Clinical Management of Tinnitus
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### Agenda

- Past and current views of tinnitus
- Audiological evaluation of tinnitus
- Acoustic treatments
- Setting tinnitus maskers

### Definition

"(Tinnitus is the) perception of a sound in the ears or in the head without the presence of an external source generating the sound."

McFadden, 1982

### Classifications

- **Subjective:**
  - Perceived only by the patient (80% of cases)
- **Objective:**
  - Identified/heard also by the examiner (20% of cases)
    - Vascular: synchronous with heartbeat (palpable)
    - Muscular: out of sync (myoclonus)
## Causes

Over 200 causes described

<table>
<thead>
<tr>
<th>Changes at any point of the auditory pathway</th>
<th>Changes from outside the ear, but affect its functioning</th>
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</thead>
<tbody>
<tr>
<td>• Cerumen</td>
<td>• Cardiovascular</td>
</tr>
<tr>
<td>• Otitis</td>
<td>• Metabolic</td>
</tr>
<tr>
<td>• Otosclerosis</td>
<td>• Neurological</td>
</tr>
<tr>
<td>• Acoustic neuroma</td>
<td>• Pharmacological</td>
</tr>
<tr>
<td>• Meniere's disease</td>
<td>• TMD</td>
</tr>
<tr>
<td>• Acoustic trauma</td>
<td>• Psychological</td>
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<tr>
<td>• Noise exposure</td>
<td>• Dietary</td>
</tr>
<tr>
<td>• Ototoxicity</td>
<td></td>
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<tr>
<td>• Presbycusis</td>
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## A new perspective on tinnitus

- The mechanisms of tinnitus generators are central
- The main factor is damage in the inner ear leading to deafferentation of the central auditory cortex
- Deafferentation leads to alterations in central plasticity resulting in changing the balance of excitatory and inhibitory activity

## Possible repercussions

Significant tinnitus may impair quality of life

- Sleep
- Concentration
- Emotional balance
- Social activities

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**Handout 3**
There is nothing to do in your case.
You will have to learn to live with it.

Is there treatment for tinnitus?

Types of treatment

- Drugs
- Surgical
- Dental
- Physiotherapy
- Psychological
- Acupuncture
- Acoustic treatments
Acoustic Treatment

Sound Therapy
- Hearing Aids
- Masking
- TRT/TAT

Tinnitus
Clinical and Audiologic Evaluation

- Multi-disciplinary team
- General and specific anamnesis on tinnitus
- Basic audiological evaluation
  - Tonal audiometry from 250 to 8000 Hz
  - Speech audiometry
  - Immittance
  - LDL - Loudness Discomfort Level
### Protocol of the American Academy of Audiology for the Assessment of Individuals with Tinnitus (2000)

- Psychoacoustic measurements
  - Pitch
  - Loudness
  - Minimum masking level (MML)

#### Pitch

- Stimulus: pure tone or narrowband (NB)
- 125 to 12000Hz
- Test one ear at a time
  - Start at 1000Hz and go up in frequency
  - Present tones at 5-10dB above the hearing threshold until closest match is found
  - Always determine the hearing threshold at the tinnitus pitch

#### Loudness

- Hold at the tinnitus pitch and increase 1 dB steps until the stimulus is equal in loudness to tinnitus
- Initial intensity: before the hearing threshold
- Test one ear at a time
- Tinnitus Loudness SL = dB HL (match) – dB HL (hearing threshold)

<table>
<thead>
<tr>
<th>Tinnitus Threshold</th>
<th>4KHz 60dB</th>
<th>4KHz 70dB</th>
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<tbody>
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<td>10 dB SL</td>
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</table>
Minimum Masking Level - MML

- Instruct the patient that the purpose of this test is to see if we can cover or mask his / her tinnitus with another sound
- Find the hearing threshold for white noise in each ear
- Use white noise (WN) and start below hearing threshold increase in 5dB steps
- Record the lowest level that covers tinnitus

The difference between this level and the hearing threshold for WN is MML.
Stop if the patient reports discomfort, even if the tinnitus is still audible.

University of Iowa

Psychoacoustic Measurements

Measuring the pitch and loudness of tinnitus has no relation to diagnosis, prognosis or treatment, but is important for counseling.

And now...what should we do??
Keep in mind...

- There is NO unique treatment for tinnitus
- There is NO consensus on the best treatment for tinnitus
- Most tinnitus treatments lack supporting evidence, such as controlled trials

2 categories of treatment:
1) Focus on tinnitus
2) Focus on tinnitus reaction

Change the reaction to tinnitus

What do you think we can do to change the reaction to tinnitus?
## Essential components of treatment

<table>
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<th>Counseling</th>
<th>Sound Therapy</th>
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<td>- The patient must understand what tinnitus is to overcome the negative associations</td>
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<tr>
<td>- There is an association between auditory system and limbic system!</td>
<td>- Current view of Tinnitus: It is the consequence of modified neural activity, generated on the central auditory pathway, after peripheral damage</td>
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<td></td>
<td>- To avoid cortical tonotopic reorganization</td>
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## Acoustic treatments

