0	+1.5	+2.0

Looks for Pattern (Think BDAE)

		Poor			Normal	Superior		
Acoustic index								
Frequency								
	Average in speech (Hz)							
Intensity								
	Average speech (dB) (3 ft)	50/80	55/75	60/70	65			

Second Question: Likely Causes Dynamics

- L-DDK RLN
 - “Can you make this sound?” (Demonstrate, confirm)
 - “Sit up straight and make this sound as quickly and cleanly as you can for seven seconds. I’ll tell you when to start and stop.”
 - Pen vs. computer

Norms L-DDK RLN

Norms	Age/Sex	Normal	SD	Authors
	6/F	3.6	n/a	Fletcher (1972)
	7/F	3.8	n/a	Fletcher (1972)
	8/F	4.2	n/a	Fletcher (1972)
	9/F	4.4	n/a	Fletcher (1972)
	10/F	4.6	n/a	Fletcher (1972)
	11/F	5.0	n/a	Fletcher (1972)
	12/F	5.1	n/a	Fletcher (1972)
	14/F	5.4	n/a	Fletcher (1972)
	18-38/F	5.3	0.8	Ptacek et al. (1996)
	18-39/M	5.1	1.0	Ptacek et al. (1996)
	66-93/F	3.9	1.3	Ptacek et al. (1996)
	68-89/M	4.1	0.9	Ptacek et al. (1996)
Results	<ul style="list-style-type: none"> • Calculate client's z-score for rate ($z = [\text{client's performance} - \text{normative performance}] / \text{norm SD}$) and enter result for rate in profiles sheet • Note strength of glottal plosives ordinarily on profiles sheet • Note rhythmic consistency of glottal plosives ordinarily on the profiles sheet 			

Speech disorder (SD)

Note

- DDK SLN, optional
 - Octave jumps x seven seconds
 - Norms should be the same as for RLN DDK
 - Not particularly sensitive
 - Pitch range restrictions may be more illuminating

Second Question: Likely Causes Structure

- Measures of mucosal closure
 - S:Z ratio (“Sit up straight and make this sound as long as you can (/s/). Start whenever you want to.” Then /z/. Then /z/, then /s/. Take longest /s/ and longest /z/, compare to norms
- (Note: Average airflow from instrumented measures preferred if available; norms ~ 110-180 ml/s)

Standard test of vocal function (S:Z Ratio)

Norms: Simple Estimate of Mucosal Closure

Norms			
Age/Sex	Norm	SD	Authors
5/F	0.83	0.50-1.14	Tait, Michel, & Carpenter (1980)
5/M	0.92	0.82-1.08	Tait, Michel, & Carpenter (1980)
7/F	0.78	0.51-1.10	Tait, Michel, & Carpenter (1980)
7/M	0.70	0.52-0.97	Tait, Michel, & Carpenter (1980)
9/F	0.91	0.75-1.26	Tait, Michel, & Carpenter (1980)
9/M	0.92	0.66-1.50	Tait, Michel, & Carpenter (1980)
8-88/F, M	0.99	0.36	Eckel & Boone (1981)
Results		<ul style="list-style-type: none"> • Calculate client’s z-score for S:Z ratio • $Z = (\text{client's ratio} - \text{normative ratio}) / \text{normative SD}$ • Enter result on Profiles sheet 	

Pattern (Verdolini & Palmer, 1997)

- Neurological:
 - Impairments in DDK rate, strength, or consistency (rate/strength may be peripheral; consistency may be central) may be paired with poor mucosal closure measures
- Structural:
 - Typically poor mucosal closure, good DDK

Second Question: Likely Causes

- Respiratory
 - Gross measure of respiratory capacity and management: Max /s/ prolongation from S:Z ratio

