

Decreased Sound Tolerance Problems in Children; Exploring Clinical Practice Guidelines

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DISCLOSURES

- Registration, Stipend, Travel Expenses covered by CAA



Boston Children's Hospital Audiology



38 Audiologists
7 Audiology Assistants

7 Clinics

25,000+ Visits per Year

- 20,000+ Hearing Tests
- 2000+ Hearing Aids
- 1000+ Cochlear Implants
- 1000+ ABR
- 600+ Inpatient
- 200+ Auditory Processing
- 150+ Tinnitus and DST

Can't measure

No standard test
battery

No Cure

No consensus on
management

No
algorithms!

No standard
definitions

Pathophysiology—
who
knows?

Main Points

- What is our role?
- Understanding Hyperacusis, Misophonia, Phonophobia (the big three) as well as Acoustic Shock, Tonic Tensor Tympani Syndrome that can be in the mix
- Evaluation
- Management



Decreased Sound Tolerance is a Family Problem

- ▶ Families may restrict their participation or avoid certain places
- ▶ School performance and attendance can be affected
- ▶ Stress dealing with the child's behavior
- ▶ Family dynamics and family relationships can be affected because family members are often sources of trigger sounds
- ▶ Children with misophonia may not be able to share meals with their families comfortably
- ▶ Family vacations in hotel rooms, car trips, airplane trips, all can be difficult when a member has misophonia



Why is it important?

Audiology often first point of contact for these families

Children and parents relieved to find someone who “gets it”

Anxiety decreases if kid and family can understand what is happening and give it a name

Family and child need to be pointed in the right direction toward management

Reducing anxiety can reduce symptoms (and raising anxiety can exacerbate them)



HYPERACUSIS

Multiple commonplace sounds of low or moderate intensity are perceived as excessively and uncomfortably loud, or cause pain. Symptoms are present across multiple settings. (Williams et al 2021)

14.4% children with hyperacusis

72% bothered by it
Nemholt et al 2019



HYPERACUSIS

Associated Conditions

- ASD
- ADHD
- Down Syndrome
- Williams Syndrome
- Tinnitus
- Hearing Loss
- Concussion
- Lyme Disease
- Migraines



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“Compared to adults, children with hyperacusis are substantially less likely to present with comorbid hearing loss or tinnitus and much more likely to have comorbid neurodevelopmental conditions such as autism spectrum disorder (ASD) or attention deficit-hyperactivity disorder”

Williams 2021



PATHOPHYSIOLOGY (maybe.....)

Overactivity of neurons in auditory pathways, abnormally increased central auditory gain

