



# TINNITUS: CAUSES & SOLUTIONS

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# GOALS

- To understand what tinnitus is...
  - Its history
  - Its causes
- To understand what **solutions** are available...
  - What works
  - What doesn't
- To understand what **resources** are available...
  - Professional
  - Educational
- Discussion of a new study on possible solutions



## TINNITUS: WHAT IS IT?

- **Tinnitus** (from Latin “tinnire,” to ring) is the perception of sound in the human ear in the absence of corresponding external sound.
- For us, tinnitus perception can include:  
**Ring**ing, **Buzz**ing, **Whistle**ing,  
**Roar**ing, **Hiss**ing, **Hum**ming,  
**Pulsate**ing, **Mus**ic—anything that is not created by the *external* world.



## TINNITUS: WHAT IS IT?

- Tinnitus is **not** a disease—it is a symptom of a mitigating medical pathology.
- In other words, it is not the cause of the problem, but is caused by something else.



# SO WHAT CAUSES TINNITUS?

## THE BETTER QUESTION: WHAT *DOESN'T* CAUSE TINNITUS?

### ○ Primary Causes:

- Exposure to loud noises (prolonged or specific)
- Medications (about 75% of medications in the Physicians' Desk Reference cause tinnitus, hearing loss, and/or dizziness—all problems related to the ear)
- Hearing loss



# SO WHAT CAUSES TINNITUS?

## THE BETTER QUESTION: WHAT DOESN'T CAUSE TINNITUS

### ○ Other Causes:

- Ear infections
- Head trauma
- Jaw Misalignment
- Wax impaction
- Presbycusis (age-related hearing loss)
- Specific diseases (i.e. [Ménière's disease](#))
- Acoustic Neuroma
- Toxic exposure (mercury, lead, arsenic)
- Neurological disorders
- Metabolic problems
- Fibromyalgia, hypertonia, lyme disease



## TWO TYPES OF TINNITUS:

- **Subjective Tinnitus:** only the patient perceives the sound (the most common)
- **Objective Tinnitus:** A sound actually emanates from the ear and can be both perceived and recorded by others.
  - Often “pulsatory”
  - Suggests a vascular disorder and medical evaluation is HIGHLY recommended.
  - Can result from what is called a “glomus tumor”



# PREVALENCE AND RESEARCH

## ○ Tinnitus is COMMON

- According to the National Institutes of Health (NIH), tinnitus affects 17% - 20% of the world's population—as many as 64 million Americans.
- 16 million people in the U.S. have sought medical treatment for tinnitus.
- 85% of these people with tinnitus also have hearing loss
- At least 2-3 million Americans have tinnitus to such a degree that it significantly affects their daily activities.



# TINNITUS PREVALENCE: VA POPULATION

Tinnitus was the most prevalent service-connected disability for **Veterans** receiving compensation in 2011

<u>Condition</u>	<u>Number</u>
<b>Tinnitus</b>	<b>928,950</b>
<b>Hearing loss</b>	<b>771, 936</b>
Post traumatic stress disorder	551,408
Scars, general	485,133
Diabetes mellitus	390,039
Lumbosacral or Cervical Strain	340,907
Impairment of the knee, general	328,968
Hypertensive vascular disease	324,431
Traumatic arthritis	316,526
Limitation of motion of the ankle	210,185

The cost to compensate veterans for tinnitus is over \$2.4 billion annually





- ◆ 6,030,000 internet sites on tinnitus.
  - 1,480,000 sites on tinnitus and causes
  - 636,000 sites on tinnitus and evaluation
  - 592,000 sites on tinnitus and remedies
  - 2,820,000 sites on tinnitus and treatment
  - 1,480,000 sites on tinnitus and depression

(Fall 2010)





- ◆ 14,900,000 internet sites on tinnitus.
  - 458,000 sites on tinnitus and causes
  - 651,000 sites on tinnitus and evaluation
  - 542,000 sites on tinnitus and remedies
  - 513,000 sites on tinnitus and treatment
  - 540,000 sites on tinnitus and depression

