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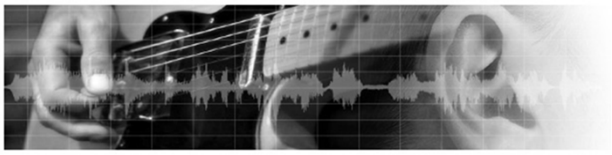

Tinnitus Management in Teens: The Perfect Storm

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Ninth Annual Live Summer Webinar Series

Wed July 6, 2016: 12-1pm Brian Fligor, ScD, PASC
Tinnitus Management with Teens: The Perfect Storm

Wed July 13, 2016: 10-11am Jennifer Martin, AuD
One Size Does Not Fit All: Selecting and Fitting Devices for Tinnitus Management

Wed July 20, 2016: 12-1pm Edward Lobarinas, PhD
Could Tinnitus Be Cured? Bench to Bedside Research

Wed July 27, 2016: 12-1pm Sharon Sandridge, PhD
Care Path for Patients with Tinnitus

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Learning Objectives

After this course learners will be able to:

- Describe the difference between the teenage brain and adult brain as relates to executive function.
- Explain how to establish a hearing loss prevention program which mitigates risk for noise-induced tinnitus, or exacerbation of an existing noise-induced tinnitus.
- Explain how to modify existing audiological management approaches to better suit the needs of a teenager.

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Agenda

- Is this really a “thing”?
- The Perfect Storm
- Tinnitus management for teenagers
  - Sound enhancement (apps, tinnitus maskers, etc)
  - Behavioral health interventions
  - Pharmacological therapy

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Teenagers as music consumers

- World Health Organization estimates 1.1 Billion young people worldwide will sustain NIHL (and tinnitus) due to recreational listening
- 95% of young adults in England attend nightclubs: 85-105 dBA (Smith, et al, 2000)
- Brazilian discos, 93-110 dBA (Santos, et al, 2007)
- NITS increased significantly only in adolescent females from 1988-1994 vs. 2004-2005 (Henderson et al, 2011)
- Majority of Flemish high school students use PLD daily, 35% set the volume control to 80% or higher (Gilles et al, 2013)
- 75% of Flemish high school students have temporary tinnitus, 18% constant tinnitus; 5% use HPD (Gilles et al, 2013)

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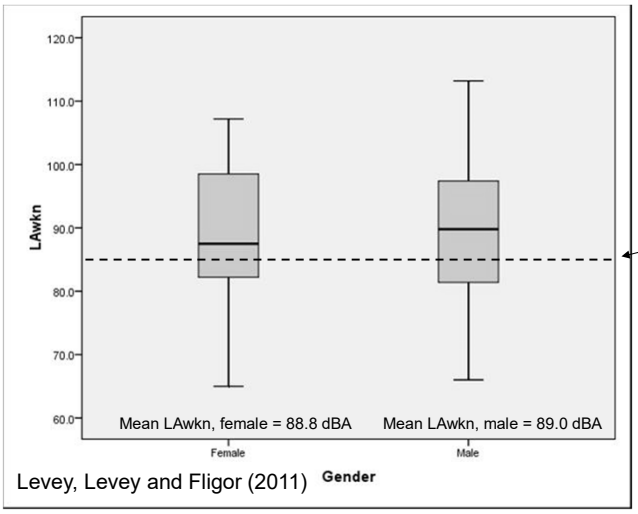
NYC estimated weekly iPod exposure



Levey, Levey and Fligor (2011)

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Box-and-whisker plot showing weekly average exposure median, interquartile range, and maximum and minimum

NYC Campus and Union Square, PLD use

Ethnicity/Race	% Exceeds Max Daily Noise Dose	% Exceeds Max Weekly Noise Dose
African	60%	60%
African American	86%*	86%**
Asian	60%	60%
Caribbean	69%	46%
Hispanic	65%	61%
White	37%	34%

*p = 0.004; **p = 0.002

Fligor, Levey & Levey (2014)

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NYC estimated weekly iPod exposures

Age	% Exceeds Max Daily Noise Dose	% Exceeds Max Weekly Noise Dose
18-24 years	68%*	65%**
25-56 years	48%	41%

*p = 0.015; **p = 0.004

"Max Dose" defined as L_{A8hn} and L_{Awkn} ≥ 85 dBA, trade 3

Non-significant: Education, gender, NIHL-risk awareness, campus vs. Union Square, mode of transit, device-type, or music genre

Significant Factor: Social identity?

