

Hand-out for Kenneth M. Grundfast's AAOP Lecture on May 8, 2021

Important, useful website for patients to get information about tinnitus:

- American Tinnitus Association: <https://www.ata.org/>

American Academy of Otolaryngology-Head and Neck Surgery Clinical Practice Guidelines for Evaluation and Management of Tinnitus:

<< <https://journals.sagepub.com/doi/pdf/10.1177/0194599814545325> >>

Diagnosis	Typical presentation	Audiologic assessment	Imaging	Treatment	Pearls	Potential Adverse Outcome
Acoustic Neuroma (AN)	An otherwise healthy patient presenting with unilateral tinnitus and gradual, unilateral sensorineural hearing loss. ^{113,213} Larger tumors can manifest with cerebellar signs and impairment of function in distribution of CN V, and CN VII.	1. Asymmetric SNHL + with speech worse than would be expected from pure tone SN thresholds. ^{19,113,213} 2. Abnormal auditory brainstem response (ABR) ¹⁹	MRI with gadolinium contrast tumors as small as 2-3 mm can be detected. ¹¹⁵	Treatment is based on location, size, and mass effect symptoms. 1. Observation 2. Cyberknife focused radiation therapy 3. Surgical excision ¹¹⁴	ANs come with heterogenous symptomatology; therefore, mass effect symptoms can be crucial to your diagnosis as well as audiological testing. Presenting symptoms vary greatly, occasionally, the sole presenting symptom is unilateral tinnitus	Tumor growth, ataxia due to mass effect on cerebellum, facial numbness and weakness, and increased intracranial pressure.
Arteriovenous malformation (AVM)	Unilateral or bilateral pulsatile tinnitus with timing of pulsations synchronous with heartbeat *Compression of the ipsilateral jugular vein with or without head rotation can ablate the objective tinnitus. ²¹⁴	Sensorineural hearing loss ipsilateral to AVM	*physical exam of the neck to examine for a bruit that can be caused by an AVM may be the first route for diagnosis. *CT and MRI can then be done, but Angiography, and often digital subtraction angiography (DSA) is still the gold standard. *Imaging features include the presence of the nidus in brain parenchyma and early venous drainage, often via dynamic studies ^{215,216} Most often	Treatment depends on AVM features determined by the Spetzler-Martin Scale (SMS). ²¹⁸ However, surgical treatment is usually necessary due to high risk of rupture and hemorrhage. ²¹⁹ Microsurgery is usually preferable but radiosurgery and endovascular embolization can be done depending on the SMS score. ^{220,221}	Pulsatile tinnitus is rare; but if found, almost always needs evaluation to rule out serious vascular or neoplastic conditions.	Intracranial bleed

