4 Squares and a Circle: Multifactorial Causes of Muscle Tension Dysphonias

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Criteria for “Primary” MTDs
(Morrison, Rammage, Nichol et al, 1983 - 2002)
- Laryngeal Isometric + anatomical model (1983)
- Glottic and Supra-glottic MTD postures differentiated (1986; 1993; 2001)
- Psychological factors differentiated (1987)
- Palpable extrinsic Lx tension sites, rating scales described 2002
- Patients with MTDs have laryngological and palpable findings
- Facilitation trials can support MTD findings

MTD laryngological findings (1993)
- Laryngeal isometric (often $2^0$ benign lesions)
- Supra-glottal lateral compression (often $2^0$ to glottal incompetence or emotional repression)
- Glottal lateral compression (more common with reflux)
- Supra-glottal antero-posterior compression
- Incomplete adduction of full folds with aphonia (often symbolic conversion)
- Bowing
- Compression of arytenoids (ATVD- falsetto)

Palpation Sites:
- Supra-hyoids:
  - at rest
  - pitch glides
  - speech, probes
Thyrohyoids:  
- at rest, yawn  
- pitch glides  
- speech, probes

Cricothyroids:  
- at rest, yawn  
- pitch glides

Pharyngeal Constrictors  
- at rest  
- phonation

Prevalence of Primary MTDs

- Population prevalence unknown

- Clinic prevalence (PVCRP, 2009; N = 472)
  - > 57%
  - 78% F; 22% M
  - Mean age: 43 (all 19 yoa or older)

- By occupation: 75% occupational voice users
When other primary pathologies contribute to the dysphonia, such as:

- neurological diseases, or
- structural changes to the vocal folds,
- expected aging changes → compensatory muscle misuse?

...they over-lie and interact with the platform components.

Lifestyle factors

Vocal Dose:

- work-related voice demands (teacher; swim instructor; singer; customer service, etc)
- recreational voice demands (team sports; coaching; group-socializing)
- family/caregiver voice demands (parenting; elder-care, large family...etc)

Some occupations are vocally demanding & stressful, leading to voice problems.
Acoustic Environment:

- Maximum noise level of unoccupied classroom: ANSI S12.60: 35 dBA (normally-hearing adult)
- Optimal signal-to-noise ratio: >= 15 dB (normally-hearing adult, 1st language); Grade 1: SNR >= 20dB (Bradley, 2008)
- Reverberation rates: between 0.4 and 0.6 sec
- Typical comfortable speaking level: 75dB (adult)

Public school and university classrooms, daycare facilities and restaurants in BC do not meet minimum acoustic standards (Hodgson et al, 1999-2008) ergo, occupational voice users must talk above comfortable loudness...

Occupational Representation for BC (N=1181)

<table>
<thead>
<tr>
<th>Occupat.</th>
<th>% BCPop</th>
<th>% Clinic</th>
<th>% BC F</th>
<th>% Clin F</th>
<th>% BC M</th>
<th>% Clin M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Singer</td>
<td>.27%*</td>
<td>18%*</td>
<td>58%</td>
<td>67%</td>
<td>42%</td>
<td>33%</td>
</tr>
<tr>
<td>Teacher</td>
<td>3.8%*</td>
<td>17%*</td>
<td>62%</td>
<td>78%</td>
<td>38%</td>
<td>22%</td>
</tr>
<tr>
<td>Sek *</td>
<td>13.4%</td>
<td>12%</td>
<td>86%</td>
<td>86%</td>
<td>14%</td>
<td>14%</td>
</tr>
<tr>
<td>Bus/Adm</td>
<td>6.9%</td>
<td>7.5%</td>
<td>41%</td>
<td>42%</td>
<td>59%</td>
<td>58%</td>
</tr>
<tr>
<td>Sales *</td>
<td>14.8%</td>
<td>7%</td>
<td>41%</td>
<td>65%</td>
<td>59%</td>
<td>35%</td>
</tr>
<tr>
<td>Actor</td>
<td>.09%*</td>
<td>3%*</td>
<td>43%</td>
<td>66%</td>
<td>57%</td>
<td>34%</td>
</tr>
<tr>
<td>Nurse</td>
<td>1.6%</td>
<td>3%</td>
<td>95%</td>
<td>100%</td>
<td>5%</td>
<td>0%</td>
</tr>
<tr>
<td>Trades *</td>
<td>9.4%</td>
<td>3%</td>
<td>4%</td>
<td>15%</td>
<td>96%</td>
<td>85%</td>
</tr>
</tbody>
</table>

Teachers: 7 Years in PVCRP

Year - % of Teachers/Employed PVCRP Pop.
- 1999 - 17 % (68/400)
- 2000 - 18.54% (66/356)
- 2001 - 20.80% (104/500)
- 2002 - 16.96% (68/401)
- 2003 - 19.21 % ( 88/458)
- 2004 - 22.83 % (87/381)
- 2005 - 24.96% (115/460)

Dominant Factors for Dysphonic Teachers (PVCRP 2007, N=149)