Incomplete myelination

Immature sensory gating

Sensory processing issues

Kennedy, Benton, Kentish, 2018



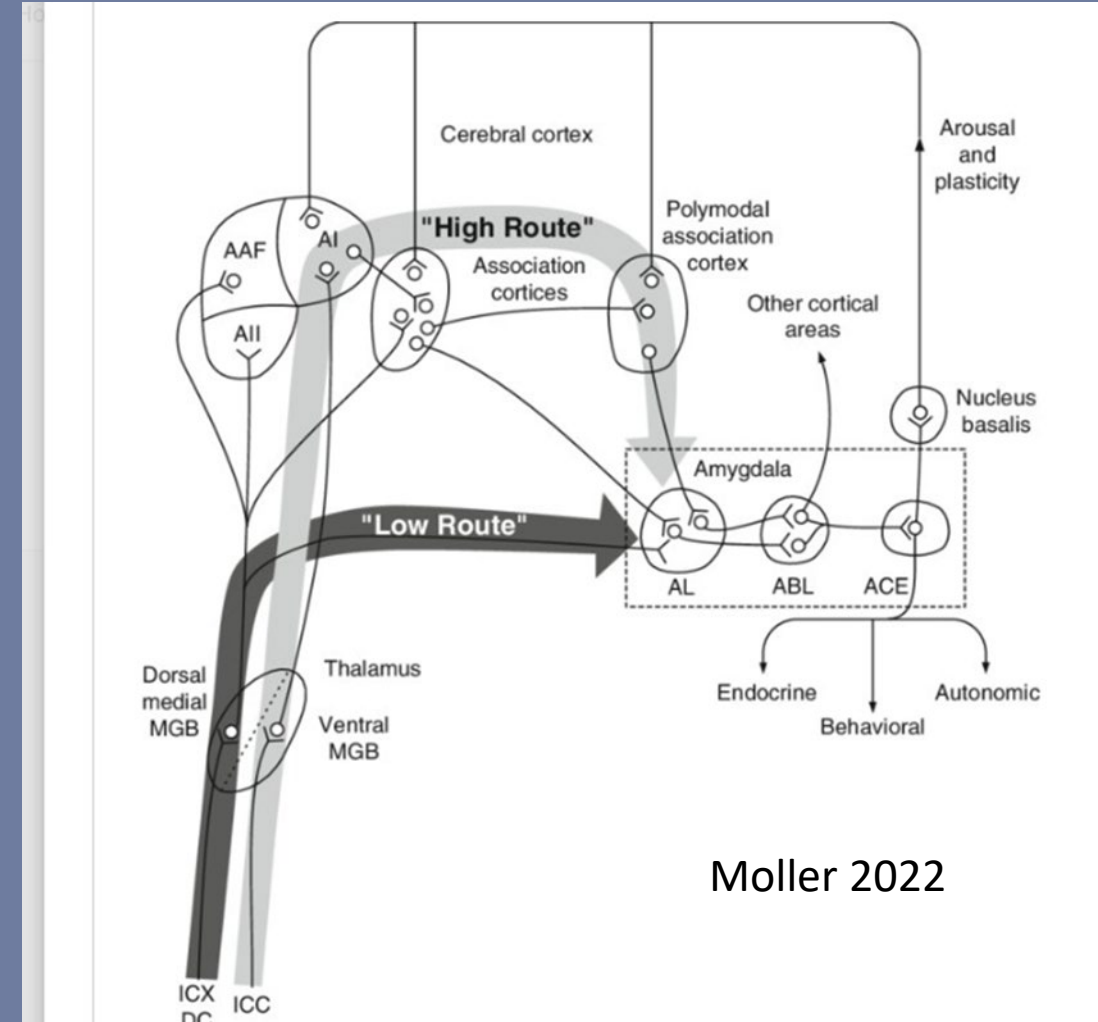
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MISOPHONIA

- Enhanced nervous system arousal- fight or flight response to “trigger” sounds
- Negative emotional reactions (anger, irritation, rage, anxiety)
- Triggers: specific, pattern based usually related to breathing, eating, talking and/or tapping sounds such keyboard, pen tapping
- Visual Triggers: repetitive movements
- Spectrum disorder
- Most commonly appears in pre-teen or teen years
- Prevalence—20% (N=500 on a US college campus)
- Wu et al 2014



Co-Morbidities

- Autistic or autistic traits
- ADHD
- OCD
- Anxiety Disorder
- Depression
- Disorders of emotional regulation

WHAT IS HAPPENING?

Brain connectivity differences

Higher mylenization in ventromedial prefrontal cortex involved in processing and regulationg emotions like fear, empathy and decision making

Greater activation of anterior insular cortex (saliience)

Kumar 2017

Motor neurons-increased connectivity between both auditory cortex and the insula (saliience) and parts of motor cortex that control orofacial movement

Kumar et al 2021



Phonophobia

- Immediate fear and anxiety
- Avoidance of feared sound or situations
- Endures with intense discomfort
- Emotions are way out proportion to the actual danger posed
- Reaction is more than expected for developmental level

Williams et al 2021



- Follows an abrupt, intense, unexpected sound
- Causes altered hearing, otalgia, aural fullness, imbalance, tinnitus, fear of or dislike of sound
- Involvement of Tensor Tympani muscle
- Hyperexcitability of auditory pathways
- Precursive state of anxiety or arousal

