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Abstract:
This backgrounder describes how Octiv hearing systems can support the ease of Tinnitus. Octiv offers the flexibility to treat individual Tinnitus via the customized sounds. Various well-known tinnitus therapy concepts are shortly summarized and it is explained how the Octiv products can be configured supporting them.
Tinnitus is the perception of a sound in the ears or in the head with no corresponding external stimuli. In the current view of tinnitus, it is considered as the perceptual consequence of modified neural activity, generated by the central auditory pathway, after peripheral damage.

A few things about tinnitus:

- Although not common, tinnitus can be **objective** – meaning the tinnitus is audible to someone else besides the patient (this type of tinnitus generally originates from middle ear). For most individuals, it is **subjective** – meaning the tinnitus is audible just to the patient.
- High frequency hearing loss is the highest predictive risk factor for tinnitus. Other risk factors are age, low socio-economic status, and noise exposure.
- The epidemiologic studies show variable rates. It is considered that 10 to 15% of the population has chronic and persistent tinnitus; and around 20% of tinnitus patients find the condition disruptive enough to seek specialized treatment.

There are more than 200 potential causes for tinnitus. They can originate from within or outside of the auditory system. Metabolic, pharmacological, dental, somatic and psychological disorders are all possible culprits for tinnitus. Therefore, it is important to note that every patient is different, and that a single treatment will never be able to satisfy the full spectrum of tinnitus patients. Furthermore, patients with different symptoms in addition to tinnitus need to be treated differently. For example, a tinnitus patient may also be suffering from hearing loss, diabetes, depression.

**Measurement of tinnitus**

Despite the fact that tinnitus is a subjective symptom, it can be measured. The Psychoacoustic measurements of tinnitus are used to measure the magnitude of the tinnitus and can be a powerful tool in counseling and also in monitoring outcomes. The most common measurements are pitch and loudness matching and minimal masking level (MML). The measurements procedures may vary according to the Tinnitus clinic. See below the suggested method by UB Speech-language & hearing clinic.

**Pitch Match (most troublesome tinnitus):**

- Use contralateral ear as reference ear; if tinnitus is equal binaurally or reported to be heard in the head, use right ear
- Use pure tone, unless otherwise indicated by patient’s description
- Start at 1000Hz and go up or down in frequency, according to patient's indication
• Present tones at 5-10dB above the hearing threshold until closest match is found

Loudness Match:
• Use contralateral ear as reference ear; if tinnitus is equal binaurally or reported to be heard in the head, use right ear
• Begin below the hearing threshold at the pitch match frequency
• Increase 2dB steps until the stimulus is equal in loudness to tinnitus

Minimum Masking Level:
• Tell the patient that the purpose of this test is to see if we can cover or mask his tinnitus with another sound
• Ask the patient to indicate changes in tinnitus (masked, partially masked, no change)
• Use white noise and start below hearing threshold
• Increase in 5dB steps
• Stop if the patient reports discomfort, even if no change occurs

http://cdswebserver.med.buffalo.edu/drupal/

The reactions to tinnitus also can be measured. The frequently used tools are the Tinnitus Questionnaires as the Tinnitus Handicap Questionnaire; Tinnitus Handicap Inventory; Tinnitus Functional Index and Tinnitus Activities Questionnaire.
How Tinnitus can be eased

Amplification: Hearing loss accounts for a large percentage of tinnitus cases. The use of hearing aids for patients who have a hearing loss may also indirectly help to reduce the effects of tinnitus by improving communication and therefore reducing stress and anxiety. Many tinnitus patients report that the primary benefit of attending a specialized tinnitus clinic is the fitting of hearing aids.

Counseling combined with amplification is a great option for the relief of tinnitus. This approach can address the three critical components of tinnitus: 1) The psychological response to tinnitus, 2) the perception of tinnitus, and 3) the quality of hearing. Furthermore, hearing instruments can reduce tinnitus audibility, enrich the sound environment, improve hearing, and also lead to long-term plasticity changes in the brain.

Besides amplification, there are other types of acoustic treatment for tinnitus. Here we point out the main features of some of these treatments. For more information follow the link.