<table>
<thead>
<tr>
<th>Dx</th>
<th># Teachers</th>
<th>% Teachers</th>
<th>% Female</th>
<th>% Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>m misuse</td>
<td>68</td>
<td>46%</td>
<td>87%</td>
<td>13%</td>
</tr>
<tr>
<td>v nodules</td>
<td>13</td>
<td>9%</td>
<td>85%</td>
<td>15%</td>
</tr>
<tr>
<td>c laryngitis</td>
<td>12</td>
<td>8%</td>
<td>58%</td>
<td>42%</td>
</tr>
<tr>
<td>v paralysis</td>
<td>11</td>
<td>7%</td>
<td>91%</td>
<td>9%</td>
</tr>
<tr>
<td>v polyp</td>
<td>7</td>
<td>.5%</td>
<td>86%</td>
<td>14%</td>
</tr>
</tbody>
</table>
Psychological factors

The body reacts to stress and anxiety by increasing resting tone in voluntary muscles. Muscles do not contract as efficiently when they are hypertonic.

Voice is used to express ideas and emotions, and dysphonia may result when these emotions are intense and suppressed/repressed.

Self-Reported Psych Conditions
(PVCRP, 2009; N = 472)

<table>
<thead>
<tr>
<th>Condition</th>
<th>1° MTD</th>
<th>Non-MTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anxiety</td>
<td>35%</td>
<td>12%</td>
</tr>
<tr>
<td>Depression</td>
<td>28%</td>
<td>18%</td>
</tr>
<tr>
<td>Psychiatric Disorder</td>
<td>12%</td>
<td>12%</td>
</tr>
</tbody>
</table>

Gastroesophageal

- 71% MTD Patients =/> 4/7 Reflux Sx, Vs VC Population: 47% (2009, N=472)
- Higher palpation scores for Thyro-hyoid and Pharyngeal Constrictors
- Higher % with A-P compression
- Reflux increases Lx tension and exacerbates co-existent dysphonia (Gill & Morrison, 1997)
- Reflux control facilitates therapy and recovery
Technique

Bad habits become programmed by repetition (Motor Learning) For example:
- The neck, back, head and shoulders are held rigidly
- Speech breathing patterns are altered
- A tightly held jaw and tongue pull up on the larynx
- Infra-hyoid muscles take up the “tug-of-war” to pull it back down again

Technique

Jaw-Tongue Functions

- Critical anatomical links to larynx
- Facial co-contraction patterns common (eg. Eyebrow adduction + jaw clench)
  FACS studies: upper face emotionally more salient, therefore Tx targets both
- 54% of MMD patients “TMJ” dysfunction vs. 22% non-MMD patients (excluding ILS) (PVCRP, 2009; N = 472)

“… but Doctor, I don’t have heartburn!”, 2011 (www.pvcrp.com)

- Patient tutorial on LPR
- Diagrams, script and vocal narration
- Patient compliance self-ratings (Likert scale)
  - (Targeted) Lifestyle changes
  - Medication compliance

Tutorial group (N= 20)  
LC: 19/20 high compliance  
MC: 16/20 high compliance

No tutorial group (N=20)  
LC: 9/20 high compliance  
MC: 14/20 high compliance
Neck Tension / Headaches and MTD
(Self-Reported, PVCRP, 2009; N = 472)

<table>
<thead>
<tr>
<th>Tension Site</th>
<th>1° MTD</th>
<th>Non- MTD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck / Shoulders</td>
<td>46%</td>
<td>28%</td>
</tr>
<tr>
<td>Chr. Headache</td>
<td>27%</td>
<td>13%</td>
</tr>
<tr>
<td>Both</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Totals</td>
<td>88%</td>
<td>51%</td>
</tr>
</tbody>
</table>
Thank you for your attention!

Therapy as 1st Tx Modality

1. to reduce causative factors & improve voice function
   (eg., bilateral vocal fold nodules)

2. to minimize effects of lesions / diseases & optimize voice function
   (eg., sulcus vocalis; vocal cord scarring; vocal paresis; dysarthrias)

Therapy as Adjuvant Rx for Phonosurgery

**Pre-Operative:**
- instruct on post-operative voice use
- eliminate vocal abuses & misuses
- model optimal post-op techniques
- counsel on reflux management

**Post-operative:**
- facilitate adaptation to structural change
- minimize scarring; maintain vocal hygiene
- optimize post-surgical voice

Vocal Senescence and Gender

**Women:**
- ↑ Epithelium
- F0 range descends
- More if smoker
- May be called “sir”
- May compensate to ↑ pitch
- ↑ tension ↓ range/ flexibility

**Men:**
- ↓ Collagen, elastin, muscle, epithelium
- F0 range ascends
- May be called “Ma’am”
- May compensate to ↓ pitch
- ↓ tension ↑ range/ flexibility
Implications

- Reduced loudness potential
- Reduced phonation duration
- Delayed voice onset
- Reduced laryngeal stability (↑ vibratory perturbation)
- Leaky VF (esp. men): thoracic ↑ + large lung volume
  → laryngeal pull → glottal chink / hypervalving

Tx: ↓ muscular compensation for aging Δ
- Help “accept” new pitch range as normal
- Increase Lx stability or Accept ↑ perturbations?
- Simplify repertoire, instructions