- Amplification alone
- Tinnitus Retraining Therapy – TRT
- Tinnitus Activities Treatment - TAT
- General sound therapy

## Benefits of amplification for tinnitus

1. **General counseling during hearing aid fitting:** helps in the understanding of tinnitus
2. **Speech amplification:** decreases attention on tinnitus
3. **Environmental sounds amplification:** reduces the audibility of tinnitus

Coles, 1985
Benefits of amplification for tinnitus

- "The sounds amplified by the hearing aids produce neural activity by the auditory system, which interferes with the representation of tinnitus in the central auditory system"
- The most effective hearing aid settings for communication are not necessarily the best for reducing tinnitus audibility

Anderson, 2002; Searchfield, 2006

Candidates for amplification

- Patients with hearing loss and tinnitus, regardless of the nature and/or extent of the loss
- It is estimated that 90% of patients may benefit from traditional amplification

Johnson, 1998; Henry et al., 2002

Acoustic treatments

- Amplification
- Tinnitus Retraining Therapy – TRT
- Tinnitus Activities Treatment - TAT
- General sound therapy
Tinnitus Retraining Therapy - TRT

- Based on neurophysiological model of tinnitus, as described by Jastreboff, 1990
- Ability of the nervous system to suffer persistent functional changes of its circuitry

Awareness
- More effective response to a noxious stimulus

Habituation
- Suppression of response to innocuous stimuli repeated

Neuroplasticity

- "It is the reduction or elimination of CNS activity in response to repetitive stimuli" (Encyclopedia of Neuroscience, 1987)
- It is a natural process of the CNS and crucial to brain function due to its inability to perform two tasks simultaneously
Why do individuals have such different reactions to tinnitus?

Neurophysiological model of Jastreboff

- **PERCEPTION**  
  AUDITORY CORTEX AND OTHERS
- **DETECTION**
- **GENERATION**

Natural habituation: occurs in 80% of patients

Criteria for selection of sounds

- A new sound (first time) attracts attention and provokes a reaction, stored in memory
- Sounds (not new) are compared to memories and ranked in perceived priority
- In situations of concentration, the brain ignores signals that could be perceived
- In situations of relaxation, the brain perceived signs that could be ignored in a state of concentration
- A signal contrasting with the other tends to be highlighted
Tinnitus impact: occurs in 15% of patients

- Situations of fear and anxiety can alter perception
- Tinnitus may “change” from a neutral sound to an important sound when the patient associates it with something negative

Tumor  Progressively increasing
Crazy  Deafness  Abnormal life
Have it for life
Disabling tinnitus: occurs in 5% of patients

In short ...

No emotional association  
Habituation

With emotional association  
Reaction: activation of the LS and ANS

Tinnitus Retraining Therapy - TRT

Protocol
- Directive counseling (hearing/tinnitus/neurophysiological model of tinnitus)
- Patient categorization: 5 types
- Use of sound generator or hearing aid with open molds
- Follow up for 18 to 24 months

Important
- Habituation only occurs if the patient can hear the tinnitus (we can't mask tinnitus)
Use the ascending technique

- Decrease all sliders to 0
- Begin to increase the level
- Instruct patient to acknowledge when the signal is mixed with the tinnitus
- 2 sounds are heard – therapy signal and the tinnitus
- Do not use total masking

MarkeTrak VIII series: The Prevalence of Tinnitus and Efficacy of Treatments (November, 2011 HR)

Acoustic treatments

- Amplification
- Tinnitus Retraining Therapy – TRT
- Tinnitus Activities Treatment - TAT
- General sound therapy

Tinnitus Activities Treatment - TAT

University of Iowa – Richard Tyler (2004)

Courtesy of Dr. Richard Tyler
Tinnitus Activities Treatment - TAT

- Counseling
  - Interactive, not directive
  - 4 topics:
    - Thoughts and emotions
    - Hearing and communication
    - Sleep
    - Concentration

- Sound Therapy
  - Used to decrease the tinnitus prominence to ease habituation

- Activities
  - Behavioral cognitive therapy (tinnitus diary and relaxation exercises)
  - Mixing point or total masking are equally effective

Counseling material - TAT
TAT: No hearing loss

- Use the ascending technique:
  - decrease all sliders to 0
  - start to increase the noise level
  - Stop when the patient reports the sound is audible and comfortable
  - Try different signal types
  - Choose what gives more relief and at the lower level
  - Not using total masking or a mixing point
  - Total masking is optional if the patient prefers sound of masking signal

TAT: Hearing loss

- First, try amplification only in Program 1
- Next, set up a mixed mode in Program 2
- Start to increase the noise level until the patient says that the sound is audible and comfortable
- Then, set signal only in Program 3 for use when the patient doesn’t want to hear anything else

Acoustic treatments

- Amplification
- Tinnitus Retraining Therapy – TRT
- Tinnitus Activities Treatment - TAT
- General sound therapy
General sound therapies

- Use of other types of sound (CD, MP3, stereo pillow)
- Should be always used with counseling
- Can be used in other therapies

Conclusion

To transform the:
Tinnitus Reaction ➔ Counseling
Tinnitus Perception ➔ Sound Therapy

All miCon instruments have the tinnitus feature available