

Screening for Auditory Symptoms Following Concussion

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Keeping things legal

- No financial conflicts of interest
- The information presented and the opinions expressed herein are those of the authors and do not necessarily reflect the position or policy of the Department of Veterans Affairs, Department of Defense, or the United States government



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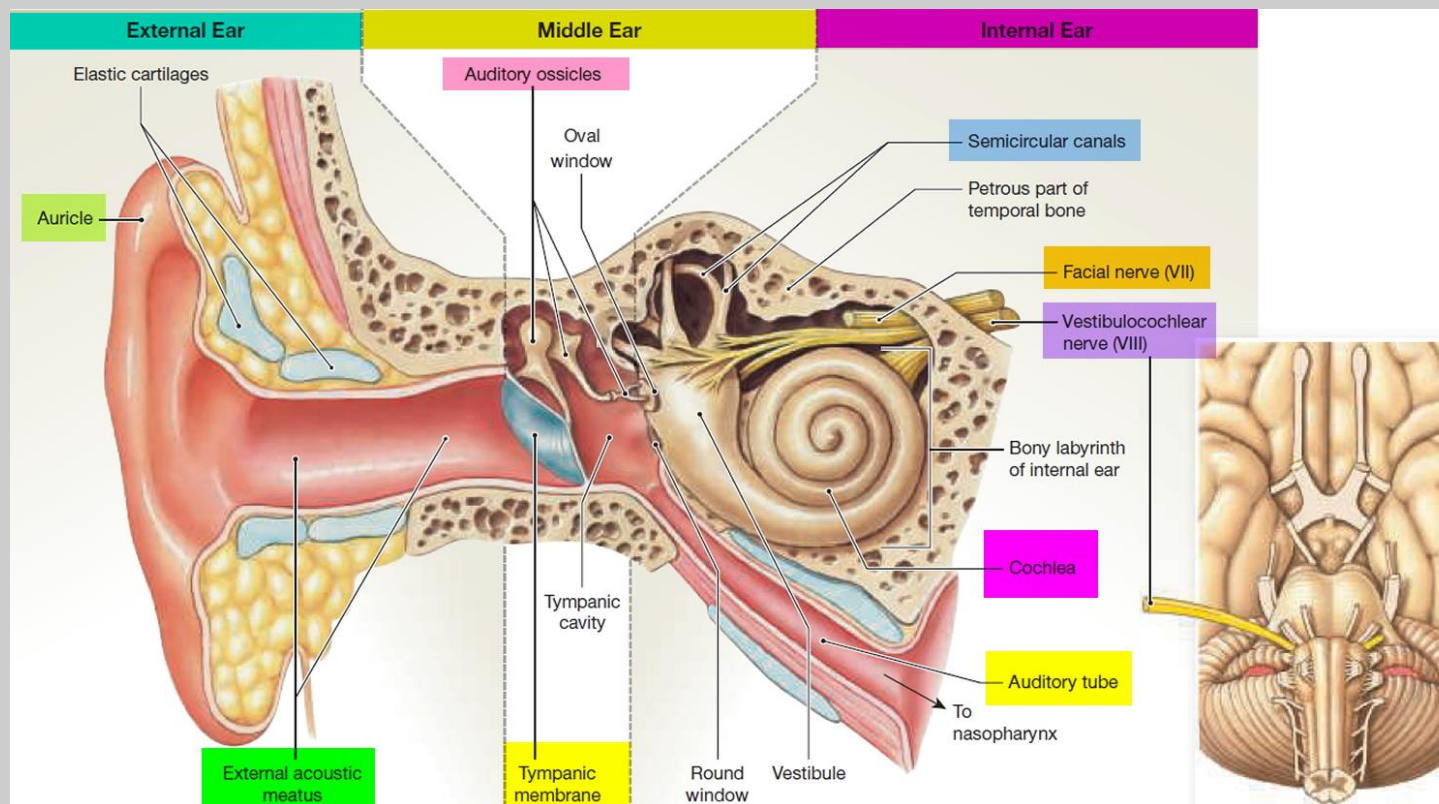
Case Study: Veteran, 52 years old

Hearing & Speech Understanding Complaints:

- Difficulty hearing in noise/multiple talkers
- Difficulty on the telephone
- Difficulty paying attention to people speaking
- Confusion of similar sounding words
- Talks louder than normal
- Needs TV louder than normal