*(August 2017)*



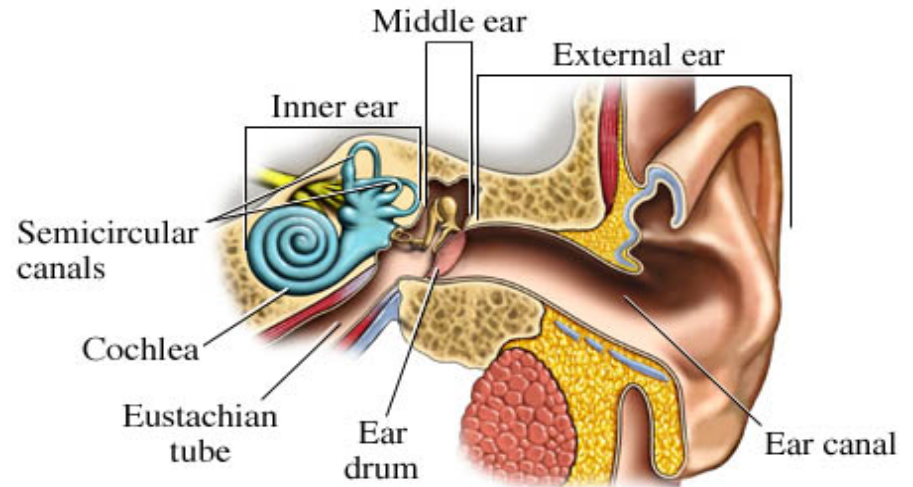
# HOW TINNITUS AFFECTS PEOPLE

- Extreme distress (very common)
- Depression
- Mood swings
- Anxiety attacks
- Tension, irritability
- Poor concentration
- Hearing interference
- Sleep disorders



# ANATOMICAL CAUSES OF TINNITUS

- Sound enters the ear canal
- It strikes the eardrum, causing it to vibrate
- These vibrations are carried by tiny bones, called ossicles, to the inner ear
- Fluid in the inner ear is then vibrated, causing hydraulic motion over the “inner ear hair cells”—nerve sensors which convert the vibrations into chemical energy
- This energy is then carried by the auditory nerve to the brain.



# HYPERACTIVE AUDITORY CORTEX: ROOT CAUSE OF TINNITUS (FOR NOW)

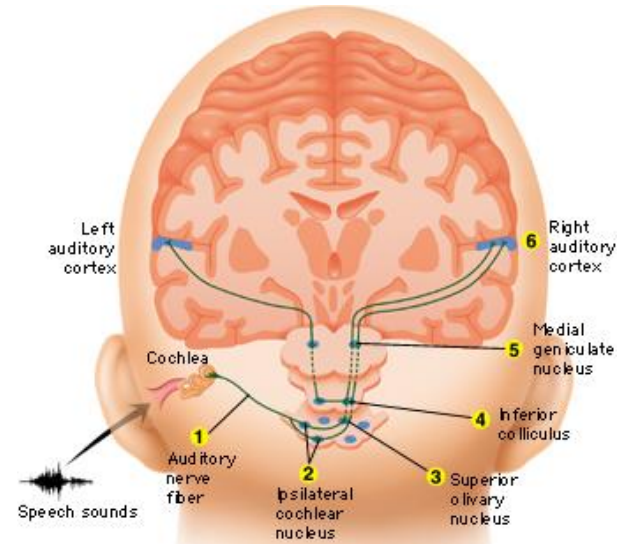


Image from scienceblogs.com

- ◆ Some years ago, scientists realized that the long-held assumption that tinnitus was an inner-ear issue was not truly the case. They began to focus on the auditory pathway - the route starting in the ear and leading to the auditory cortex (AC) in the brain.
- ◆ Studies which analyzed the structure and activity of auditory brain regions found abnormalities. For example, the AC is more active in tinnitus patients.
- ◆ This led to the idea that if the hyperactivity could be reduced, this should have an effect on the tinnitus precept. As a result, new treatment approaches were developed which target this hyperactivity of the AC.



# WHAT CAUSES TINNITUS?

- Neurophysiological Model – Perception & Reaction
  - As a person experiences tinnitus, they may or may not give it much attention, or priority.
  - When ‘ignored’ it is blended into the surrounding listening environment, and often goes undetected, or is transient tinnitus.



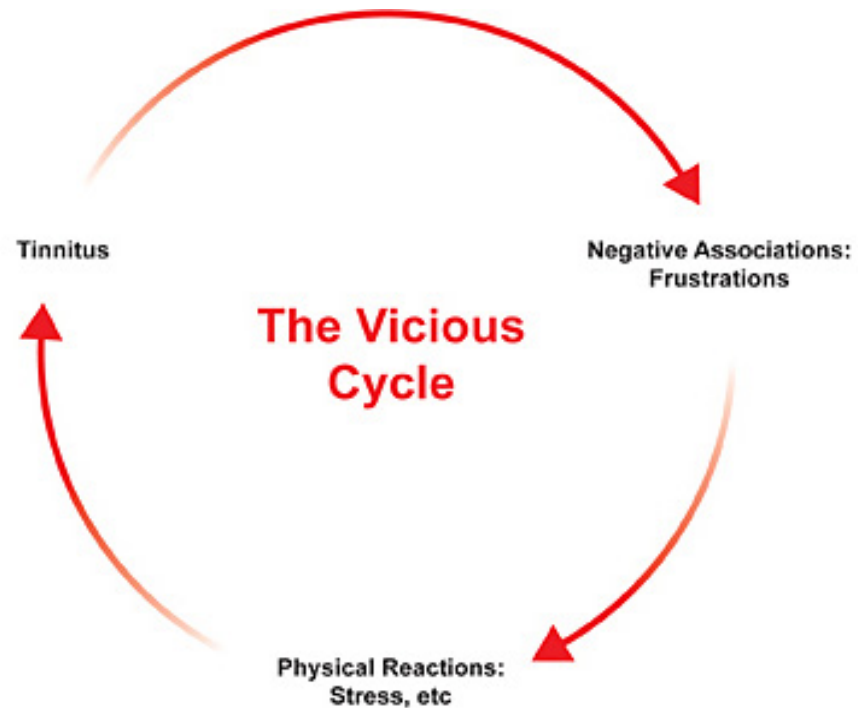
# WHAT CAUSES TINNITUS?

