SOUND THERAPY FOR TINNITUS: DOING MORE HARM THAN GOOD?

INTERCAMPUS PROGRAM IN COMM SCIENCES AND DISORDERS
DISCLOSURES

• Faculty at the University of Kansas
  Department of Hearing & Speech

• PHD Candidate at the University of Kansas
  Auditory Effects of Concussion

• Complimentary KSHA Registration
  For speaker agreement
OBJECTIVES

At the end of the session, participants will be able to:

• Discuss the pros and cons of sound therapy for tinnitus management with potential patients.

• Apply a few basic rules of sound therapy application in patients with tinnitus and hyperacusis.

• Monitor the efficacy of sound therapy treatment plans in their patients.
AGENDA

1. SOUND THERAPY OVERVIEW
2. RISKS AND BENEFITS OF SOUND THERAPY
3. APPLICATION OF SOUND THERAPY
4. OUTCOME ASSESSMENT
YOU WILL NOT LEAVE TODAY’S 90 MINUTE SESSION PREPARED TO LAUNCH A TINNITUS PROGRAM AT YOUR PRACTICE
TINNITUS AND HYPERACUSIS PROGRAM


The program will provide a framework for best practices in the assessment and management of tinnitus and hyperacusis.

The 10.5 semester credit online Advanced Studies in Tinnitus and Hyperacusis Certificate Program is designed to:

- Provide specialized training to expand clinician’s knowledge of tinnitus (ringing in the ears) and hyperacusis (hypersensitivity to sound).
- Enhance the skills and expertise necessary to obtain a comprehensive and holistic understanding of the pathology and consequences of tinnitus and hyperacusis.
- Bring the professional up to date on the contemporary evidence that provides scientific support for treatment decisions for those with tinnitus and hyperacusis.
The International Hearing Society is proud to present the Tinnitus Care Provider Certificate Program

November 8-9, 2019
Marriott Chicago O'Hare Airport
Chicago, Illinois

The Tinnitus Care Provider Certificate Program is a two-day workshop and assessment to learn how to help your patients with tinnitus. This comprehensive curriculum focuses on tinnitus patient care involving physiology, psychology, measurement, management, and practice organization. A Tinnitus Care Provider certificate will be awarded only to those participants who attend the workshop and meet the passing standard of the assessment.

https://www.ihsinfo.org/IhsV2/tinnitus/
IOWA TINNITUS CONFERENCE

https://medicine.uiowa.edu/oto/education/conferences-and-events/international-conference-management-tinnitus-and-hyperacusis

Management of the Tinnitus & Hyperacusis Patient

27TH ANNUAL INTERNATIONAL CONFERENCE

The University of Iowa

June 13-14, 2019
FOR PROFESSIONALS AND PATIENTS
Department of Otolaryngology - Head and Neck Surgery
Department of Communication Sciences and Disorders
Professional Resources

The American Tinnitus Association is pleased to offer resources to tinnitus health providers.

Find a Healthcare Provider

Use ATA's Health Professional Directory to find a local doctor with experience in tinnitus management and support.

Learn More
SOUND THERAPY OVERVIEW
What Is Sound Therapy?

Definition is not clear…. but it could include any combination of:

- Environmental Enrichment
- Masking
- TRT / Habituation Therapy
WHY SOUND THERAPY?

TINNITUS: Brain perception of sound in the absence of real acoustic stimuli to the auditory system (Hobson et al 2012)

TINNITUS Affects 5-43% of the general population (McCormack 2016)

There is currently no cure

Tinnitus originates in the peripheral auditory system for most sufferers (Jastreboff 1988)
Why Sound Therapy?

As many as 90% or more tinnitus sufferers have comorbid hearing loss (Sanchez et al 2005; Mazurek et al 2010; Weisz et al 2006).

Amplification works to reduce tinnitus perception when the pitch falls in the hearing aid response range; particularly below 6kHz (McNeill et al 2012; Schaette et al 2010).
WHY SOUND THERAPY?

50 patients fit with hearing aid
50 fit with noise generator
50 used no device/ counseling only

All three groups showed significant reduction of TSI scores and tinnitus loudness ratings

but the NO DEVICE GROUP showed a smaller effect

Folmer and Carroll (2006)
Sound therapy can be effective for hyperacusis

Exposure to continuous low-level broadband noise shown to improve objective measures of loudness hyperacusis (Dauman & Bouscau-Faure 2005)

**Formby et al 2003**: Uncommon use of sound therapy Exposure to a lower sound level than UCL (50 dB for example) and gradually increase exposure over time in 5-dB steps until 50 dB is tolerable
WHY SOUND THERAPY?

…Because we need to TRY something?