Fligor, Levey & Levey (2014)

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Noise and Drug-induced SNHL: common pathway, shared pathophysiology

- Dose-effect relationship, Cumulative through lifetime
- Genetic predisposition
- Similar insidious impact on speech intelligibility

Auditory Injuries:
- NIPTS (also NITTS)
- Tinnitus
- Abnormal pitch perception (diplacusis)
- Loudness intolerance (hyperacusis)

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Tinnitus

A perceived sound (ringing, buzzing, hissing, etc) that cannot be attributed to an external stimuli

- Phantom auditory perception (Jastreboff, 1990)
- 93% report some sensation of tinnitus in quiet settings (Heller and Bergman, 1953)
- 28% report perception of tinnitus
- 2% "suffer" (dependent on age, location, and clinical definition)
- Noise exposure is the most common cause

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Most Frequently Reported Problems with "Bothersome" Tinnitus

- Getting to sleep (or maintaining sleep)
  - Teenagers: 8-9 hours sleep needed, avg. 6 hours
  - Sleep-awake cycle different from adults
- Persistence of tinnitus (can't escape)
- Understanding speech (possibly because of concomitant hearing loss)
- Despair, frustration, depression
- Annoyance, irritation, inability to relax
- Poor concentration or confusion

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Tinnitus Reaction… not the perception

**Barring sinister medical sources, the problem is not the tinnitus itself, but the patient's reaction to the tinnitus! Tinnitus activates the sympathetic response of the autonomic nervous system ("fight/flight/freeze") and because the tinnitus is persistent, sufferer is locked into state of hypervigilance and anxiety/fear/dread

<u>Human brain as a pattern establisher:</u>

- Cause-Effect relationship MUST exist
- Implications for circumstances occurring concomitant with, but unrelated to, tinnitus onset

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Management of Tinnitus

Habituation of the Reaction

vs.

Habituation of the Perception

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Tinnitus Reaction… not the perception

Human brain as a pattern establisher:

- Acoustic Trauma (what else happened?)
- Chemotherapy (why was this drug necessary?)
- Major medical event (you get the picture)

Limbic and Autonomic Nervous System
("The Lizard Brain")
-Thalamus = attention/arousal (vigilance)
-Hippocampus = long term memory
-Amygdala = emotional context to memory (self-preservation)

Assignment of significance, negative emotional context to signal, chronicity of signal = Conditioned Reflex…

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The Teenage Brain

- Puberty (~12 years), brain reorganization through age 16 years due to massive changes in brain chemistry
- Hypothalamus (sensory gating) deals out the anxiety, stress, motivations (smell and hearing **bypass** H-T, go directly to T)
- Thalamus → hippocampus and amygdala: "Lizard Brain": more in control than in adults (easier to believe pattern exists when there is, in fact, no pattern)
- Prefrontal cortex (executive function; consequence realization; the "emergency brake") mature at age 25 years

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The Teenage Brain

The Three Fables

- "The Imaginary Audience": Delusion of always being watched and judged
- "Special and Unique": Any event that happens to them has only ever happened to them ("the chosen one")
- "Invincibility": bad things can happen to others, but not to me (lack of consequence realization d/t immature prefrontal cortex)

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Tinnitus "Suffering"

- VERY high rate of co-morbidity with anxiety and depression
  - Are they already depressed and anxious? Low trigger?
  - Teenage brain: Puberty (12-16 years of age)
- Not the perception of the tinnitus, but the reaction to it
- Inappropriate assignment of importance of the tinnitus, results in the limbic system expressing a fear reaction
- Activation of the sympathetic response of the autonomic nervous system
  - Conditioned reflex (inappropriate assignment of cause-effect)
  - State of fight-or-flight
  - Persistence of tinnitus results in persistence of fight-or-flight (remains in hyperanxious state)