- Neurophysiological Model – Perception & Reaction
  - When given high priority (Prioritization) it can become a focal point. If attention is continually paid to it and it is put as high priority, the brain will more easily detect it with time, even in the presence of other background sounds (brain can remember consistent neural patterns).
  - When tinnitus stands out and is given high priority, it can lead to negative emotions, such as anxiety and stress, which can result in other issues such as insomnia or withdrawal.



# WHAT CAUSES TINNITUS?

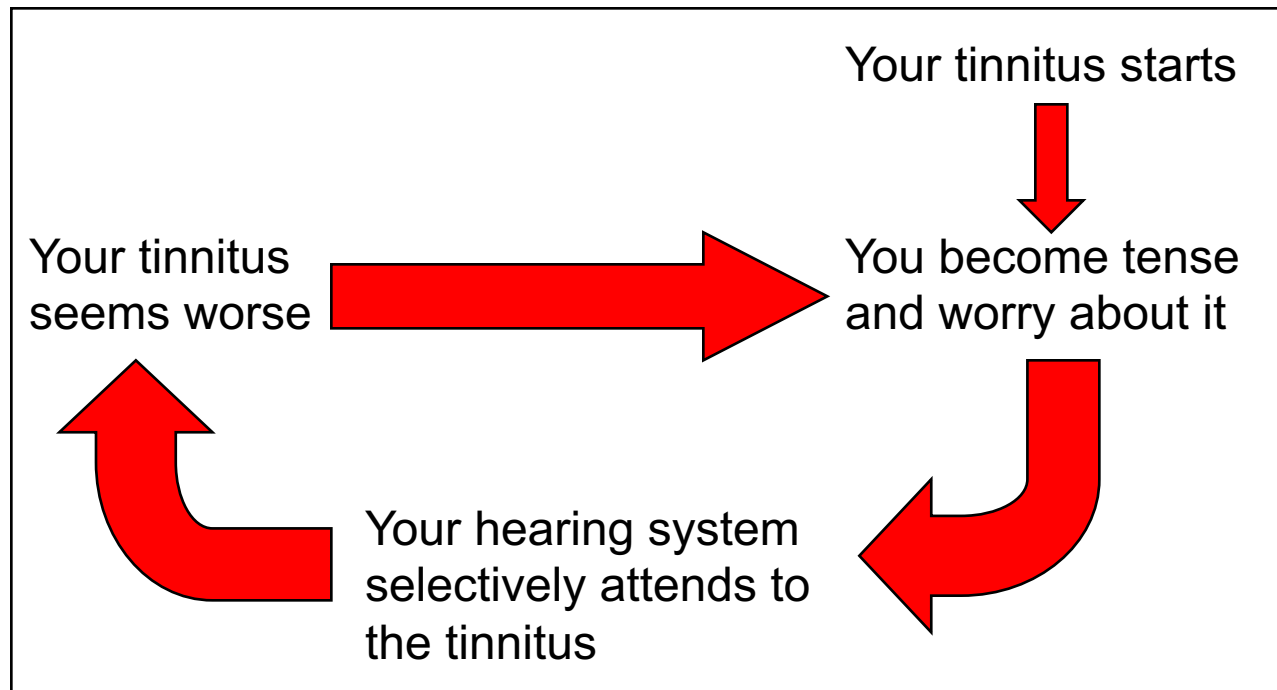
- Once this connection is established, a cycle can begin that includes the limbic system (emotion/associations) and autonomic nervous system (physical/bodily reactions).
- This connection is commonly known as “The Vicious Cycle/Circle”



# THE VICIOUS CYCLE OF TINNITUS

Impact on life is primarily emotional:

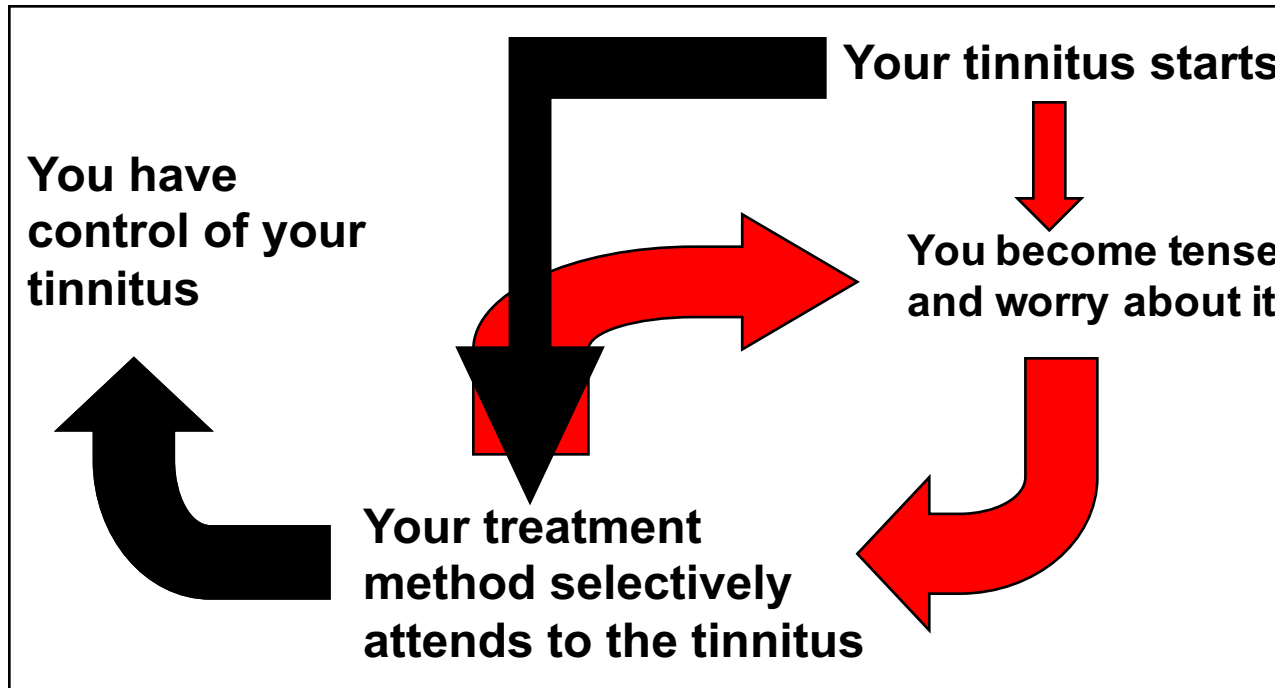
- Frustration and anger
- Stress
- Defeat, depression and self doubt



