

ReSound AleraTS™: The role of wireless streaming in tinnitus management

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Tinnitus is the perception of sound in the absence of an acoustic stimulus. It can vary greatly in its perceptual characteristics from person to person. Although the exact mechanism of tinnitus causation is unknown, the origin of tinnitus activity is believed to lie somewhere within the auditory pathways (Henry et. al, 2008). Tinnitus is a concern for many people, and affects approximately 10-15% of the overall population, with approximately 20% of that population suffering from clinically treatable tinnitus (A. Davis & Refaie, 2000; Jastreboff & Hazell, 1998). In addition, approximately 80% of all tinnitus sufferers also have hearing loss. This shows the importance of having an effective combination unit, such as ReSound AleraTS™, which can address both the hearing loss and tinnitus concerns of these individuals.

There are different approaches of treating tinnitus, such as medical management (in cases where the tinnitus can be addressed medically), educational counseling and sound therapy, each having a unique approach to tinnitus management. Up until now, little research has been published in regards to the effectiveness of hearing instruments, tinnitus sound generators (TSGs) or combination units for tinnitus management. This may be partly to due to the fact that past ear-level technology for tinnitus management has been far from ideal, and this lack of flexibility has not addressed the unique needs of each individual. For the most part, people struggling with tinnitus have had to make due with either white noise generators, or preset music that may not always be preferred by the user. Within the different tinnitus management programs available, each has some distinct differences on how they incorporate sound into their management protocols, and past technologies have not offered the flexibility to meet all these requirements.

In this paper, we will review some of the more well-established tinnitus management programs, such as Sound Therapy, Tinnitus Retraining Therapy (TRT) and Progressive Tinnitus Management (PTM), and how sound enrichment and wireless streaming using the ReSound Unite™ Mini Microphone can play a beneficial role in achieving the goals of these tinnitus management programs.

Tinnitus management programs

Sound Therapy

In almost all tinnitus management programs, sound therapy of some kind plays a significant role. Although counseling alone can be used without sound therapy, it is often times not as effective as using a combined approach. Counseling-only type treatments aren't intended to change, or reduce the acoustic perceptions of the tinnitus, but rather change the reactions to tinnitus, and the negative effects it may bring. This can be very beneficial in regards to improving one's reactions to their tinnitus, but may not be enough for some tinnitus sufferers.

Sound therapy's main intention is to divert one's attention away from the tinnitus. By introducing sound into one's environment, we are able to minimize the contrast between the tinnitus and the background environment (Figure 1). For example, in a quiet room tinnitus is easily detected since there is a large discrepancy between the loudness of the tinnitus and quietness of the environment. By enriching the environment with sound, we increase the loudness of the background environment, therefore making the tinnitus less prominent and noticeable. Sound therapy can have immediate effects, helping to reduce tinnitus audibility (e.g. masking/partial masking) which can also potentially result in taming the underlying tinnitus. Sound stimulation may also reverse or modify the abnormal cortical reorganization thought to be responsible for tinnitus (Searchfield et. al, 2010).

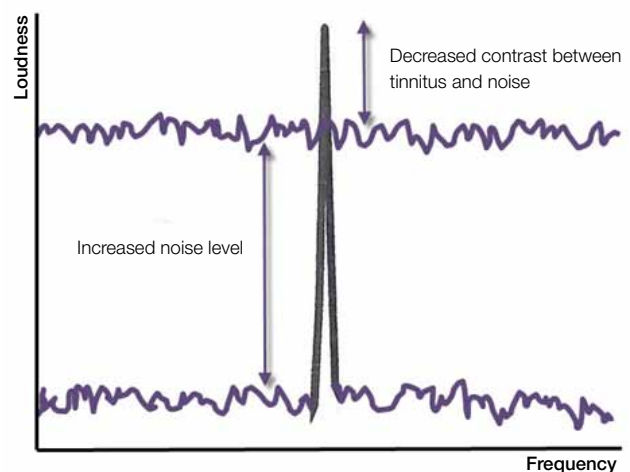


Figure 1: Increasing the background noise level reduces the contrast between the tinnitus and the background sound level.