			found in the transverse and/or sigmoid sinus. ²¹⁷			
Idiopathic Intracranial hypertension (IIH)	Young to middle-aged obese or overweight female with bilateral pulsatile or non-pulsatile tinnitus, headaches, otalgia, transient blurred vision, may see papilledema with ophthalmoscope exam.	*Mildly decreased bilateral pure tone thresholds * Abnormally prolonged P100 latency vestibular evoked myogenic potentials (VEMP). ^{222,223}	1. MRI/MRA is done to rule out other causes of high ICP 2. Lumbar puncture opening pressure above 25 cm H ₂ O ^{224,225} 3. Diagnostic criteria by Freidman et al 2013 can be used. ²²⁶	Weight loss is most common and efficacious recommendation; however, frequent eye exams should be done. ^{224,225} If severe or resistant to supportive treatment, optic nerve sheath fenestration or CSF diversion via a shunt may be indicated. ^{226,227}	*Tinnitus with visual disturbances and headaches in this patient population is highly suspicious for high ICP and an ophthalmic exam should be promptly done. *Some studies have shown that etiologies such as sigmoid sinus diverticulum (SSD), semicircular canal dehiscence (SCD), and transverse sinus stenosis (TSS) can cause IIH, in which a diagnosis of IIH with pulsatile, subjective or objective tinnitus can raise suspicion and necessitate further testing for the cause of IIH. ²²⁸⁻²³¹	Visual impairment, blindness
Semicircular canal dehiscence (SCD)	Patient with tinnitus, a possible low-frequency hearing loss, vertigo and/or oscillopsia after specific sounds or pressure changes, namely during a Valsalva maneuver (called Tulio's phenomenon). ²³²	Mild, low frequency conductive hearing loss in both ears yet a highly localizing Weber test to the affected ear. The stapedial reflex will be present despite the presence of conductive hearing loss. ^{233,234}	*Physical exam findings are notable for a Weber exam that is positive in the affected ear, positive pressure in the ear canal causes upward internal rotation of the eye and a Valsalva maneuver leads to the opposite eye rotation. *Diagnosis is usually clinical but a CT temporal scan have become standard. VEMP can also be used and show decreased air and bone conduction.	*For patients with pressure-induced symptoms, a tympanostomy tube can be used. ²³⁵ *Surgical repair using the middle fossa craniotomy approach is more common; however, the transmastoid approach can also be used. ¹²	Unique symptoms and physical exam are suspicious for SCD, but audiology can be a crucial tool.	Often debilitating symptoms
Psychiatric disorder	* There are various presentations. Patients with severe tinnitus may develop depression and/or anxiety or a severe psychiatric disorder can be associated with tinnitus. ^{42,162,163} * It is important to note that veterans with PTSD may have high rates of tinnitus. ^{11,166,168} * Often, patients may be anxious, agitated, have obsessive tendencies, and can have suicidal ideation due to their unrelenting tinnitus. * Caution, psychotic individuals may try to harm the clinician.	Usually normal hearing or mild hearing with a common audiologic pattern of presbycusis	MRI scan or auditory brain response (ABR) testing may be warranted to help allay unrealistic fears of having a brain tumor	Treatment depends on the underlying psychiatric disorder but can include CBT and anxiolytic medications.	Tinnitus can be so severe and so bothersome that the tinnitus can trigger for a patient to feelings of hopeless and even have suicidal ideation	Suicide
Acoustic shock (AS)	Tinnitus and/or hearing loss with a history of chronic 'industrial' noise-induced hearing loss or a prior acute loud noise exposure.	No audiometric pattern and, often, a normal audiological assessment. ²³⁶ The Grindleford criteria can also be used. ²³⁶ A possible positive Stenger test may indicate AS. ²³⁷	Usually not needed unless symptoms suspicious for another disorder.	*Prevention of further loud noise exposure *Supportive treatment—steroids are controversial	A careful history should be taken, including any occupational exposures such as ex-military status or recent incidents of acute loud noise exposure.	Permanent hearing loss

Presbycusis	Older individual with tinnitus and progressive, unilateral or bilateral, hearing loss in which speech seems mumbled and more difficult to comprehend with a lot of background noise. A female's voice may be more difficult to hear than a male's voice. ⁵⁸	Audiometric screening the whispered voice test. The pure tone, speech audiometry, and Hearing in noise (HINT) tests are used to diagnose presbycusis. Some central auditory tests can be done such as rollover testing. ^{238,239}	Imaging usually not needed but can be done if other symptoms are present that are suspicious for another disease. ⁵⁸	<ol style="list-style-type: none"> 1. Hearing protection to prevent further damage.^{58,240} 2. Hearing aids, cochlear implants, assistive/amplification devices, training in speech-reading, and treatment to decrease excess cerumen.^{58,241} 	Presbycusis is the most common cause of tinnitus; however, a thorough examination is important as to not miss a more dangerous diagnosis.	Hearing loss
Ototoxic medications	Prior ototoxic medication use but usually due to high doses of medication like in the case of oncological use, multiple ototoxic medications used synchronously, comorbid kidney failure, use in an elderly patient, or hypoalbuminemia that presents with tinnitus and/or hearing loss. ²⁴²	In patients starting cochleotoxic chemotherapy, a baseline audiometric test, preferably before starting treatment. ²⁴³ Ototoxic usually begins to affect hearing above 8,000 Hz and progresses to lower frequencies at a variable rate. ²⁴⁴	Diagnosis with clinical with aid from audiometric testing. The Chang ²⁴⁵ and Tune ²⁴⁶ grading system may be employed.	<p>*Prevention²⁴³</p> <p>*Removal of ototoxic medication</p> <p>*Certain agents to mitigate the effects of ototoxic medication-induced tinnitus and/or hearing loss apply to the ototoxic medication used. Co-enzyme 10Q has been studied particular to tinnitus.²⁴⁷ steroids, Sodium Thiosulphate, N-acetylcysteine and magnesium among others are potential mitigation agents.²⁴⁷</p> <p>*Rehabilitation strategies such as the use of amplification devices and close follow up.²⁴⁸</p>	Acute onset tinnitus requires a careful review of prior medication use. Acute tinnitus during a hospital stay is suspicious for ototoxic medication use. Tinnitus in oncology patients is also highly suspicious for ototoxicity.	Permanent hearing loss and tinnitus