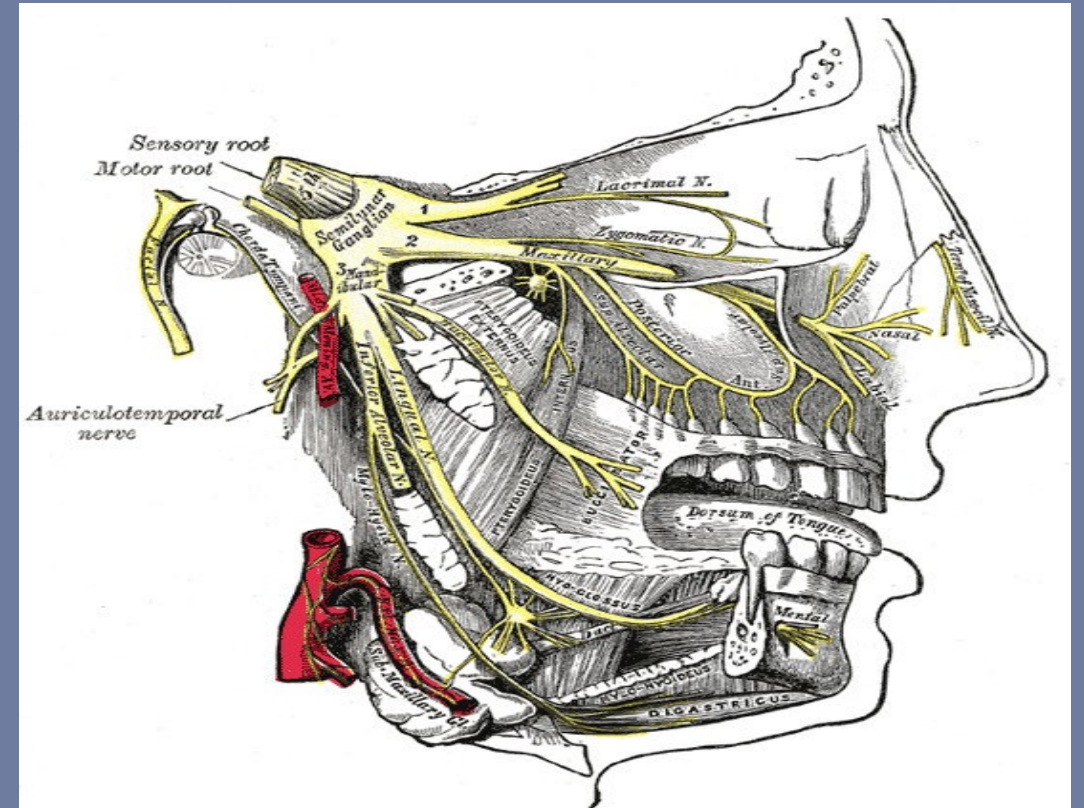
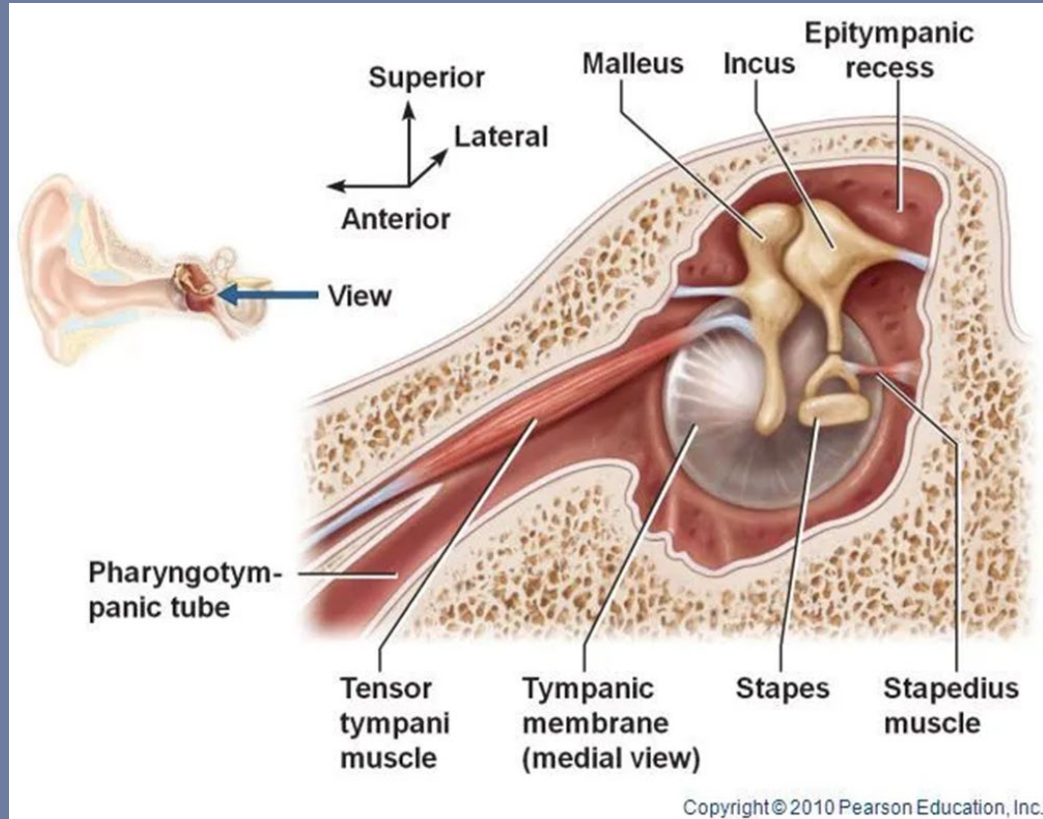
McFerren, Baguley 2007