We’re good at ruling out serious pathology, but poor at treating the regular tinnitus problem

67% of patients in a UK study reported good investigation of tinnitus source but were not offered any treatment options (McFerran et al 2018)
RISK & BENEFITS OF SOUND THERAPY
BENEFITS SHOWN WITH SOUND THERAPY

Table 3. A Comparison of the Results of Various Studies and the Measures Used

<table>
<thead>
<tr>
<th>Measures</th>
<th>Treatment</th>
<th>Before</th>
<th>After</th>
<th>Change in Score</th>
<th>% Change</th>
<th>Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>THI</td>
<td>Open-ear hearing aids</td>
<td>57.9</td>
<td>27.9 (12 mo)</td>
<td>30</td>
<td>51.81</td>
<td>Parazzini et al, 2011</td>
</tr>
<tr>
<td></td>
<td>Hearing aids + fractal tones</td>
<td>58.71</td>
<td>42 (6 mo)</td>
<td>16.71</td>
<td>28.46</td>
<td>Sweetow and Sabes, 2010</td>
</tr>
<tr>
<td>TRT (open-ear hearing aids)</td>
<td>51.82</td>
<td>25.18 (6.91 mo)</td>
<td>26.64</td>
<td>51.41</td>
<td>Del Bo et al, 2006</td>
<td></td>
</tr>
<tr>
<td>TRT (hearing aid)</td>
<td>47%</td>
<td>20.5% (12 mo)</td>
<td>N/A</td>
<td>26.5</td>
<td>Herráiz et al, 2006</td>
<td></td>
</tr>
<tr>
<td>THQ</td>
<td>Hearing aid + counseling</td>
<td>59.2</td>
<td>37.4 (12 mo)</td>
<td>21.8</td>
<td>36.82</td>
<td>Searchfield et al, 2010</td>
</tr>
<tr>
<td></td>
<td>Counseling alone</td>
<td>50.8</td>
<td>43.6 (12 mo)</td>
<td>7.2</td>
<td>14.17</td>
<td></td>
</tr>
<tr>
<td>TRQ</td>
<td>Hearing aids + fractal tones</td>
<td>52.57</td>
<td>40.86 (6 mo)</td>
<td>11.71</td>
<td>22.28</td>
<td>Sweetow and Sabes, 2010</td>
</tr>
<tr>
<td>TSI</td>
<td>Hearing aids</td>
<td>38.2</td>
<td>29.6 (6 mo)</td>
<td>8.6</td>
<td>22.51</td>
<td>Folmer and Carroll, 2006</td>
</tr>
<tr>
<td>TQ</td>
<td>Hearing aids</td>
<td>29.73</td>
<td>24 (6 mo)</td>
<td>5.73</td>
<td>19.27</td>
<td>Schaette et al, 2010</td>
</tr>
<tr>
<td>BDI</td>
<td>Hearing aids</td>
<td>5.2</td>
<td>5.2 (6 mo)</td>
<td>0</td>
<td>0</td>
<td>Folmer and Carroll, 2006</td>
</tr>
<tr>
<td>VAS</td>
<td>Hearing aids</td>
<td>71.18</td>
<td>60.09 (6 mo)</td>
<td>11.09</td>
<td>15.58</td>
<td>Schaette et al, 2010</td>
</tr>
<tr>
<td></td>
<td>TRT (hearing aid)</td>
<td>6.6</td>
<td>6.4 (12 mo)</td>
<td>0.2</td>
<td>3.03</td>
<td>Herráiz et al, 2006</td>
</tr>
<tr>
<td></td>
<td>Hearing aids</td>
<td>7.5</td>
<td>6.3 (6 mo)</td>
<td>1.2</td>
<td>16</td>
<td>Folmer and Carroll, 2006</td>
</tr>
</tbody>
</table>
If sound therapy is shown to help reduce the perceived volume or duration of daily tinnitus in some studies for some patients…

Is there any risk in trying it?

Cases to support there is a risk in ‘trying’ to help if the help is not done appropriately.
Fit at large retailer with bilateral amplification

Amplification is a appropriate first course of action, BUT no attention paid to underlying medical source of tinnitus

Financial Implications?
Don’t fit tinnitus patients without On-Ear Measures

- Proprietary algorithm compared to DSL targets for 65 dB SPL in an open-fit configuration
- Audio-shaped TRT advised

Shetty & Pottackal (2019)

*Best benefit for tinnitus when gain at tinnitus pitch increased until tinnitus is suppressed, beyond prescribed gain from NAL-NL2 or DSL v5*
The Risk of Trying | Patient RJ

- Increased tinnitus
- Perception and distress over 4 month period

- White noise for masking at 50 dBSPL without appropriate evaluation
Suppression in the primary and secondary auditory cortices was progressive, not unlike hearing loss restricted to a specific frequency range.