Temporomandibular joint disorder (TMJ)	UL/BL tinnitus, ear discomfort, and a possible history of bruxism. Physical exam includes a finding of flattened molars, TTP over TMJ, and a possible clicking noise upon opening the jaw.	Normal audiometric testing.	MRI is the gold standard with Panorex view of maxilla/mandible with focus on TMJ in order to evaluate the articular disc's location and shape as well as to see if a joint effusion is present. ²⁴⁹	-Mouthguard -Steroid injection -Physical therapy	Otalgia and jaw pain, often with chewing, and locking of the jaw with tinnitus is suspicious for TMJ.	Chronic facial pain, chronic headaches, dental disease, and arthritis of the TMJ
Whiplash injury	Tinnitus commonly after a motor vehicle accident or other traumatic event where whiplash could have occurred. Physical exam is significant for head movement against resistance changes the character of the tinnitus perceived.	Normal hearing or hearing consistent with presbycusis	*CT/MRI scan cervical spine. Results depend on severity of injury and other comorbid injuries. *flexion-extension Xrays can be notable for a kyphotic angle *Quebec task force classification of whiplash severity can be used ²⁵⁰	Acute and severe treatment: *soft cervical collar and early motion restriction. ²⁵¹ *high dose IV methylprednisolone treatment ²⁵² *imaging and acute care management. Chronic pain from severe injury or pain + tinnitus from non-severe initial injury: ²⁵³ *Physical therapy *Cortisol injections at facet joints *NSAID use *Acupuncture ²⁵⁴	Chronic tinnitus with a brief MVA or occupational injury may suspect for a non-severe whiplash injury with long-lasting symptoms.	Chronic tinnitus, hearing loss, and hyperacusis. Additionally, depending on severity, spinal cord or vertebral damage. ^{255,256}
Seeking financial compensation	A patient usually presenting with hearing loss and/or tinnitus usually due to acoustic shock, either acute or chronic, that occurred at work or during a motor vehicle accident.	See acoustic shock.	See acoustic shock.	Use caution in providing documentation.	Patients may request a tinnitus diagnosis in order to receive financial compensation or evade taking responsibility for an event through the legal system. Additionally, it may be important to screen these patients for mental health disorders, especially veterans. ^{257,258}	Tense patient-physician relationship; patients with more pain and objective symptoms were more likely to file litigation claims. ²⁵³ These patients can also present with significant psychiatric
	Patient may also have psychiatric distress such as PTSD, panic attacks, or specific phobias surrounding an event that caused the tinnitus. ²⁵⁷					distress and trauma around their accident.
Atherosclerotic carotid artery disease (ACAD)	*Objective, pulsatile tinnitus, usually unilaterally, in an older patient with atherosclerotic risk factors like diabetes, smoking, hypertension, hypercholesterolemia, or a prior diagnosis of atherosclerotic disease. *Physical exam is notable for unremitting tinnitus with moderate neck compression. ¹⁵	Usually no hearing loss or benign presbycusis ²⁵⁹	*Color doppler carotid ultrasound ²⁶⁰ *CT to rule out AVM	*carotid endarterectomy ²⁶¹ *ligation in patients with distal internal carotid artery atherosclerosis ²⁶²	ACAD is a common cause of objective pulsatile tinnitus and in patients older than with atherosclerotic risk factors carotid ultrasound to examine for carotid artery disease is crucial. ²⁶⁰	Stroke
Chiari Malformation type 1 (CM-1)	*A 30-50-year-old patient presenting with aural fullness, fluctuating tinnitus, vertigo, and hearing loss, most commonly bilateral HL. *due to Chiari, there can be motor	*Bilateral symmetric sensorineural hearing loss at lower frequencies ²⁶³	*MRI with T1 sagittal images are gold standard ²⁶³	*Surgical decompression and possible shunt	In patients with neurological symptoms and tinnitus, workup is always necessary and urgent.	Increased intracranial pressure and hydrocephalus, motor and sensory lesions of the upper extremities, debilitating otologic symptoms