Australian Call Center Workers 2002
Health and Safety Study

Acoustic Shock



Tensor Tympani Muscle and Trigeminal Nerve



Neuroanatomy, Cranial Nerve 5 (Trigeminal)
Trevor Huff; Luke J. Weisbrod; Daniel T. Daly.



HYPERACUSIS

- Disorder of auditory pathways and central auditory gain
- Caused by injury, acoustic shock, stress, psychological distress
- Improves with sound therapy and/or CBT
- Can occur at any age for many reasons.
- 14% per Nemholt et al 2019
- Audiologists own it, with help as needed

MISOPHONIA

- Brain based, neurological, not psychiatric (probably)
- Don't know cause
- No evidenced based treatments
- Usually has onset in pre-teen to teen years,
- 20% of a large sample of US college students
- Nobody owns it!!

PHONOPHOBIA

- Psychiatric
- Often there is a precipitating event
- Treated with CBT
- Can occur at any age
- Don't have prevalence numbers
- Psychologists own it



Be mindful of your patient's sound sensitivities



OBJECTIVE OF AUDIOLOGICAL EVALUATION FOR DST

HISTORY

- Impact of DST on daily life
- Careful inventory of problem sounds
- Description from child of their reaction
- Coping strategies—are they working?
- Find out if co-occurring disorders: Anxiety, Depression, Neurodevelopmental issues, learning issues
- Medical/Otologic history

EVALUATION

- Rule out hearing loss, cochlear dysfunction, retrocochlear signs, middle ear dysfunction, evidence for hyperacusis (LDLs)

DIAGNOSIS—WHICH ISSUE OR COMBO?

REFERRALS

AUDIOLOGICAL FOLLOW-UP PLAN IF NEEDED



Boston Children's Hospital

Where the world comes for answers

Test Battery

Tympanometry

Middle ear muscle reflexes

Air conduction 250-8000 Hz including interoctaves

Bone conduction

Speech reception thresholds

Word recognition

DPOAES 2000-8000 HZ

LDLs (see reference Aazh 2018)

Discretion and clinical judgement



Red Flags for ENT Referral

- ✍ New diagnosis of hearing loss
- ✍ Unilateral complaints
- ✍ Ear or jaw pain
- ✍ Autophony or vertigo
- ✍ Chronic middle ear issues
- ✍ Abnormal middle ear reflexes
- ✍ Significant supra-normal bone conduction thresholds with significant distress from disorder



Next Steps

- Counseling
- Sharing information—documentation, letters, phone calls
- Audiological follow-up for Tinnitus Retraining Therapy TRT, Support
- Referrals to other helpers



Who are the helpers?

Audiologists

School based audiologists and SLPs

OTs-“down-regulate” nervous system

Psychologists-coping, exposure therapy if appropriate, relaxation strategies, treat co-morbidities

Physicians- diagnose, treat underlying medical conditions and co-occurring disorders