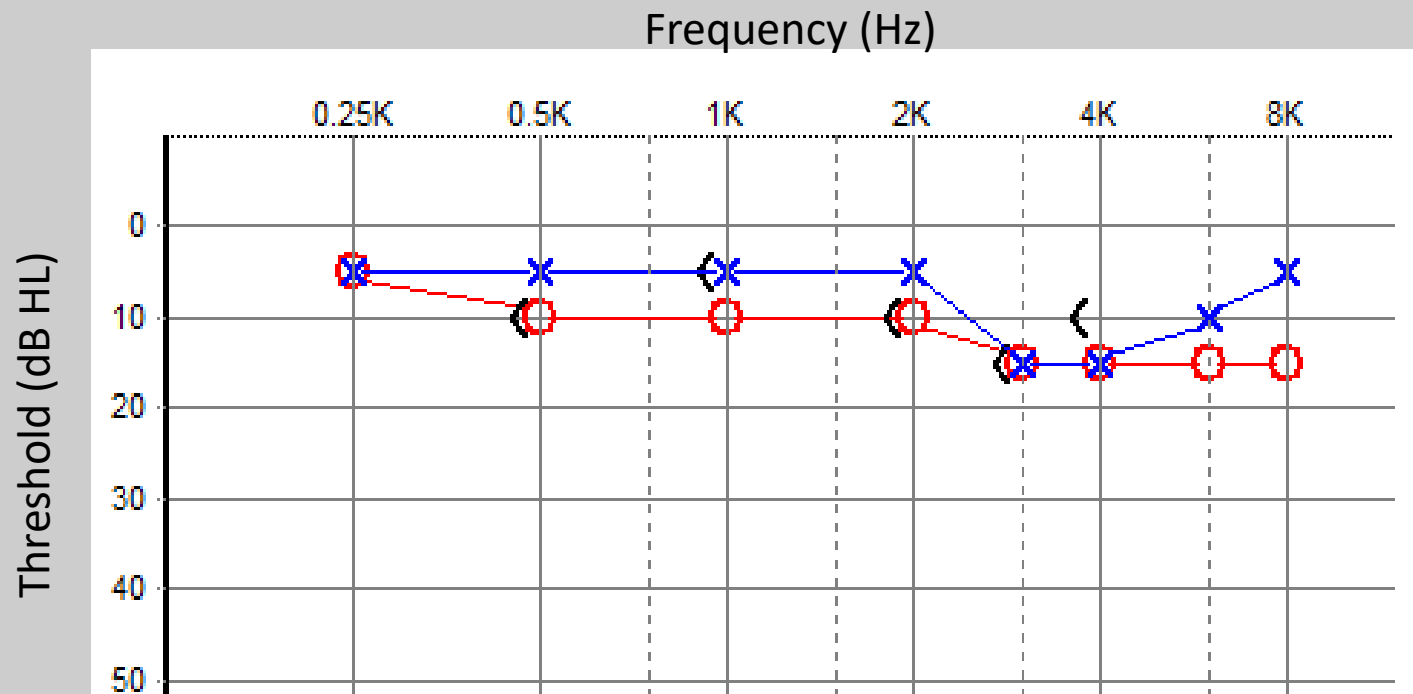


The Auditory Pathway:



Pure-Tone Audiogram:

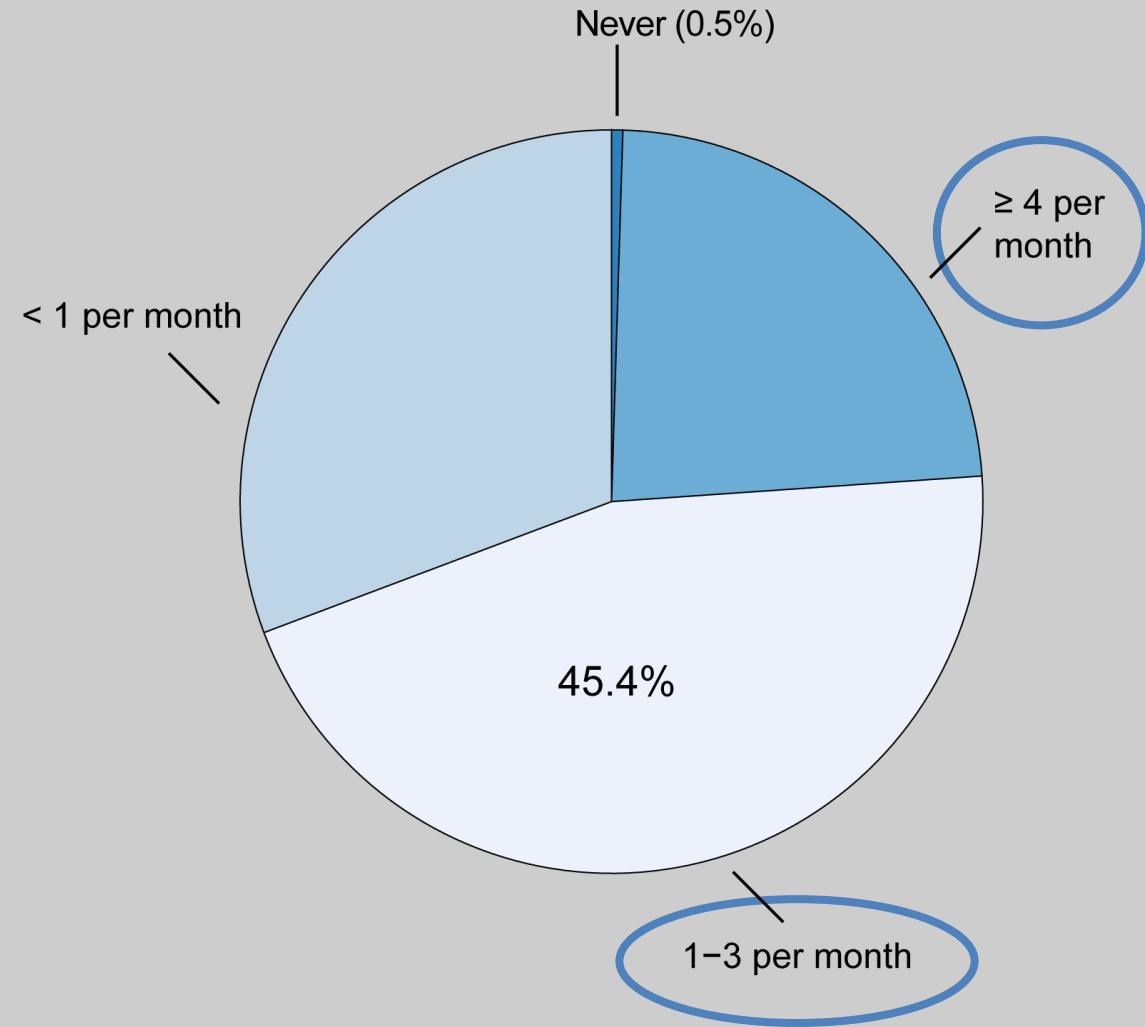
What is “normal” hearing?



Scope of the Problem

Survey of Audiologists:

“How often do you encounter patients who have communication difficulties despite having normal or near normal pure-tone hearing thresholds?” (n=205)

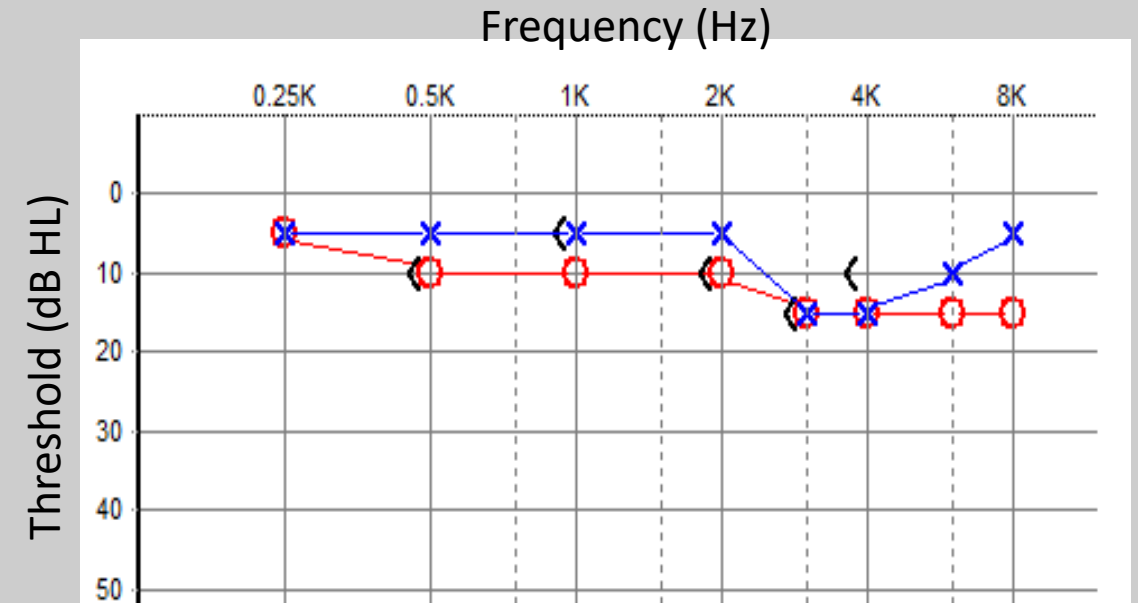


Blast Exposure & Auditory Symptoms



Case Study:

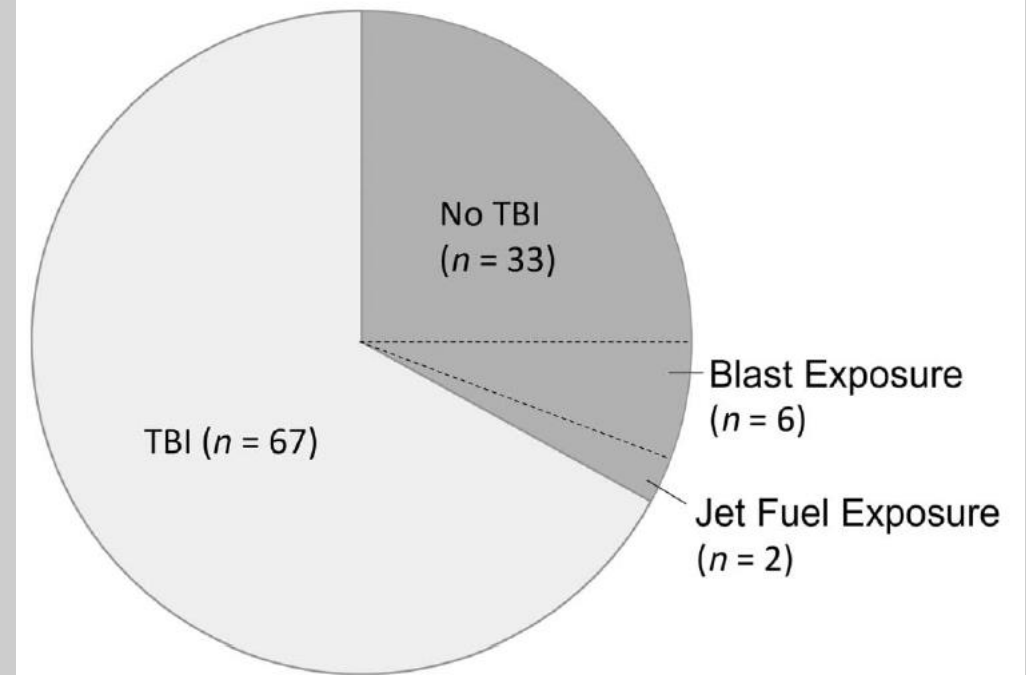
- Diagnosed with TBI stemming from blast exposure from IED and reported 2 additional blast exposures