	weakness, muscle atrophy, and ataxia *due to the possible presence of syringomyelia, neck pain and cape-like paresthesias over the shoulders and arms can be present					
Headache (Migraine, Vestibular migraine (VM), Tension-type)	Patient presenting either with headaches consistent with tension-type headaches or migraines in which the tinnitus can present as an aura before a migraine or synchronous to the headache. ²⁶⁴ Of note, the tinnitus displays laterality, in which the location of the tinnitus— unilateral, left or right side – mirrors the headache. ²⁶⁴ Hyperacusis and sudden, transient hearing loss, and even hemifacial spasm can occur along with the tinnitus. ²⁶⁵ Pulsatile tinnitus secondary	*In migraines, particularly VM, sudden SNHL can occur during migraine episode. It is fluctuating, unilateral or bilateral, and usually affects low frequencies. ²⁶⁷	*Studies can be done to rule out other diagnoses if needed *Migraine, VM, or tension-type headache is diagnosed clinically.	*typical medical for migraine headaches can include NSAIDs, Acetaminophen, Tetracyclines for maintenance therapy, Triptans for abortive therapy, possible anti-epileptics, Botox therapy ^{268–270} *complementary and alternative medicines ^{181,183,202}	Tinnitus can commonly present with migraines; however, migraines without a headache but symptoms such as auras, photophobia, hyperacusis, facial pain, and tinnitus are more difficult to diagnose.	Silent brain infarcts, permanent hearing loss and vestibular deficits, ^{271,272} possibly due to migraine-induced vasospasm.
	to migraines are a rare cause of PT. ²⁶⁶					
Sigmoid Sinus Diverticulum (SSD)	Patient is often a middle aged woman, similar in characteristic to IIH, presenting with pulse-synchronous PT in which the tinnitus is relieved by putting pressure on the internal jugular vein ipsilateral to the tinnitus.	*Bhatnager et al (2020) found an average of a pure tone threshold result of a 6 dB low-frequency bone conduction hearing loss ²⁷³	*MRI and cerebral angiography are the gold standard which shows a dominant transverse sigmoid sinus that is larger than 3 mm that protrudes into the mastoid air cells. ^{274,275} *Temporal bone CT can be used ²⁷⁴ *CT angiogram, MRA, digital subtraction angiography (DSA) are sometimes done to rule out another cause of PT	*Stenting of diverticulum ²⁷⁶ *mastoidectomy with resurfacing and reconstruction, often with bone grafting ^{275,277} *Endovascular surgery with or without coiling ²⁷⁵	*Be aware of the relationship between SCD, IIH, and SSD, in which if one is found, it may necessitate testing for other disorders. ^{228–230}	Can lead to other diseases described here such as SCD and IIH, hearing loss, debilitating PT tinnitus
Otosclerosis	A young patient, usually female with progressive mixed SNHL and CHL (up to 80% bilaterally) and tinnitus. Some patients may also present with vertigo. Physical exam can be notable for hypervascularization on the inferior TM, called “Schwartz sign.” ²⁷⁸ Patients may have a family history of similar symptoms in an autosomal	*Tympanometry reveals decreased compliance ²⁸¹ *Advanced otosclerosis can present with decreased speech discrimination *Air conduction hearing loss at low frequencies *Absent stapedial acoustic reflex in one or both ears *Carhart notch on audiometry, which is a 10 to 15-dB	*high resolution CT imaging shows a characteristic hypodense area of demineralization around the cochlea and labyrinth, called the “double-ring sign.” ²⁸³	*Supportive measure to mitigate tinnitus *Hearing aids in mild cases *cochlear implant or direct acoustic cochlear implant ²⁸⁴ *Stapedotomy, stapedectomy, and laser-assisted stapedotomy. Patients may need hearing aids after surgery. ²⁸⁵	A young patient with a possible family history, progressive CHL, and tinnitus is suspicious for otosclerosis. Sometimes these patients present with BPPV, but their age is suspicious for advanced otosclerosis. ^{286,287} Additionally, due to possible hormonal regulation of ossicular growth, otosclerosis can present or worsen at puberty or during pregnancy. ^{287–289}	Permanent hearing loss and debilitating tinnitus symptoms.