Source: Focus groups conducted by ReSound and interviews with key stakeholders

# BREAKING THE CYCLE

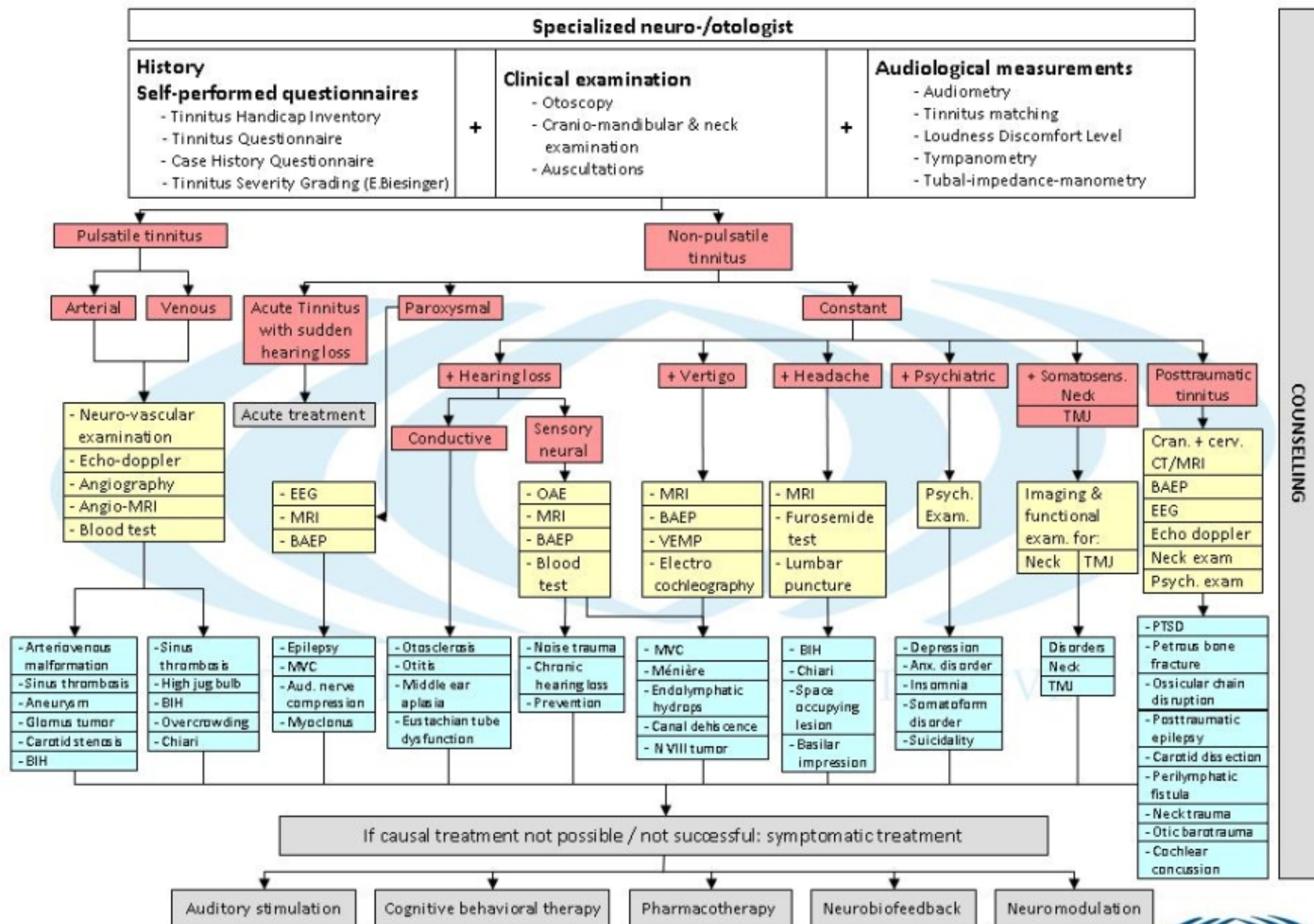
- For the best results counseling and sound therapy should be administrated in combination.
- The goal: to be in control of one's reactions to their tinnitus.



# TINNITUS: EVALUATION

- Consult with your physician
- Case History
- Medical evaluation
  - MRI / CT Scan
  - Physiological evaluation
  - Toxicological evaluation
- Have an audiological evaluation
  - Puretone Air and Bone Audiometry
  - Tympanometry & Reflex Decay Testing
  - Site of Lesion Testing
  - Tinnitus Matching Evaluation





**Abbreviations:** BAEP = Brainstem auditory evoked potential, BIH = Benign intracranial hypertension, MVC = Microvascular compression, OAE = Otoacoustic emissions, PTSD = Posttraumatic stress disorder, SOL = Space occupying lesion, TMJ = Temporomandibular joint, VEMP = Vestibular evoked myogenic potential



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# TINNITUS: EVALUATION

## ○ *Case History*

- 70% of diagnosis relates to the case history for most medical pathologies
- Actual diagnostic testing is primarily used to confirm interpretation of the case history and only about 30% of the time renders an unanticipated cause.



# TINNITUS: EVALUATION

- ***Case history consists of:***
  - Medical history
  - Pharmaceutical history
  - Hearing history
  - Concurrent symptoms (dizziness, pain, nausea)
  - Onset of tinnitus (when?)
  - Sudden or gradual?
  - Event-related?



# TINNITUS: EVALUATION

- *Case history consists of:*
  - Quality of tinnitus (what does it sound like?)
  - Loudness (quantity & variation)
  - Sleep habits
  - Attempted treatment methods
  - Other professional treatment (physician, chiropractor, neurologist, mental health professional, etc.)
  - Questionnaires, Questionnaires, Questionnaires...



# TINNITUS: EVALUATION

## ○ *Audiological Evaluation*

- *Puretone Testing:* evaluates hearing thresholds
- *Tympanometry:* evaluates middle ear performance
- *Acoustic Reflex Testing & Site of Lesion Testing:* evaluate performance of the auditory nerve



# TINNITUS: EVALUATION

- ***Tinnitus Matching Test:*** evaluates tinnitus in respect to severity
  - ***Intensity level:*** How loud is it?
  - ***Frequency:*** What pitch is it?
- This information can serve to help with treatment methods (discussed later)



# TINNITUS: EVALUATION

## ○ *Tinnitus Matching Test*

- ***Threshold:*** the minimum level at which the patient perceives the specific frequency
- ***Sensation Level:*** the intensity level at which the patient perceives the tinnitus above their threshold for hearing that frequency.