Second Question: Respiratory

Norms			
Age/Sex	Norm (sec)	SD	Authors
5/F	8.3	4.0	Tait et al. (1980)
5/M	7.9	1.4	
7/F	10.2	2.6	Tait et al. (1980)
7/M	9.3	1.7	
9/F	14.4	3.1	Tait et al. (1980)
9/M	16.7	8.5	
8-88/F, M	17.73	7.65	Eckel & Boone (1981)
Results	<ul style="list-style-type: none"> Calculate client's z-score as $z = \frac{\text{client's score} - \text{norm}}{\text{norm SD}}$ 		

Second Question: Respiratory

- Metabolic testing (anaerobic respiration during speech → fatigue)
- Capnometer (CO₂) testing (low CO₂ → possible asthma, paradoxical vocal fold motion disorder)

Second Question: Likely Causes

- Acoustic clues
 - Fo (average/range)
 - “3” on “1-5” count
 - Semitone pitch range on /a/
 - Intensity (average/range)
 - Conversational speech
 - Intensity range task

Norms: Fo

Age/sex	Norm	SD/Range	Authors
7/F	294 Hz	---	Fairbanks, Wiley, & Lassman (1949)
7/M	281 Hz	---	
8/F	297 Hz	---	
8/M	288 Hz	---	
10-12/F	237.5 Hz	198-271 Hz	Horii (1983)
10- 12/M	226.5 Hz	192-269 Hz	
17-25/F	217 Hz	1.7 semitones	Fitch & Holbrook (1970)
17- 25/M	116.7 Hz	2.1 semitones	
20-29/F (non-smoker)	224.3 Hz	192-275 Hz	Stoicheff (1981)
20-29/M	120 Hz	---	Hollien & Shipp (1972)
30-39/F (non-smoker)	213.3	181-241 Hz	Stoicheff (1981)
30-40/F	196.3 Hz	171-222 Hz	Saxman & Burk (1967)
30-39/M	112 Hz	---	Hollien & Shipp (1972)

Norms: Fo

Age/sex	Norm	SD/Range	Authors
30-40/F	196.3 Hz	171-222 Hz	Saxman & Burk (1967)
30-39/M	112 Hz	---	Hollien & Shipp (1972)
40-49/F (non-smoker)	220.8 Hz	190-273 Hz	Stoicheff (1981)
40-50/F	1886. Hz	168-206 Hz	Saxman & Burk (1967)
40-49/M	107 Hz	---	Hollien & Shipp (1972)
50-59/F (non-smoker)	199.3 Hz	176-241 Hz	Stoicheff (1981)
50-59/M	112 Hz	---	Hollien & Shipp (1972)
60-69/F (non-smoker)	199.7 Hz	143-235 Hz	Stoicheff (1981)
60-75/F	196.6 Hz	---	McGlone & Hollien (1963)
60-69/M	112 Hz	---	Hollien & Shipp (1972)
70+/F (non-smoker)	202.2 Hz	170-249 Hz	Stoicheff (1981)
80-94/F	199.8 Hz	---	McGlone & Hollien (1963)
80-89/M	146 Hz	---	Hollien & Shipp (1972)

Norms: Fo (Semitones)

Age/Sex	Norm (semitones)	SD	Authors
18-38- yr, F	32.8	4.4	Ptacek et al. (1966)
18-39 yr, M	34.5	5.2	Ptacek et al. (1966)
66-93 yr, F	25.1	7.9	Ptacek et al. (1966)
66-93 yr, M	26.5	6.3	Ptacek et al. (1966)
<ul style="list-style-type: none"> Calculate client's z-score for semitone pitch range ($z = [\text{client's range} - \text{norm}]/\text{normative SD}$) and enter result on Profiles sheet. 			

Second Question: Likely Causes Acoustic Clues (Intensity)

- A-weighting, three feet mic-to-mouth
- Norm for average is approximately 65 dB (Hirsh, personal communication)
- Norm for range is about 40 dB (rumor has it)

Side Notes

- Patient motivation
- Patient self-efficacy (confidence)
- Patient identity (personal versus social)
- Patient personality
- Barriers (e.g., family support, cost, etc.)

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Presented by:

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