	dominant fashion with incomplete penetrance. ^{279,280}	reduction of nose transmission, specifically in bone conduction, around 2000 Hz *Wideband acoustic immittance (WAI) shows a PR closer to 1, indicating a stiff ear canal ²⁸²				
Fractured Incus/ loose ossicular chain/ partial ossicular discontinuity	A rare disorder in which a patient presents with clicking and crunching noises that may vary with certain noises or positions, mild to moderate hearing loss, and possible autophony, after a known incident in which there is foreign body penetration of the ear canal or a negative pressure system was generated within the ear canal. This usually includes digital manipulation or sneezing. ¹⁰⁹⁻¹¹²	*Audiometric testing usually reveals mild to moderate high frequency conductive hearing loss in affected ear with normal acoustic reflexes. ^{109,290} *Wideband acoustic immittance (WAI), which measures power reflectance (PR), is helpful to identify ear canal pathologies non-invasively. A PR of 1 indicates a stiff middle ear and a PR of 0 indicates a loose ossicular chain. Patients with a fractured incus will have CHL + a PR near 0 in the	A high resolution CT can be done to detect ossicular fractures. ²⁹³	*exploratory tympanotomy and ossiculoplasty ^{109,294}	Although rare, a diagnosis of ossicular fracture may be suspicious if a patient presents with a known incident of digital manipulation of the ear canal immediately followed by hearing loss with testing indicative for CHL at high frequencies and a PR notch around 600 to 700 Hz in the affected ear. Older, female patients with osteoporosis may have a slightly higher predilection to ossicular fractures. ²⁹⁵	Permanent hearing loss and debilitating tinnitus symptoms.
	dominant fashion with incomplete penetrance. ^{279,280}	reduction of nose transmission, specifically in bone conduction, around 2000 Hz *Wideband acoustic immittance (WAI) shows a PR closer to 1, indicating a stiff ear canal ²⁸²				
		affected ear at 600 to 700 Hz. ²⁹⁰⁻²⁹²				

Table I: Common reasons why tinnitus sufferers seek medical evaluation.

Seeking Cure/Relief
Desire to get rid of the tinnitus ³²⁻³⁴
Learn ways to cope with the tinnitus ³⁵
Improve hearing that is impaired by the tinnitus ³⁶⁻³⁹
Get help with inability to fall asleep because of tinnitus ^{40,41}
Alleviate depression/anxiety triggered by tinnitus ^{1,42-44}
Improve ability to concentrate ^{45,46}
Improve quality of life that has been impaired by tinnitus ^{45,47-49}
Diminish suicidal ideation ⁵⁰
Seeking help with litigation
Assist in affirming that a preceding event was the cause of tinnitus
Assist with affirming that accommodations in the workplace are warranted ^{43,51}
Information gathering
Find out if there is anything new in management of tinnitus
Allay fear that tinnitus is a sign of a brain tumor, incipient dementia, or some other worrisome disorder