# TINNITUS: EVALUATION

- *Evaluation of Sensation Level*
  - *Score of 1 to 3dBSL: Mild (90%)*
  - *Score of 4 to 6dBSL: Moderate (7%)*
  - *Score of 7 to 9dBSL: Severe (2%)*
  - *Score greater than 10dBSL: Profound (<1%)*
- *Sensation level determines aggressiveness of treatment*



# TINNITUS: TREATMENT

- Many people are *wrongly* told that nothing can be done about their tinnitus and that they will just have to learn to live with it.
- Although there is no cure for tinnitus, those affected can learn techniques to successfully manage their tinnitus to the point where it is no longer a problem for them.
- People with tinnitus can continue to lead full and productive lives.
- No Permanent Cure--strictly management 

# TINNITUS: TREATMENT

## ○ *Common Sense & Cheap Solutions*

- **Avoid exposure to loud noise:** use muffs or plugs when possible.
- **Avoid stress:** there is subjective data showing stress exacerbates tinnitus, which is bad since tinnitus exacerbates stress—a vicious cycle.
- **Avoid all the bad stuff:** nicotine, caffeine, alcohol, salt, political discussions with family members—all the stuff people normally say are bad for you for other reasons can exacerbate tinnitus as well.



# TINNITUS: TREATMENT

## ○ *Common Sense & Cheap Solutions*

- **Review your Medications:** Talk with your physician; if you're taking a medication that can cause tinnitus, discuss alternatives.
  - *NOTE: Do not desist from taking your medication as prescribed until you have spoken to your physician about it.*
- **Sound Awareness:** Maintain some sound in your environment to help distract the brain from the tinnitus (television, radio, fan, etc.)



# TINNITUS: TREATMENT

- ***BEWARE OF QUACKERY***

- Apple Cider Vinegar
- Jaw re-alignment / Tooth-pulling
- Ginkgo biloba and other herbal supplements
- B-vitamins, zinc, magnesium
- Antioxidants
- Plenty of pineapple, garlic, kelp, and sea vegetables
- Quietus

*Most of these are home remedies and may work via the placebo effect or changes to a healthier diet. Herbal supplements are not tested or approved by the FDA.*



# SOUND THERAPY

- Also known as Acoustic Therapy
- Uses external sound to provide relief from tinnitus
- Rationale: Increase level of external sounds in the patient's environment to decrease the perception of tinnitus
- Goal: To decrease the contrast of the tinnitus against the background (i.e. sound signal); habituate to both the noise and tinnitus.



# SOUND THERAPY

- Goal: decrease overall signal strength of tinnitus
- Based on contrast of stimulus and background (i.e.. tinnitus and TSG noise)



The candle strength is decreased at a busy dinner table,  
as opposed to being isolated in the dark




# TINNITUS MASKING

- Total masking has been proven ineffective as a long-term solution.
  - Intensity required to totally mask may cause difficulties in hearing, pain/discomfort, or sensorineural loss
  - May have detrimental effect on tinnitus – not as effective (Jastrebroff)



# TINNITUS MASKING

- Partial masking has been proven more effective as a long-term solution.
    - “..is most often effective at an apparent intensity much less than that of the patient’s tinnitus” (Hazell, 1978)
    - “..use the lowest level masker that provides adequate relief” (Tyler & Babin, 1986)
- 

# SOUND THERAPY RELIEVES THE SYMPTOMS

- **Sound therapy**

- Represses the vicious cycle of tinnitus, anxiety, and increased tinnitus perception by "re-educating" the brain

- **The strong link between hearing loss and tinnitus**

- By treating hearing loss (with amplification), perception of tinnitus may concurrently improve
- Hearing instruments have often been used to treat tinnitus



# SOUND THERAPY RELIEVES THE SYMPTOMS

- **White noise**

- The most widely used and researched sound stimuli
- Has the best possible effect on relieving tinnitus, as it is easy to defocus from white noise

- **Narrowband noise**

- More frequency specific

- **Residual Inhibition**

- By getting sound stimuli during the day, the brain is most often retrained by night-time
- The user can usually sleep without a hearing device due to the daytime-training, but this many not always be the case.



# SOUND THERAPY RELIEVES THE SYMPTOMS

- **White noise**

- The most widely used and researched sound stimuli
- Has the best possible effect on relieving tinnitus, as it is easy to defocus from white noise

- **Narrowband noise**

- More frequency specific
- Variations: *Pink noise, brown noise, blue noise, red noise.*

- **Natural sounds**

- Rain, oceans, heart beat, running water

- **Fractal music**



# SOUND THERAPY: INEXPENSIVE OPTIONS

- **Sound Spas**
  - **Homemedics**
  - **Norelco**
  - **Usually ~ \$50.00**



# SOUND THERAPY: INEXPENSIVE OPTIONS

- **Cell Phone Apps (iPhone search)**
  - **"Starkey Relax"**
  - **"Sound Oasis Lite"**
  - **"Sound Oasis Pro"**
  - **"Sound Therapy"**
  - **"Whist"**
  - **"Tinnitus Help"**
  - **Available through iTunes**
  - **Ranges from Free to \$15.99**



# TINNITUS: TREATMENT

- Sound Therapy Devices:
  - **Neuromonics** is an Australian-based company that has devised a treatment device called **Oasis** for the treatment of tinnitus.
  - **Oasis** utilizes your tinnitus frequency/sensation level accompanied by soothing music to help break the tinnitus/stress vicious cycle.
- ***Be Careful:*** there is no Holy Grail for tinnitus.