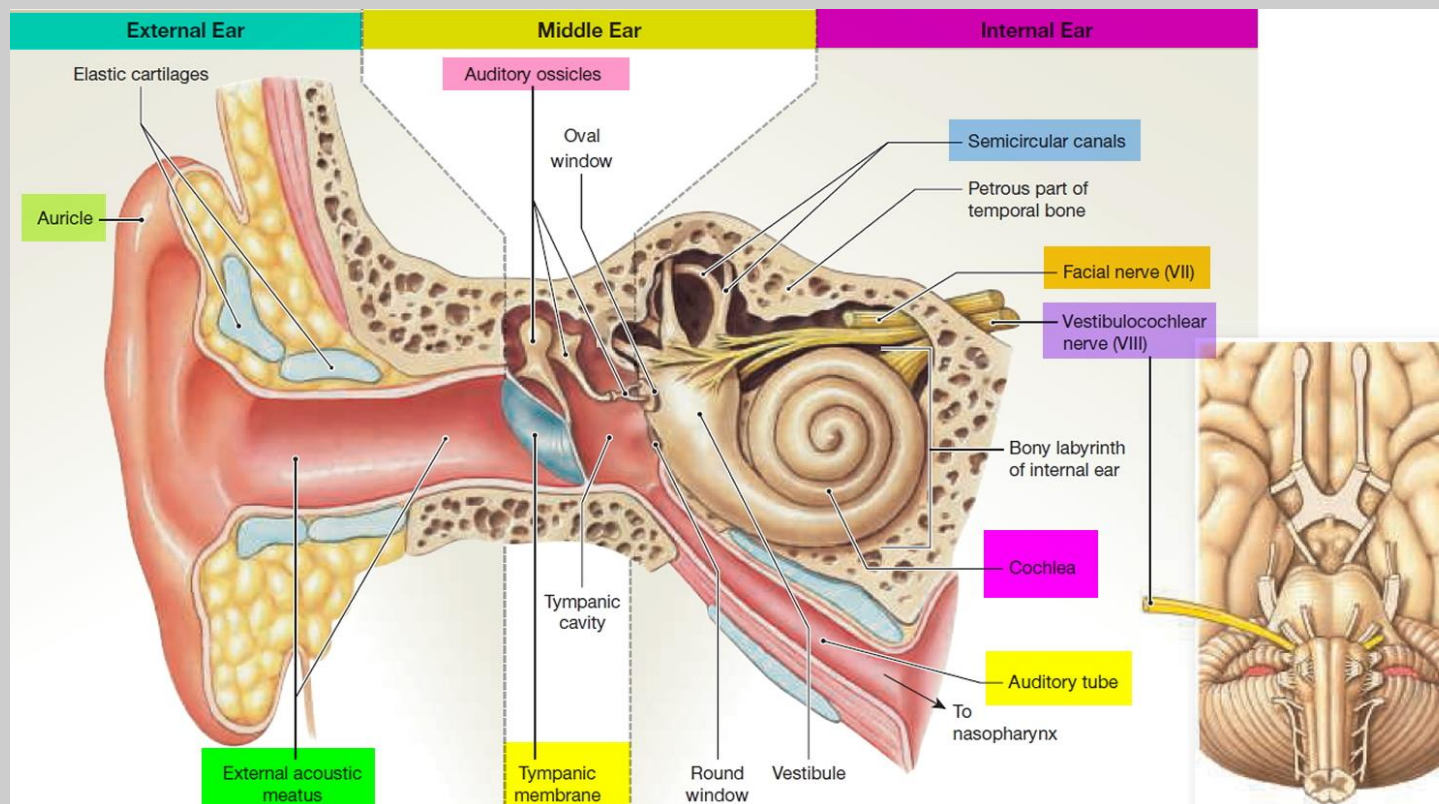
Scope of the Problem: mild TBI

- Of 100 normal-hearing Veterans that received specialized auditory testing, approximately **67% had a TBI diagnosis**

Figure 3. Numbers of patients in the retrospective review with a previous traumatic brain injury (TBI) diagnosis, significant blast exposure history, and significant jet fuel exposure history prior to auditory processing evaluation.



The Auditory Pathway:



Performance on tests of central auditory processing by individuals exposed to high-intensity blasts

Frederick J. Gallun, PhD;^{1-2*} Anna C. Diedesch, AuD;¹ Lina R. Kubli, MS;³ Therese C. Walden, AuD;³ Robert L. Folmer, PhD;¹⁻² M. Samantha Lewis, PhD;¹⁻² Daniel J. McDermott, MS;¹ Stephen A. Fausti, PhD;¹⁻² Marjorie R. Leek, PhD¹⁻²

Auditory difficulties in blast-exposed Veterans with clinically normal hearing

Gabrielle H. Saunders, PhD;^{1-2*} Melissa T. Frederick, AuD;¹ Michelle Arnold, AuD;³⁻⁴ ShienPei Silverman;¹ Theresa H. Chisolm, PhD;³ Paula Myers, PhD⁴

SCIENTIFIC REPORTS

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Decreased sound tolerance associated with blast exposure

Sarah M. Theodoroff^{1,2}, Kelly M. Reavis^{1,3}, Susan E. Griest^{1,2}, Kathleen F. Carlson^{1,3,4}, Tanisha L. Hammill⁵ & James A. Henry^{1,2}

Chronic effects of exposure to high-intensity blasts: Results of tests of central auditory processing

Frederick J. Gallun, PhD;^{1-2*} M. Samantha Lewis, PhD;¹⁻² Robert L. Folmer, PhD;¹⁻² Michele Hutter, MS;¹ Melissa A. Papesh, PhD;¹ Heather Belding, BS;¹ Marjorie R. Leek, PhD¹⁻³