Table II: Causes of tinnitus

	Non-pulsatile		Pulsatile	
	Common	Less Common	Common	Less Common
Otological/Vestibular	Impacted cerumen ^{52,53} Persistent otitis media with effusion ^{14,54,55} Presbycusis ^{56–58} Exposure to loud noise/acoustic shock ^{1,41,56,59–65} Otosclerosis ^{66 *}	Labyrinthitis ⁶⁷ Mastoiditis ^{14,68} Congenital Deafness ⁶⁹ Cholesteatoma ⁷⁰ Meniere's disease ⁵⁶ Eustachian tube dysfunction ⁷¹ Foreign body in ear canal ^{72,73} Thoracic outlet syndrome ⁷⁴	Palatal, Middle Ear, and Tensor Tympani Myoclonus ^{75–79} Fibromuscular dysplasia ⁸⁰ Idiopathic intracranial hypertension (IIH) ^{81–83}	-
Infection	Sinus infection/Nasal Congestion ¹⁴	Otosyphillis ^{84,85} Lyme Disease ^{86,87} COVID-19 infection ⁸⁸	-	-
Vascular/Hematologic	Anemia ^{89-90 *} Hypertension ⁹¹	-	Atherosclerotic Coronary Artery disease Fibromuscular dysplasia ⁸⁰ Idiopathic intracranial hypertension (IIH) ^{81–83}	ICA or Vertebral Dissection ^{92,93} Aneurysm ⁹⁴ Jugular bulb abnormalities ^{95,96} Abnormal Emissary Vein ^{97,98} Glomus tympanicum or glomus jugulare tumor Vertebral artery(s) compression secondary to cervical spine damage ^{99,100}
Orofacial	Temporomandibular Joint Disorder (TMJ)/ Dental malocclusion ^{16,17 *}	-	-	-
Traumatic	Concussion/Traumatic Brain Injuries ^{63,101–103} Skull fractures/Temporal bone trauma ^{104,105 *}	Tympanic membrane perforation ¹⁰⁶	CSK leak ¹⁰⁷ Perilymphatic fistula ¹⁰⁸	Fractured incus/loose ossicular chain/partial ossicular discontinuity ^{109–112}
Neoplastic	-	Vestibular schwannoma ^{113–115} Meningioma ^{107,116 *} Chronic Myelogenous Leukemia ¹¹⁷	-	Temporal Bone Paraganglioma ^{118,119} Schneiderian papilloma ¹²⁰ Cholesterol Granuloma of the Middle Ear/Petrous Apex ¹²¹ Metastatic disease ^{122 *}
Medications/Substances	Antibiotics (Aminoglycosides, Tetracycline, Macrolides, Quinolones, Vancomycin, Metronidazole) ^{123–128} Chemotherapies (Cisplatin) ^{129–131} Salicylates ^{132,133} Loop Diuretics (Bumetanide, Furosemide) ^{134,135} Anticonvulsants (Carbamazepine) ¹³⁶	Baclofen ¹³⁷ Hydroxychloroquine ¹³⁸ Antidepressant Withdrawal ¹³⁹	-	-
Autoimmune	Fibromyalgia ^{140,141}	Multiple Sclerosis (MS) ^{142–144 *} Systemic Sclerosis ¹⁴⁵ Behcet's Disease ¹⁴⁶	Paget Disease ^{147,148*}	Takayasu disease ¹⁴⁹
Endocrine/Metabolic	Thyroid disorders ^{150 *} Vitamin B ₁₂ Deficiency ¹⁵¹	Cushing's Disease ¹⁵² Diabetes ¹⁵³ Hyperlipidemia ¹⁵⁴	-	-
Neurologic	Migraine ^{155,156}	Epilepsy ^{155,157}	-	-
Psychiatric ¹⁵⁸	Obsessive compulsive disorder ^{159,160} Anxiety ^{42,116,161–163} Depression ^{42,43,162–164} Suicidality ¹⁶⁵ PTSD ^{101,166–168} Somatoform disorders ¹⁶⁹ Dementia ¹⁷⁰ Factitious/related to litigation ^{116,171}	-	-	-
Congenital/Inherited	-	Chiari I Malformation ¹⁷²	-	-

*Can be reported either as pulsatile or non-pulsatile.