# TINNITUS: TREATMENT

- Sound Therapy Devices:
  - The patient utilizes the device whenever tinnitus is present to help habituate themselves to the sound, and theoretically listening to the soothing music help the brain realize that the Danger Instinct is not needed when tinnitus is present.
  - Six-month treatment process
  - Cost: \$5,000
- ***Be Careful:*** there is no Holy Grail for tinnitus.



# TINNITUS: TREATMENT

- ***Hearing aids:*** Can help mask the tinnitus, but are only appropriate if hearing loss is present.
  - Normal hearing aids can help simply by helping you be aware of natural sounds in your environment.



# TINNITUS: TREATMENT

- Some instruments can come with built-in white noise generators (called *maskers*) to create a distraction sound to reduce the effects of your tinnitus.
- 70% of tinnitus sufferers report at least partial remediation of the tinnitus as a result of using hearing aids, and about 20% near-complete.
- 10%, however, report hearing aids increased the tinnitus



# TINNITUS: TREATMENT

## ○ *Hearing aids: Widex*

- High-end digital product with many key features you would expect for such a product.
- For tinnitus relief, utilizes “Zen Sound Programs”, playing random, harmonic tones to provide sound therapy to relax to



# TINNITUS: TREATMENT

## ○ *Hearing aids:* Other Manufacturers

- In 2013, the VA required *all* of their manufacturing partners to include a tinnitus masking option in their hearing aids.
- Because of this, *all* major manufacturers now have it available: *Starkey, Phonak, Unitron, Siemens, ReSound, Rexton, Oticon*



# TINNITUS: TREATMENT

## ○ *Hearing aids:* Practitioners

- Currently, the FDA restricts tinnitus treatment to be provided *only* by trained medical personnel—audiologists and physicians.
- Oregon recently “cracked down” on hearing instrument specialists who were advertising tinnitus treatment, as it is not in their scope of practice.



# TINNITUS: TREATMENT

## ○ *Surgery*

- Rarely helps when utilized specifically for tinnitus
- Should only be conducted to treat concurrent pathologies (i.e. ossicular fixation).
- Severing the auditory nerve was attempted in the 1950s and found to worsen the tinnitus.



# TINNITUS: TREATMENT

- ***Behavioral Changes:*** Stress remains the primary ingredient for change in tinnitus.
  - Changing your reaction to tinnitus
  - The Danger Instinct and over-generalizing
    - How does tinnitus make you feel?
    - If the tinnitus continues, what does it mean for you?
  - Imagine the tinnitus as a radio in the background
    - It's there
    - You can hear it
    - It doesn't need to be there
    - If nobody turns off the radio, what damage will it do?
    - Try to avoid the “all-or-nothing” mentality.



