Vocal Dose in the Aging Larynx: Putative or Causative

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Aging has been defined as the collection of changes that render human beings progressively more likely to die (Medawar, 1952)

Population Age Structure
(U.S. National Institute on Aging)
Older birth cohorts (60+ and 75+) demonstrate a higher rate of growth than general population in U.S.A

Workforce Participation
(U.S. Department of Labor)
The body and aging

- **Sarcopenia** - age-related loss of muscle mass, strength and function (Waters et al., 2000; Vandervoort & Symons 2001)
  - Secondary to
    - Structural and functional changes to muscles, tissues, and joints
    - Remodeling of muscles, tissues, and joints
    - Physical inactivity plays a role in accelerating decline

The aging larynx

- Thinning of lamina propria (Men esp.)
- Decreased in elastic fibers
- Loss of Hyaluronic Acid
- Increase in / disorganization of collagen
- Loss of range of laryngeal joints
- Decrease in myofibrils in the muscles
- Reduced respiratory capacity and pliability

The impact of aging voice

- Estimates of a current voice disorder in the elderly range from 20-29% (Golub et al., 2006; Roy et al., 2007)
- Voice impairment leads to impairments in QOL in the elderly (Verdonck-de Leeuw et al, 2004)
- Reported that seniors engage in reduced talking time (Bastian & Thomas, 1997)
- Limited knowledge of role of physical and vocal inactivity in the development of age related dysphonia

Presbylarynx

**Incomplete closure during phonation from VF atrophy and bowing** (Honjo & Ishiki, 1980; Biever & Bless, 1989; Linville et al., 1989; Linville, 1992; Bloch & Behrman, 2001; LaGorio et al., 2010)

- Anterior or spindle-shaped glottal gap
- Glottal configuration highly variable across phonatory conditions

**Prominent vocal processes**

- **Altered vibratory traits** (Biever & Bless, 1989; Linville, 1992)
  - increased aperiodicity
  - reduced mucosal wave
  - decreased amplitude of lateral excursion
Presbyphonia

Elderly voices demonstrate a unique clustering of traits (Ptacek & Sander, 1966; Ptacek et al., 1966; Ryan & Burk, 1974; Hartman & Danhauer, 1976; Hartman, 1979; Kendall, 2007;)

- soft, altered pitch, strain/effort, breathy, rough, voice breaks


- $F_0$ increased in men and decreased in women
- Pitch range reduced
- Vocal intensity decreased at all loudness levels
- Perturbation: increased NHR, shimmer (more noise in signal)

Physical activity in seniors

Tanaka & Higuchi (1998); Tanaka & Seals (1997)

- Senior athletes w/ active lifestyle show improved well being longer than their inactive counterparts
- Senior athletes demonstrate that loss of physical independence before age 75 yrs is 2/2 disease, genetics, and destructive lifestyle

Vocal activity in seniors

Elderly Singers:

- Perceived younger and exhibit less jitter and greater intensity (Prakup at al, 2009)
- Demonstrate greater frequency range (Brown et al, 1990, Brown et al, 1991)
- Perceived younger and exhibit less jitter and F0 variability (Kim & Muller, 1997)
- Show less jitter and shimmer with larger phonation ranges (Ramag & Rangel, 1983; Orlikoff, 1990)

Purpose of the study

AIM: Quantify voice-use in a group of individuals diagnosed with presbyphonia and compare and contrast voice use by gender and by employment status (employed or retired)
Participants

15 male and female participants

Recruitment criteria
- 65-years-old or greater
- current self-perceived voice problem
- auditory-perceptual diagnosis of vocal asthenia by a Speech-Language Pathologist
- visual perceptual diagnosis of age-related dysphonia due to vocal fold atrophy by an Otolaryngologist

Protocol

Medical evaluation/Subject recruitment
↓
Screenings
Hearing (40 dB HL at 0.5, 1, and 2 kHz)
Cognition (Mini Mental Status Examination)
Mood (Elderly Depression Scale)
↓
Data Collection
APM
↓
Data Retrieval and Analysis

Results

Age: \( M = 75.77 \pm 5.98 \) (66 - 91)
- 13 participants analyzed
  - 7 men, 6 women
  - 2 participants had missing data
  - equipment failure and corrupt calibration signal

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<th>Range</th>
<th>Minimum</th>
<th>Maximum</th>
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Phonation Time: Gender

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<th>Std. Deviation</th>
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<td>00:07:53:620</td>
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<td>Female Employed</td>
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<td>00:11:04:464</td>
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<tr>
<td>Female Total</td>
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<td>00:12:21:069</td>
<td>6</td>
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<tr>
<td>Male Retired</td>
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<td>00:08:48:508</td>
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<td>00:03:10:505</td>
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<tr>
<td>Male Total</td>
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<tr>
<td>Total Retired</td>
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<tr>
<td>Total Employed</td>
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**Reference:**
- Ziegler, Verdolini Abbott, Johns, Hapner
- Hunter & Titze, 2010
- Titze, Hunter, & Svec, 2007
- Sodersten, 2002
- Masuda, 1993
- Watanabe, Shin, Oda, Fukaura, Komiyama, 1987
Questions Remain

- Is there a change in voice use (e.g., talk time) as we age?
- Do older adults without voice complaints exhibit reduced talk time?
- Does voice therapy alter voice use (e.g., talk time)?
- Does voice training prolong vocal longevity?

Conclusions

- Individuals with presbylarynx and presbyphonia exhibit reduced phonation times
  - Males less talk time than females (sig);
  - Retired less talk time than employed (not sig but trend)
  - Talk time not correlated with V-RQOL

Next Steps

- Examine phonation time in older adults who do not present with presbylarynx (control group)
- This pilot study was only a glimpse into examining vocal inactivity? Further examination is needed.
- Future studies into vocal dose in the elderly may offer the potential to utilize a quantitative measure of change w/ voice therapy for this population beyond QOL and NOMS?
Thank you