JOURNAL OF NEUROTRAUMA 36:702–712 (March 1, 2019)
Mary Ann Liebert, Inc.
DOI: 10.1089/neu.2018.5801

Blast Exposure Impairs Sensory Gating: Evidence from Measures of Acoustic Startle and Auditory Event-Related Potentials

Melissa A. Papesh,^{1,2} Jonathan E. Elliott,^{1,3} Megan L. Callahan,^{1,4} Daniel Storzbach,^{1,3,4} Miranda M. Lim,^{1,3,5,6} and Frederick J. Gallun^{1,2}

Auditory and Cognitive Factors Associated with Speech-in-Noise Complaints following Mild Traumatic Brain Injury

DOI: 10.3766/jaaa.16051

Eric C. Hoover*
Pamela E. Souza†
Frederick J. Gallun‡

SCIENTIFIC REPORTS

OPEN

Auditory biological marker of concussion in children

Nina Kraus^{1,2,3,4}, Elaine C. Thompson^{1,2}, Jennifer Krizman^{1,2}, Katherine Cook^{5,6}, Travis White-Schwoch^{1,2} & Cynthia R. LaBella^{5,6}

INTERNATIONAL JOURNAL OF AUDIOLOGY
<https://doi.org/10.1080/14992027.2020.1860261>



ORIGINAL ARTICLE

Baseline, retest, and post-injury profiles of auditory neural function in collegiate football players

Grant Rauterkus^a, Deborah Moncrieff^{db}, Gregory Stewart^c and Erika Skoe^d

JSLHR

Research Article

Auditory and Cognitive Behavioral Performance Deficits and Symptom Reporting in Postconcussion Syndrome Following Mild Traumatic Brain Injury

Kathy R. Vander Werff^a and Brian Rieger^b



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Scope of the Problem: mild TBI

- Preliminary analysis of an ongoing study with the OHSU Concussion Clinic found that when asked about auditory symptoms, **90%** self-reported an increase in difficulties following their concussion (n=73)

Common Auditory Symptoms:

- Difficulty Hearing/Understanding Speech



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Common Auditory Symptoms: Difficulty Hearing/Understanding Speech

Speech understanding in complex environments:

- Background noise
- Sound localization
- Listening over the telephone
- Sound quality
- Listening to rapid speech



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Gallun et al. (2012; 2016);
Hoover et al. (2017);
Papesh et al. (2023)

Common Auditory Symptoms: Difficulty Hearing/Understanding Speech

- “My daughter won’t talk to me anymore because I ask her to repeat herself so much.”
- “I mostly stay alone because I can’t hold normal conversations with people. It’s embarrassing when I can’t understand what people are saying.”
- “I can’t hear the radio in my squad car. I worry that I’m missing information that could put people at risk, even though they told me my hearing was normal.”

Common Auditory Symptoms:

- Difficulty Hearing/Understanding Speech
- Tinnitus: ringing in the ears
 - Somatosensory Tinnitus: changes in tinnitus percept with head, neck, or jaw movements

Common Auditory Symptoms:

- Difficulty Hearing/Understanding Speech
- Tinnitus: ringing in the ears
 - Somatosensory Tinnitus: changes in tinnitus percept with head, neck, or jaw movements
- Problems with Sound/Noise Sensitivity

What can you do to help your patients?



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1. Screen for auditory symptoms:

Concussion Management Guidelines Neglect Auditory Symptoms

Sarah M. Theodoroff, PhD,*† Melissa Papesh, AuD, PhD,*† Tyler Duffield, PhD,‡ Melissa Novak, DO,‡ Frederick Gallun, PhD,*† Laurie King, PhD,*‡§ James Chesnutt, MD,‡§ Ryan Rockwood, ATC,‡ Marisa Palandri, OT,‡ and Timothy Hullar, MD*†

TABLE 1. Common Auditory Symptoms Associated With Concussion Defined and Suggested Screening Questions

Auditory Symptoms	Definition	Screening Question
Tinnitus	Perception of sound in the absence of an external [acoustic] source.	Do you experience ringing in the ears (tinnitus) that lasts for at least 5 min?
Noise sensitivity	General intolerance to everyday sounds that encompasses a range of psychological attributes that contribute to the degree an individual is reactive to noise.	Do you have a problem tolerating sounds because they often seem too loud or bother you for other reasons?
Hearing difficulty	Trouble understanding speech or other sounds in quiet or noisy environments.	Do you have any difficulties understanding speech or other sounds? Do you feel like you have more difficulties hearing in noise compared with others?