# TINNITUS: TREATMENT

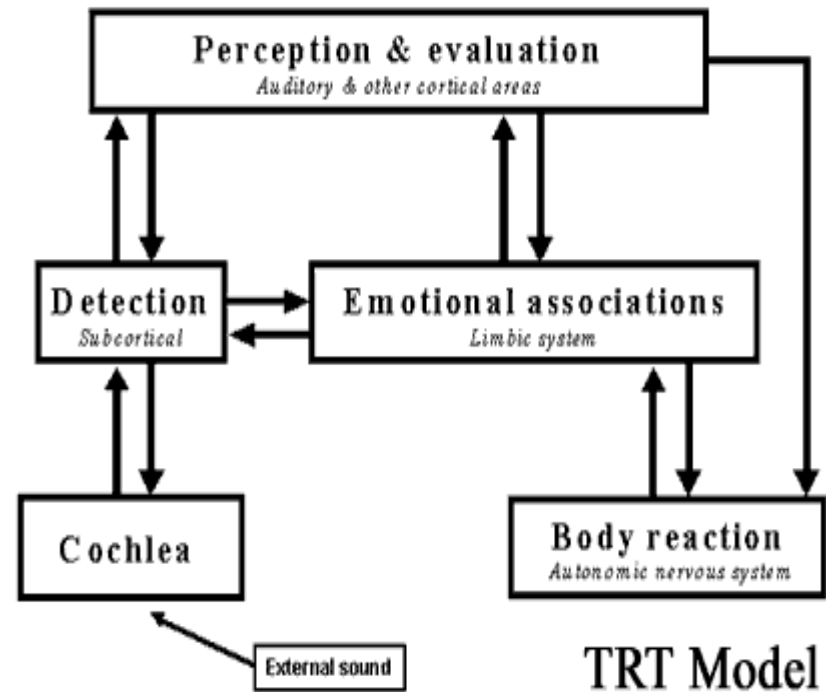
## ○ *Psychotherapy*

- For 20% of tinnitus sufferers, therapy should be a serious consideration.
- The link between tinnitus and depression is so overwhelming, it is a logical conclusion that psychotherapy be included in the overall treatment protocol—even in milder cases.
- Psychotherapy has gone beyond the couch and now typically includes group sessions, homework activities.
- Personal sessions should be re-established as stress levels increase.
- Key factor: Take control of “middle of the night” thinking



# TINNITUS: TREATMENT

- ***New Advances:*** Tinnitus Retraining Therapy
  - **Steps**
    - Initial evaluation including Tinnitus Matching Test.
    - Directed counseling by Group and individualized therapy.
    - Use of sound generators
  - **Cost**
    - \$2,000 - \$3,000 for sound generators
    - Directed counseling appointments are additional

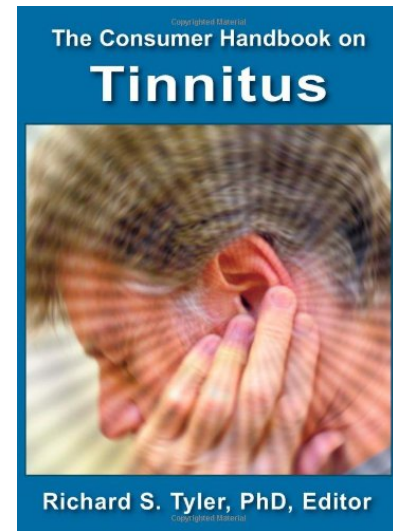


# TINNITUS: RESOURCES

## **The Consumer Handbook on Tinnitus:**

In this book:

- Top world contributors on tinnitus
- Gain knowledge of the many common causes of tinnitus
- Understand common reactions and problems faced by other sufferers
- Learn how tinnitus is likely represented in the brain
- Discover different ways you can change your reaction to tinnitus
- Recognize how communication difficulties are related to tinnitus
- Read about how tinnitus affects sleep and what you can do about it

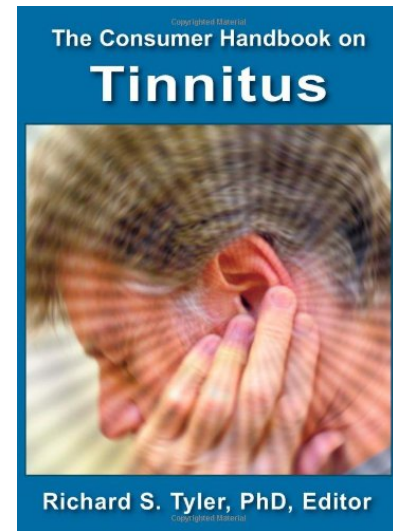


# TINNITUS: RESOURCES

## **The Consumer Handbook on Tinnitus:**

In this book:

- Find out ways to increase the quality of your life by taking charge
- Hear what you should expect from your physician and practitioners
- Unveil the facts about herbs, supplements and alternative medicines
- Understand your reaction to loud sounds (hyperacusis)
- Discover how tinnitus fits into your total emotional and spiritual life
- Uncover sound therapies that work
- Find out where else help is available



# TINNITUS: RESOURCES

## ○ *Websites & Organizations*

- [www.WebMD.com](http://www.WebMD.com)
- [www.ATA.org](http://www.ATA.org) (American Tinnitus Association)
- [www.mayoclinic.com/health/tinnitus/DS00365](http://www.mayoclinic.com/health/tinnitus/DS00365) (The Mayo Clinic)
- [www.ENTnet.org/healthinfo/hearing/tinnitus.cfm](http://www.ENTnet.org/healthinfo/hearing/tinnitus.cfm) (Ear Nose & Throat Physician organization)
- [www.Audiology.org](http://www.Audiology.org) (American Academy of Audiology)
- [www.AudiologyOnline.com](http://www.AudiologyOnline.com)
- [www.ASHA.org/public/hearing/disorders/tinnitus.html](http://www.ASHA.org/public/hearing/disorders/tinnitus.html) (American Speech-Hearing Association)
- [www.tinnitus-pjj.com](http://www.tinnitus-pjj.com) (Website for Dr. Pawel Jastreboff)



QUESTIONS?