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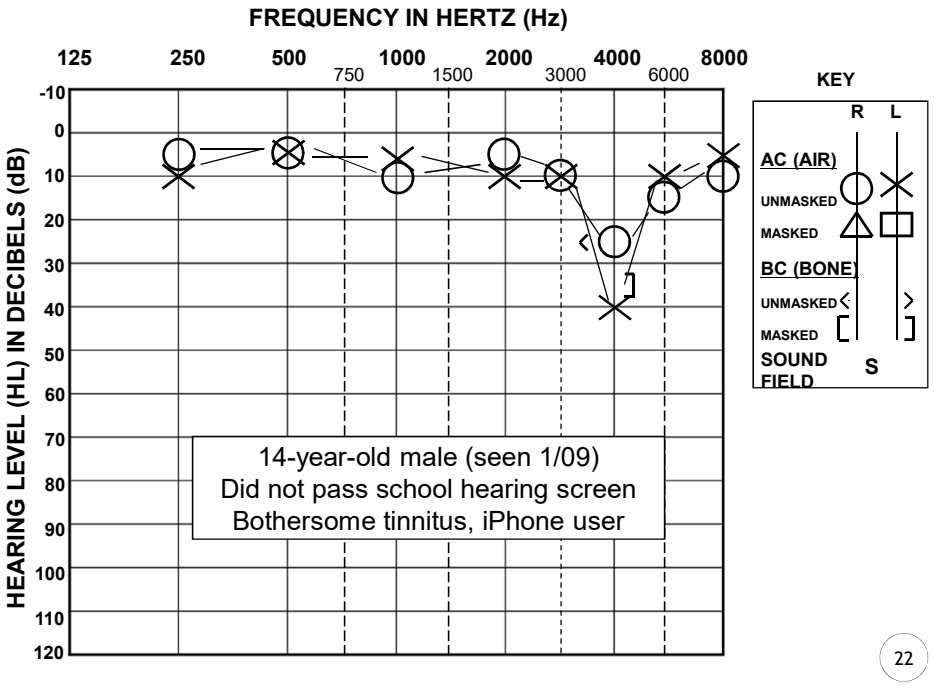

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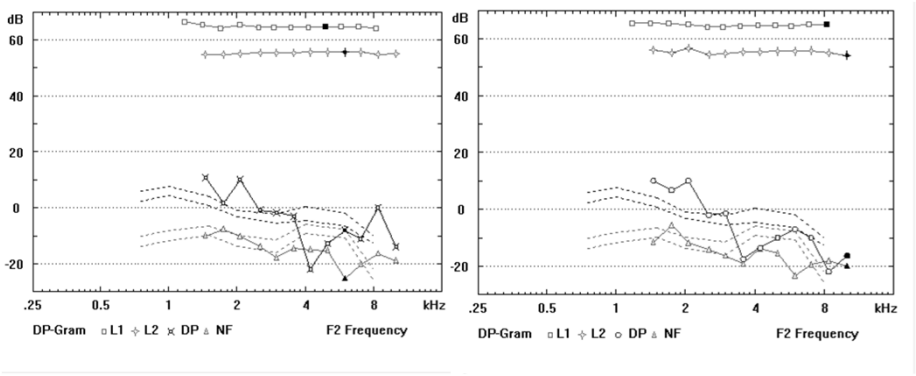
DPOAEs, 14-year-old iPod users (1 ½ years), *notched audiogram*



- Reduced or absent DPOAEs at frequencies 4000 Hz and above re: 95% normals (Gorga, et al., 1997)

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Pediatric Tinnitus Patient: JI

- Jan 2012, 14 years old, SSNHL with aural fullness and tinnitus, no dizziness, no migraine
- Work-up by ENT for Lyme disease/autoimmune, oral prednisone 12 days: Hearing and aural fullness improved, tinnitus did not
- Audiological evaluation, informational audiological counseling and imagery ("what's your favorite sound?"), and sound enhancement: improved dramatically
- Jan 2013, exacerbation, grades dropped A's to D's, and JI was housebound for weeks: at risk for repeating sophomore year