Table III: Help for tinnitus sufferers.¹¹

Step in management	Description
Education	
Education, information and reassurance ^{3,35,173}	Describe relevant anatomy and physiology; tell patients about the American Academy of Otolaryngology-Head and Neck Surgery AAO-HNS tinnitus clinical practice guidelines ¹¹ available online at https://www.entnet.org/content/clinical-practice-guideline-tinnitus , provide brochures available from AAO-HNS
Encourage utilization of website of the American Tinnitus Association (ATA)	Encourage patients to join the American Tinnitus Association (A.T.A.) and use the A.T.A. website [https://www.ata.org/] as primary source of information; can call 1-800-634-8978 to get phone consultation with a tinnitus advisor; discourage random internet searches for tinnitus cures;
Other credible online resources	British Tinnitus Association (BTA): https://www.tinnitus.org.uk/ National Organization for Rare Disorders: https://rarediseases.org/ ENT Health: https://rarediseases.org/ Audiology: http://www.audiology.org . Current research and trials: http://www.tinnitusresearch.org
Behavioral Medicine	
Psychiatric treatment	Psychotherapy, cognitive behavioral therapy, or psychiatric medicines such as SSRIs, SNRIs, or other medications directed against anxiety and depression may be used to quell the distressing portion of the disease
Complementary and Alternative Medicine	
Supplement medications ^{11,174-181}	Ginkgo biloba, zinc, Vitamin B12, Red Ginseng, and Gushen Pian are commonly used by tinnitus sufferers
Sleep inducing medications ¹¹	Melatonin or other herbal meds are often used.
Complementary and alternative medicine (CAM) ¹⁸¹⁻¹⁸⁶	Acupuncture, Clinical hypnosis (Erkisonian hypnosis), hyperbaric oxygen are among many alternative therapies.
Mind/Body Integrative Medicine	
Sound generation ^{11,187-189}	Various sound enrichment technologies from wearable sound generators to mobile phone applications that use recorded sounds habituate patient to another noise besides their tinnitus. Can also include hearing aids which is commented on below see below.
Smart phone apps ¹⁹⁰⁻¹⁹²	Some apps include AudioNotch, MyNoise, NatureSpace, and Quieten.
Biofeedback ¹⁹³⁻¹⁹⁵	Various techniques to monitor one's own physiological state to decrease stress and anxiety over tinnitus symptoms that may cause a hyperarousal state.
Tinnitus Retraining Therapy ¹⁹⁶	A multimodal habituation-based treatment; tinnitus-specific educational counseling and sound therapy
Hearing aid referral ^{11,36,197-200}	Mitigating presbycusis with hearing aids can decrease the perception of tinnitus
Relaxation with mind/body interventions ²⁰¹⁻²⁰³	Benson-Henry, Meditation, yoga, tai chi, Mindfulness techniques.
Cognitive Behavioral Therapy (CBT) ²⁰⁴⁻²⁰⁸	Distract the brain, allay fears, manage anxiety; Can be either used formally in person or informally through guided readings or phone applications
Non-surgical treatment anatomic sites proximate to the ear	
Evaluation +/- treatment for temporomandibular joint disorder ^{209,210}	Dentist, oral maxillofacial surgeon; best to identify selected providers who have interest in tinnitus, preferably work with physical therapist
Physical therapy ^{209,211,212}	Focus on neck, specifically the TMJ or cervical spine
Surgical treatments at anatomic sites proximate to the ear	
Removal of acoustic tumor	
Repair of superior semicircular canal dehiscence	
Stapes surgery	
Repair of dehiscent sigmoid sinus	
Repair of perilymphatic fistula	
Repair of venous sinus stenosis	
Carotid endarterectomy for ACAD	
Repair of DAVF	
Possible future strategies	
Bimodal/multimodal neuromodulation ²⁷⁻³⁰	Potential new mechanism of treatment although more studies are needed to validate the efficacy of this possible treatment.
Clinical Trials	
Clinical Trials	Referral from Clinician, Tinnitus Research: * http://www.tinnitusresearch.org *Clinical Trials.Gov