Tinnitus Retraining Therapy: This is treatment based directly on the Dr. Pawell Jastreboff model. It uses a precise and individual combination of sound therapy and teaching / demystification / learning about tinnitus and hyperacusis mechanisms, with directions about how to return to normal life without provoking symptoms. It provides relief from tinnitus because it induces habituation to the tinnitus perception. It is contraindicated for patients with low motivation or with expectations of quick or immediate relief, or patients unwilling to use sound for 8 hours per day. TRT can be conducted in conjunction with amplification or alone in case of normal hearing level. Counseling and sound is used to produce an enduring sense of reduced tinnitus after the cessation of sound. That is due to the decline in response to familiar auditory stimuli (tinnitus) due to repeated exposure. It is recommend to use the lowest sound level that reduces tinnitus detectability. TRT suggests the use of a mixing point – blending of tinnitus and the therapeutic sound. The procedure recommends using whatever kind of sound that produces greatest relief, which is oftentimes a broadband sound.

http://www.tinnitus.org/

Tinnitus Activities Treatment: Implemented by Dr. Richard Tyler, it is a treatment for the reaction to tinnitus using counseling, sound therapy and activities based on behavioral cognitive therapy as a tinnitus diary and relaxation therapy. Counseling is focused on individual
needs and structured into four topics: 1. Thoughts and Emotions; 2. Hearing and Communication; 3. Sleep and 4. Concentration. The sound therapy aims to decrease the prominence of tinnitus and facilitate habituation. For the sound therapy, one can use whatever kind of sound that produces greatest relief. It is suggested to use the lowest level of sound that provides adequate relief, regardless if it masks tinnitus or not.


**Masking:** Dr. Jack Vernon defined tinnitus masking as the achievement of some degree of relief of tinnitus through the use of external sound. Thus, even if it partially obscures the tinnitus but still affords relief, it is successful masking. Masking can be used in conjunction with amplification or alone for individuals with normal hearing. It is suggested to use whatever kind of sound that produces the greatest relief (hearing instruments, sound generators, combination aids, non-wearable devices, tabletop devices, pillow speakers, etc). It is recommended to use the lowest masker level that provides adequate relief.

This is accomplished by:

- Total masking: covering up tinnitus sound
- Partial masking: changing the sound of tinnitus by changing the perceived loudness

[http://tinmitusmasking.net/](http://tinmitusmasking.net/)

Various further therapy concepts are as well available. See also

[http://www.neuromonics.com](http://www.neuromonics.com)
Tinnitus Noiser in Connexx 7

In the previous section we described several different acoustic treatments that can be used to minimize tinnitus. All of them at least to some degree involve the use of an instrument that interferes with the perception of tinnitus by reducing the contrast between tinnitus and background sounds.

The Tinnitus Noiser is a broadband noise that can be used alone or combined with individual amplification for the tinnitus relief. This function is now available in all Octiv products. In the new BestSound technology, the frequency shape of the noise can be adjusted precisely for each individual wearer and while the level of the noise can be set in Connexx, the wearer still has the possibility to adjust this manually via a remote control or a designated onboard control.

Setting the Tinnitus Noiser
The Tinnitus Noiser function can be manipulated under the Finetuning in Connexx 7. By clicking on the Tinnitus, you will see three options: Microphone, Noiser, and Noiser + Microphone.

Figure 1: Tinnitus Noiser Mode interface in Connexx 7
If your patient does not have a hearing loss, go straight to the Noiser option. Set the Noiser according to the sound therapy option you prefer:

**TRT:** To set the Noiser, you need to look for the mixing point: the point where the noise mixes with the tinnitus, without masking it! Use a broadband noise with an ascending technique. Decrease all the sliders to 0, and then start increasing the noise level until the patient says that the sound is mixed to tinnitus. Explain to the patient that the Noiser should not cover the tinnitus, but that both sounds should be heard: the Noiser and the tinnitus itself.

**TAT:** To set the Noiser, also use the ascending technique and stop when the patient says that the sound is audible and comfortable. Many patients report that broadband noise is easier to listen to than it is to listen to their tinnitus. The goal here is not to find total masking or mixing point, but you can use total masking if the patient prefers it. You can try one or two types of noise. At the end, choose what gives more relief and has lower level.

**Masking:** To set the Noiser, choose a Narrow Band Noise at the tinnitus pitch frequency. Use the ascending technique and stop when the patient says that the Noiser is covering the tinnitus. You can adjust the Noiser for partial or total masking. It is recommended to use the lowest level of masking noise that provides adequate relief.