(Pienkowski & Eggermont 2012; Irvine et al 2000; Pienkowski et al 2011)
Cats exposed to broad moderate noise (70 dB SPL) showed an increase in neural spontaneous firing, an increase in the synchrony of neural firing, and cortical tonotopic map reorganization... without hearing loss.

*Is the same possible at lower dB SPL levels?*

(Pienkowski & Eggermont 2012)
TAKE HOME MESSAGE

1. Long-term exposure to nontraumatic broadband noise (BBN) produces the same anatomical, physiological, and behavioral symptoms of hearing loss associated with tinnitus.

2. Concerning possibility that BBN exposure may be sufficient to unmask, exacerbate, or prolong tinnitus symptoms, even without damaging the cochlea.

Attarha et al 2018 Review
Sereda et al 2018 Cochrane Review:
No data to support sound therapy works over waiting list control, placebo, or education with no device

None of the studies measured depressive symptoms or depression, anxiety symptoms or generalized anxiety, or other important outcomes of interest in this review.
1. Familiarize yourself with all available practice guidelines

2. Read current Cochrane reviews
   • Fernandez et al 2015 | Interventions for Tinnitus
   • Sereda et al 2018 | Sound Therapy
   • Phillips et al 2010 | TRT
   • Martinez-Devesa 2010 | CBT for Tinnitus
   • *and Fuller et al 2017 review of current guidelines
1. Comprehensive Case History
2. Standardized Subjective Questionnaire
3. Standard audiology & immittance
4. Loudness Discomfort Levels
5. Categorize patient: Is this primary tinnitus or secondary from an underlying medical source needing referral?
Figure 1. Approach to the differential diagnosis of tinnitus symptoms

- **Tinnitus**
  - **Pulsatile**
    - Pulse synchronous
      - Vascular
        - Idiopathic intracranial hypertension
        - Systemic hypertension
        - Arterial bruits
        - Venous hums
        - Arteriovenous malformation
        - Vascular tumours
    - Pulse asynchronous
      - Mechanical
      - Neurologic signs
      - No neurologic signs
        - Chronic noise exposure
        - Acoustic trauma
        - Ménière disease
        - Semicircular canal dehiscence
      - Abnormal otoscopy findings
      - Normal otoscopy findings
      - Other causes
        - Presbycusis
        - Chronic noise exposure
        - Acoustic trauma
        - Head trauma
        - Otosclerosis
        - Ootoxic medication

*Most common causes of tinnitus.*

Wu et al 2018
CATEGORIZE YOUR PATIENT AND PROCEED ACCORDINGLY

FIGURE 3. Temporal manifestations of tinnitus (Henry et al, 2016).
## Table 1  Categories of Tinnitus and Hyperacusis Patients

<table>
<thead>
<tr>
<th>Category</th>
<th>Hyperacusis</th>
<th>Prolonged Sound-Induced Exacerbation</th>
<th>Subjective Hearing Loss</th>
<th>Impact on Life</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>Low</td>
<td>Counseling only</td>
</tr>
<tr>
<td>1</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>High</td>
<td>Sound generators set at mixing point</td>
</tr>
<tr>
<td>2</td>
<td>—</td>
<td>—</td>
<td>Present</td>
<td>High</td>
<td>Hearing aid with stress on enrichment of the auditory background</td>
</tr>
<tr>
<td>3</td>
<td>Present</td>
<td>—</td>
<td>Not relevant</td>
<td>High</td>
<td>Sound generators set above threshold of hearing</td>
</tr>
<tr>
<td>4</td>
<td>Present</td>
<td>Present</td>
<td>Not relevant</td>
<td>High</td>
<td>Sound generators set at the threshold; very slow increase of sound level</td>
</tr>
</tbody>
</table>
5. Appropriate counseling regarding tinnitus

*If appropriate amplification does not improve symptom…. or not needed

6. Tinnitus Psychoacoustic Evaluation (Pitch, Loudness, MML)

7. CBT has the most evidence… but (insert evidence-based treatment of choice here)
If you want to deliver amplification and sound therapy for tinnitus, follow a published tinnitus management program:

1. Progressive Tinnitus Management (PTM)
2. Tinnitus Activities Treatment (TAT)
3. Tinnitus Retraining Therapy (TRT)

Or test, amplify appropriately, then refer.
AMPLIFICATION + SOUND THERAPY
TIPS AND APPLICATION
1. BILATERAL AMPLIFICATION

Del Bo 2007 suggests that the best clinical result for someone with tinnitus requires binaural amplification.