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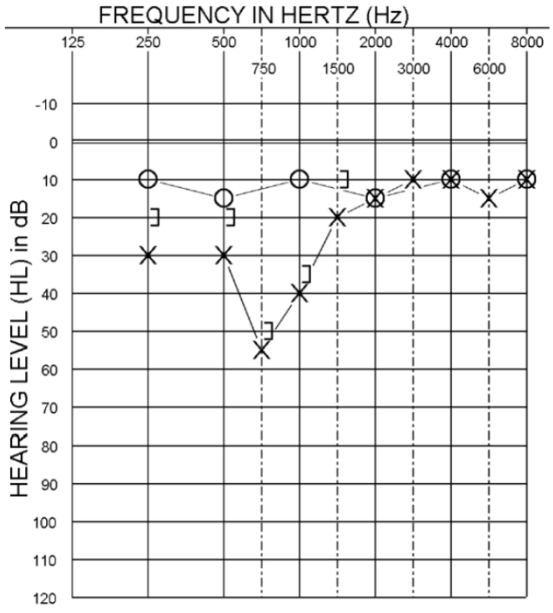
JI's audiogram Jan 2013



-Normal tymps
-CNT left reflex
(right normal)
-100% WRS AU at
PB Max
Minimum Masking Level
White noise = 44 dB HL
Max tolerated = 60 dB HL

Tinnitus Reaction Questionnaire Score = 54
("clinically significant = 17)

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Management of JI

- Otologically cleared (no tumor)
- Good family support (adult brother attends all appointments)
- Evaluations by BCH Psychiatry, originally no ongoing therapy, now on low dose anti-anxiety meds (Celexa)
- Continuous sound enhancement ("Sleep Sounds" through iPod in study hall, left ear only); iPhone connected to powered speaker in bedroom; combination tinnitus masker-hearing aid in left ear April 2013
- Was every 2 weeks, 30-minute "check in" 1st month, now monthly 30-minute "check in" (or PRN)
- In school, has made up work from 8 weeks total missed

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Tinnitus Interventions: Extinguish the Conditioned Reflex

- Informational counseling (one-on-one vs. group)
- Sound enhancement (white noise generator; tinnitus maskers; combo devices- hearing aid with tinnitus masker)
- Tinnitus Retraining Therapy (Jastreboff)
- Behavioral Health (CBT, Mindfulness, etc)
- Anti-anxiety medications
- Hearing loss prevention program to mitigate exacerbation of tinnitus and hearing loss

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Can't I just take a pill?

For assisting in reaction to tinnitus:

- Anti-anxiety medications
  - Benzodiazepine; e.g., Clonazepam (Klonopin): Anti-anxiety (and anti-seizure)
- Anti-depression medications
  - Selective serotonin reuptake inhibitors (SSRI); e.g., Fluoxetine (Prozac; Sarafem): anti-depressant and anti-OCD; e.g. Sertraline (Zoloft): anti-anxiety (and anti-depressant/anti-OCD)
  - Careful use in children and teenagers (suicide risk)
- Close medical management by psychiatrist
- Beware "homeopathic" remedies… Quietus and other snake-oil and internet "cure-alls"

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Management of Tinnitus: Reaction Habituation

1. It's not their fault…
2. It's not the tinnitus, it's their reaction to it.
3. The tinnitus is neutral
4. Enhanced environmental sound.
5. ENSURE future exposures are less than 100% noise dose (prefer 50%)
6. Connect with a team of providers in complementary fields.

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Management of Tinnitus: Reaction Habituation (specific to teenagers)

1. Raise self esteem
2. Use sound enhancement to combat the notion they have no control over their bodies
3. Parents must be turned into allies
4. Watch those unhealthy repetitive thoughts (CBT)

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Summary

- The teenage brain is not like the adult brain
  - Relative balance between Prefrontal Cortex (executive function) and Limbic System (emotion, memory, appetite, instinct) is not the same
  - Rapid and uncontrolled hormonal changes
  - The Three Fables
- Tinnitus management tools are the same, but applied differently
  - CBT is more "reconditioning" than "rethinking"
  - Control over their bodies
  - Team approach ***imperative***

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