In case your patient has hearing loss, try amplification-only first, to see what happens to the tinnitus. When tinnitus continues to be a concern, designate a hearing instrument program with a Noiser + Microphone mode. Using an ascending technique, you can do masking, look for the mixing point (TRT) or even look for an audible and comfortable sound (TAT).

You also can choose to have one program with amplification alone and another program with the mixed mode. Sometimes, it is also beneficial to have a third program with Noiser only for those moments when the patient does not want to hear anything else.
Figure 2: Tinnitus Noiser+Microphone Mode in Connexx7

The patient is also able to alter the hearing instrument gain or the noiser via the onboard volume control (rocker switch) or remote control unit. It is also possible to configure a binaural fitting so that the patient can control the amplification volume on one side and the Noiser volume in the other side.

All the tinnitus patients should be encouraged to use the hearing devices for at least 8 hours per day and some type of general sound during the night, such as CDs, tabletop devices, or stereo pillows.
Counseling:

Counseling is the most widely employed tinnitus management strategy. It ranges from providing general information on tinnitus to more formal counseling on the neurophysiological and psychological models of tinnitus as well as on strategies for coping with tinnitus. In addition, counseling may include providing specific guidance on modifying perceptions or lifestyles to cope.

In TRT, a process called "directive counseling" is used to assist in resolution of the intimate associations among the tinnitus signal, the limbic system, and the autonomic nervous system, a part of the brain that functions in a protective role. Directive counseling has little in common with the gradually increasing self-realization of traditional psychological counseling; rather, directive counseling takes the form of a series of intensive, interactive, individualized educational sessions - including an initial session and two or three follow-up sessions over a twelve to eighteen month period. During directive counseling the tinnitus sufferer participates in an in-depth discussion in which the source and meaning of his or her tinnitus is detailed through demonstrations of anatomy (structure), physiology (function), and real examples in "story format" to make the tinnitus phenomenon understandable and demystified. Essential in directive counseling is a thorough explanation of the rationale and importance of healthy neutral non-masking sound in the ultimate resolution of the problem. The directive counseling structure remains basically the same in each of the sessions; however, the nature and detail of
the explanations and the analogies used changes as the sufferer's view of his or her tinnitus gradually matures during the process. The above recommendations were abstracted from:
http://home.comcast.net/~nagler/trt.html

In 2001, Tyler and Bergan introduced the concept of picture-based counseling for tinnitus patients. For each counseling session and topic, they produced a series of illustrations that are shown to the patient. The advantages of this approach are:

• The session proceeds in a orderly fashion
• The clinician does not overlook important concepts
• It is easier for the patient to understand concepts
• The treatment can be easily used by other clinicians
• In studies comparing tinnitus treatments, it is easier to control counseling across conditions and therapists.
• The discussions can be adapted to the needs and sophistication of each patient.

Their approach, in TAT is by listening to the patient; providing information about hearing, hearing loss, tinnitus and attention; discussing ways to make tinnitus less important and changing lifestyle to manage better. They believe that providing information on tinnitus and related issues helps patients realize they are not alone; removes some of the fear of the unknown and assists in developing realistic expectations.

The above TAT counseling recommendations were abstracted from:
Common FAQs from patients

1) I already have one annoying sound; if I use the Noiser won’t I then have two?
The Noiser, in addition to your tinnitus is used to compete with the representation of the
tinnitus in the brain. It is important to induce neural plasticity in the auditory cortex to
achieve habituation.

2) How long should I wear the hearing instruments each day? Can I use them
during sleep?
Try to use the devices at least for eight hours per day. During the night, try to use a
more general kind of sound like a CD with nature sounds, or special purpose tabletop
devices or stereo pillows.

3) What should I do if the device is too noisy?
If the Noiser is too loud and you can’t stand it, you need to contact your hearing care
professional.

4) How long does it take for the tinnitus to disappear?
Each patient is different, so it is difficult to say. But it is important to know that the
neural plasticity in the auditory cortex takes some time to occur. The first thing that
improves is the reaction to tinnitus, that is the condition when the patient still perceives
the tinnitus but does not feel annoyed anymore. Most of the acoustical treatments to
tinnitus have a duration of 12 to 18 months.

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