Educators-implement accommodations recommendations



Hyperacusis Counseling, Management

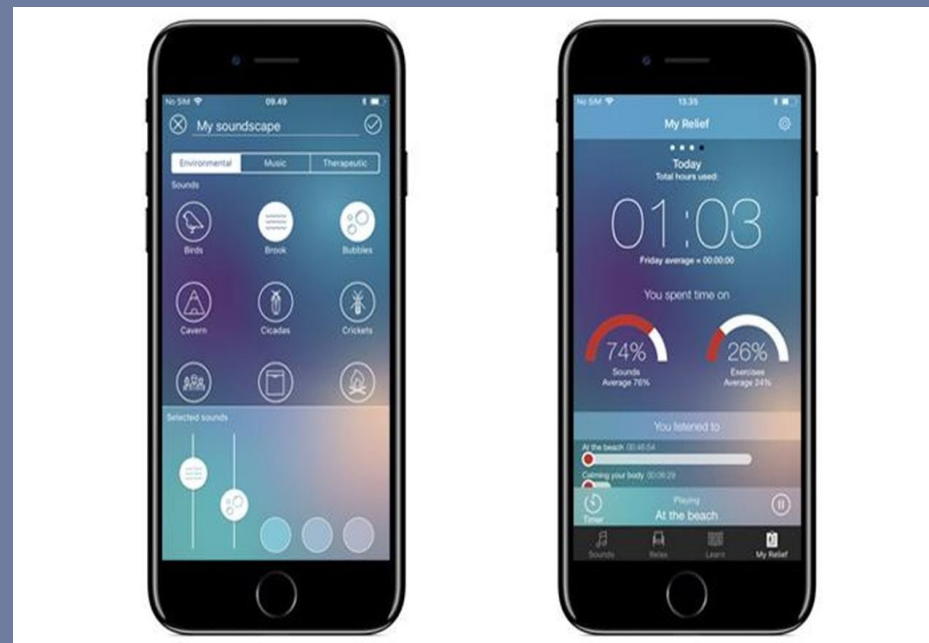
- Education pathophysiology simplified, avoidance of sound increases symptoms, stress and anxiety effects
- Reassure that everyday sounds the child avoids will NOT hurt their ears or hearing
- Recommend weaning from ear defenders, enriched sound environment, gradual exposure to trouble so
- Tinnitus Retraining Therapy including wearable sound generators if needed
- Referrals psychology, OT, neurology if needed. Co-existing issues like anxiety or depression should be treated.
- School accommodations, contact with teachers and specialists

Misophonia Counseling, Management

- Education of family and child that child's responses to triggers are due to a brain-based condition and are not behavioral or manipulative
- Not psychiatric/psychological condition—neurological fits better
- Recommend family strategies—trigger free zone at home, eat outside, brainstorm solutions
- Self care—exercise, diet, sleep
- [The Parent's Guide to Misophonia: Regulate, Reason and Reassure](#) by Dr. Jennifer Brout
- Diagnose and treat co-morbid conditions—neuropsychology, behavioral health, psychiatry
- Don't yet have evidenced based treatments—research is happening!
- Development of coping skills with behavioral health, OT
- School accommodations, contact with teachers and specialists



SOUND THERAPY OPTIONS



School Accommodations Hyperacusis

504 plan

- **Have a plan**
- **Breaks or “Quiet Corner”** to regulate and regroup, while staying in room
- **Calming** activities, **Soothing**/Happy sounds via earphones
- **Alternative** place to eat lunch, seating away from noises that bother, **warning** for fire alarm
- **Hearing protection used judiciously** for legitimately loud sounds OR to get child into a situation that they would not otherwise tolerate
- **Gradual** exposure to difficult environments or sounds, with support and an “out” such as earplugs nearby, so child does not feel trapped



School Accommodations Misophonia

504 Plan

- Breaks as needed during school day with silent signal to teacher that student needs to leave
- Background noise—via sound machine in classroom near child’s desk, or via ear buds, earphones, sound generators
- Test taking in a separate room (alone)
- Alternative place to eat lunch
- Disallow snacking and gum chewing in class
- Alternative assignments or ways to make-up work due to missed time in class
- Priority for a single dormitory room if student goes on to college



Resources:

Hyperacusis: Over-Sensitivity to Sound

Karen L. Anderson, Ph.D.

Successforkidswithhearingloss.com

It's Too Loud: What to do for kids with sound sensitivities

Brianna Hester, Au.D.

Successforkidswithhearingloss.com

A Quick Misophonia Guide for Teachers

Dr Jennifer Brout

International Misophonia Research Network

www.misophoniaresearch.com

[A Parent's Guide to Misophonia](#) by Dr. Jennifer Brout

(available on Amazon)

www.Misophoniainternational.com

soquiet.org/misophoniatools

www.misophonia.duke.edu

American Tinnitus Association

Ata.org

The British Society of Audiology

thebsa.org.uk



Boston Children's Hospital

Where the world comes for answers

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Recent Articles

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Mednicoff, S.D., Barashy, S., et al (2022) Auditory affective processing, musicality, and the development of misopoia reactions. Fron Neurosci. Sept.

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Swedo, S.E., Baguley, D.M. et al. (2022) Consensus definition of misophonia: a delphi study. Front Neurosci. March, Vol. 16

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Thank you

Questions?

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