Trotter 2008 found no difference in tinnitus improvement between unilaterally and bilaterally aided patients.

Jastreboff 2000 reports anecdotal clinical evidence of tinnitus switching ears in unilateral cases.
• Open-fit coupling is recommended (if acoustically appropriate)

• Allows natural environmental sound to enter the ear, as well as amplifying those sounds, improving perceived sound quality

• Reduces potential to enhance internal noise through occlusion

(Del Bo 2007; Forti 2010; Sandlin & Olsson 1999)
3. AMPLIFICATION BANDWIDTH FOR TINNITUS

- Masking effects are best when tinnitus pitch falls in frequency response of hearing aid, per TRQ score. (McNeill et al. 2012; Folmer & Carroll, 2006; Schaette et al 2010)

**Hearing loss dependent?**
- Extending the bandwidth to include tinnitus > 4kHz did not result in a reducing in tinnitus (Moffat et al 2009)
- Extending the bandwidth past tinnitus pitch is recommended; especially in mild-moderate hearing losses where it might provide masking benefit
4. SOUND THERAPY FOR TINNITUS > 4kHz

- To achieve masking and provide high-frequency stimulation, combination amplification + sound therapy should be offered to patients with high-pitched tinnitus and high-frequency hearing loss (above 4 kHz).

- Normal environmental sounds are usually limited to frequencies below 4 kHz.

(Vernon and Meikle, 2000, 2003)
5. USE STRUCTURED SIGNALS

- Replace broadband signals with structured signals like filtered, modulating noise, music or speech (Pysanenko et al. 2018; Shore et al. 2016; Henry et al. 2004)

- Music filtered to match tinnitus percept, altered/notched to exclude tinnitus is shown to suppress tinnitus-related hyperactivity (Davis et al. 2007, Neuromonics; Okamoto et al. 2010)

- Acoustic coordinated reset neuromodulation, which randomly presents brief tones both above and below the pitch of the tinnitus to improve desynchronization and cortical map differentiation (Wegger et al. 2017)
6. SAFE SOUNDS THERAPY SETUP

- Low-frequency noise bands may temporarily exacerbate tinnitus
- 2kHz – 12kHz filtered noise is commonly used in the Oregon Tinnitus Clinic

- **Bilateral sound therapy** prevents development of abnormal central receptive fields or shifting of unilateral tinnitus to the non-treatment ear

- Sandline & Olsson 1999: 54% of patients (n=1664) reported a single tinnitus sound. **Using sound therapy that encompasses all sounds** increases effectiveness

- **Ears may need to be tested and fit separately** for maximum effect
  - Or one at a time depending on interaction effect of sounds in bilateral fit

Vernon & Meikle Ch 14, Jastreboff Ch 15, Tinnitus Handbook, 2000
7. SAFE SOUND THERAPY SETUP CONT.

General Rules of Sound Level

Normal hearing: *Sound TX or hearing aid with Sound TX and amplification off or mild gain around tinnitus frequency if possible?*

Hearing Loss with Thresholds < 70 dBHL: Amplification + Sound Tx

Hearing Loss with Thresholds > 70 dBHL: Amplification only

Constant noise > 60 dB SPL may lead to cortical change

Jastreboff & Jastreboff 1999; Jastreboff 2000; Pienkowski & Eggermont 2012
True TRT includes counseling and 'some' type of auditory enrichment

- This could include TV, radio, environmental sounds at mixing point
- Often it includes bilateral sound generators using narrowband (~ 2 octave) noise

Figure 4  Theoretical dependence of the effectiveness of habituation on the intensity of the sound used for the sound therapy.
9. PROPRIETARY PROGRAMS

LEVO SYSTEM

iPod + headphones

Proprietary Tone (pitch-matched, amplitude modulated tone) played at 50% of tinnitus level or lower (habituation method/not masking)

Customizable TX sounds for testing and treatment

Data logging that records patient usage

+ Used overnight
Neuromonics

- **Stage One: Symptom Relief**
  - 2 months
  - 2-4 hours/day

- **Stage Two: Break the Cycle**
  - 4 months
  - <2 hours/day with gradually declining use

- **Stage Three: Maintenance**
  - Use as needed 2-4 hours/week indefinitely

(Davis et al 2008)
Desyncra

- iPod + headphones
- Worn during waking hours
- Customizable TX sounds for testing and treatment
- Neuromodulation

https://www.desyncra.com/
OUTCOME ASSESSMENT
HOW CAN I TELL IF ITS WORKING?

• Pre & Post Subjective Questionnaire (30, 60, 90 days)

• Patient satisfaction surveys
  • Include patients who proceed with amplification only and amplification with sound therapy

• Redo UCLs
Thank You!

Questions?