1. Screen for auditory symptoms:

- Did symptoms start occurring after the injury?
- If pre-existing, did symptom severity increase after the injury?

Screening Question
Do you experience ringing in the ears (tinnitus) that lasts for at least 5 min?
Do you have a problem tolerating sounds because they often seem too loud or bother you for other reasons?
Do you have any difficulties understanding speech or other sounds? Do you feel like you have more difficulties hearing in noise compared with others?

New clinical tools should include auditory symptoms:

- Headache
- Cognitive
- Emotion
- Ocular Motor
- Vestibular
- Sleep
- Cervical
- **AUDITORY!**

		Current Symptoms Yesterday/ Today						Before the Injury/ Pre-Injury								
Auditory		0=No Problem 3=Moderate Problem 6=Severe Problem														
A1	My hearing problems cause me difficulty in my daily life	0	1	2	3	4	5	6		0	1	2	3	4	5	6
A2	I have difficulty telling where sounds are coming from	0	1	2	3	4	5	6		0	1	2	3	4	5	6
A3	I use hearing protection (earplugs/earmuffs) in quiet places	0	1	2	3	4	5	6		0	1	2	3	4	5	6
A4	Everyday sounds are too loud or painful	0	1	2	3	4	5	6		0	1	2	3	4	5	6
A5	The ringing in my ears (tinnitus) changes when I move my head, jaw, or clench my teeth	0	1	2	3	4	5	6		0	1	2	3	4	5	6
A6	Everyday sounds or people's voices seem unclear or unnatural	0	1	2	3	4	5	6		0	1	2	3	4	5	6
A7	I have difficulty having a conversation with a group of people	0	1	2	3	4	5	6		0	1	2	3	4	5	6
A8	I have difficulty hearing on the phone	0	1	2	3	4	5	6		0	1	2	3	4	5	6

2. Refer to an audiologist:

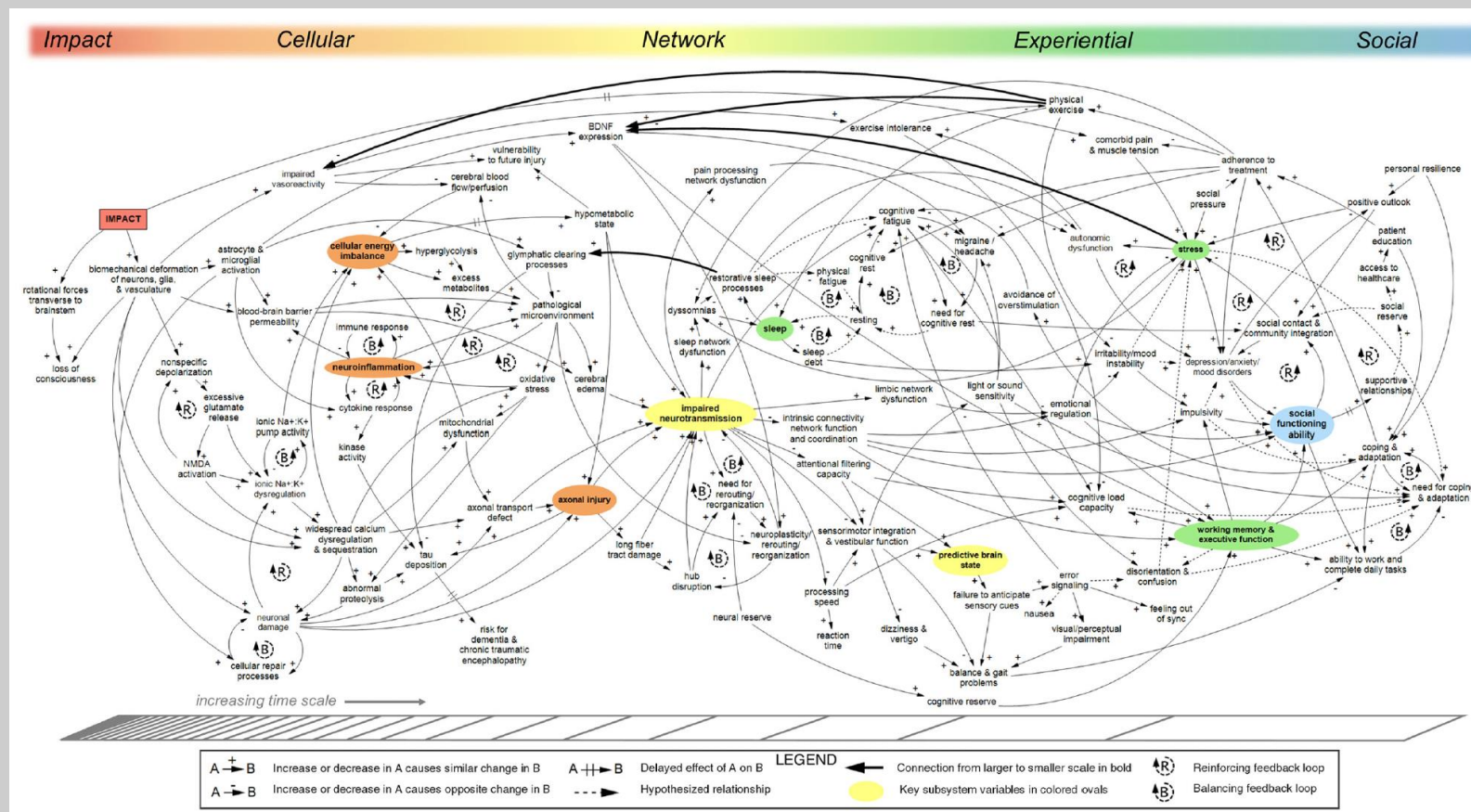
Refer patient for a standard audiological assessment:

- Determine whether patient does/does not have normal hearing
- Detailed self-report symptom questionnaires
- Counseling & auditory rehabilitation
- Referral to a specialist:
 - Speech understanding in noise & auditory processing testing
 - Tinnitus
 - Sound/noise sensitivity

2. Multidisciplinary Approach:

Include an audiologist onto your concussion team:

- How do auditory symptoms impact assessment & rehabilitation of other symptoms?
- Do auditory symptoms change over time?



3. Use effective communication strategies:

Increase access to visual cues during communication:

- Be in the same room as the communication partner
- Always face the listener while speaking with them
- Ensure good lighting
- If using a mask, consider one with a clear panel
- Be mindful of placing objects or hands in front of mouth

3. Use effective communication strategies:

Reduce environmental distractions:

- Reduce background noise
 - Mute the TV, turn off sink, etc.
 - Move away from other people talking
- Reduce visual “noise”
- Get the listener’s attention

3. Use effective communication strategies:

Use “clear speech” when talking

- Louder ≠ Clearer!
- Natural pace & pauses
- Avoid over-exaggeration

3. Use effective communication strategies:

If there is a communication breakdown:

- Rephrase rather than repeat
- Orient listener to the topic
- Check understanding before moving on

Summary:

- Auditory symptoms are common following concussion, even in those with clinically “normal” hearing sensitivity
- It is important to screen for common auditory symptoms during concussion assessments by asking about issues related to:
 - Speech understanding
 - Tinnitus
 - Sound/Noise Sensitivity
- Connect with an audiologist & refer patients when needed
- Always use effective communication strategies and counsel your patients on the use of these strategies if they are struggling

Questions?

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Online resources from the NCRAR:
ncrar.research.va.gov

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Resources

Tinnitus (ringing in the ears)

The method of **Progressive Tinnitus Management (PTM)** was developed by NCRAR researchers over 10 years ago. It is a stepped-care method of tinnitus management, meaning that people with tinnitus receive the level of services that are required by the severity of their condition. Please click on the below links for access to PTM materials.

- Educational video about tinnitus "Ringing in the Ears: What Can I do About It?"
- Tinnitus Questions and Answers (brochure) 
- How to Manage Your Tinnitus: A Step-by-Step Workbook 
- **Progressive Tinnitus Management (PTM) Videos**
 - Session 1 with Audiologist: Using Sound Part 1
 - Session 2 with Psychologist: Stress and Distraction
 - Session 3 with Audiologist: Using Sound Part 2
 - Session 4 with Psychologist: Changing Thoughts Part 1
 - Session 5 with Psychologist: Changing Thoughts Part 2

Hearing and Hearing Loss

- How does the Brain Help Us Hear? (brochure)  (Gallun/Saunders)
- Hearing Conservation (brochure)  (Dann/Saunders)
- Tips for Improving your Listening Experience (brochure)  (Lewis/Saunders)
- Hearing Aids: The Basics (brochure)  (O'Connell Bennett/Saunders)

Balance

- Dizziness and Balance (brochure)  (Kampel/Saunders)



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