ReSound

rediscover hearing

Many different instruments can be used for sound therapy. For example, with most ear-level devices, a broadband white noise generator is used, although some devices have proprietary signals that can be used in place of, or in conjunction with the white noise. However, users are limited to the sound sources that are available within these devices.

Another form of sound therapy is table top sound generators. Table top sound generators offer different sound options, such as running creeks, birds chirping, soothing ocean waves, as well as other nature-type sounds. Many table top sound generators are able to use different sound cards, allowing one to change the sound signal at their convenience. Table top sound generators can be used to enrich a quiet room with sound, therefore diverting one's attention away from the tinnitus. They are often times used in the bedroom to help one sleep, but can be used to enrich multiple environments with sound. A limitation to table top sound generators are that they are not always conveniently portable, nor discrete, like an ear-level device, and therefore are limited when and where they can be used.

With the recent popularity of smart phones and the applications that can be downloaded with them, a number of tinnitus 'apps' are now available. These tinnitus applications typically offer different types of noise (i.e. white, pink, violet, etc.), as well as nature-like sounds that can be downloaded for a minimal cost and played over the external speaker or via headphones. Although the portability of the smart phone is quite convenient, if the user has a hearing loss, it is not taken into account, and thus the sound therapy signal provided by these phones may not be maximized.

More commonly used in treating tinnitus are open-fit hearing instruments. Open-fit hearing instruments have been beneficial to a number of tinnitus sufferers, since the open ear canal allows for more natural sound to enter, and therefore provides a form of 'natural' sound therapy (Del Bo, et. al 2008). Hearing street noise, or people talking can enrich one's environment with sound, therefore making the tinnitus harder to detect. Although many people benefit from using hearing instruments alone for tinnitus management, there are a number of people where amplification alone is not sufficient.

ReSound AleraTS™ is a combination hearing instrument and tinnitus sound generator (TSG) that delivers a broadband white noise generator that can be frequency-shaped according to the users preferences using low and high cut filters. In addition, it can be combined with the ReSound Unite™ Mini Microphone (Figure 2) to wirelessly stream numerous sound signals. This means that, literally, any sound source could be used for sound therapy. The limitations of only having a few restrictive sound sources to treat tinnitus have now been lifted. Users can upload any sound source to an MP3 player, connect it to the ReSound Unite™ Mini Microphone via a stereo plug, and have that sound source wirelessly streamed to their hearing instruments, allowing them to choose and use the sound signals that are most beneficial and therapeutic to them. For example, one would not be limited only to listening to white noise, but could stream other types of noise, such as pink, red, violet, blue, etc, which differ in their frequency shape, and could provide more benefit depending on the characteristics of the tinnitus. In addition, other sound signals, such as nature-like sounds, music or speech could also be used. It is important to remember that individual differences can influence the effectiveness of specific sound over others.



Figure 2: The ReSound Unite™ Mini Microphone

Sounds used for sound therapy can vary in their temporal, spectral and emotion-evoking characteristics (Searchfield et. al, 2010).

Searchfield et al showed that a rain sound signal was preferred over a white noise sound signal when it came to masking the tinnitus. Some argue that more dynamic sounds (i.e. rain) are better at helping to mask tinnitus, compared to less dynamic sounds (i.e. white noise) (Henry et. al, 2004). In addition, music was the least favored when it came to masking the tinnitus due to the cognitive stimulation and the attention it brings.

However, when measuring these three sound signals in relation to decreasing tinnitus annoyance, music was preferred over white noise, with rain once again being the most preferred (Searchfield et. al, 2010).

Sound therapy can be used in a variety of ways to help enrich one's acoustic environment. For example, depending on the time of day, or the environment one is in, such as work versus home, a particular sound source might be preferred over another. Wireless streaming offers flexibility with sound therapy never seen before, and allows for true customization of any tinnitus management program, according to a user's needs and preferences.

Tinnitus Retraining Therapy (TRT)

Tinnitus Retraining Therapy (TRT) is a tinnitus management program that is based on the neurophysiological model of tinnitus, which educates the tinnitus patient to better understand the mechanisms involved with tinnitus, their reactions to tinnitus and ultimately helps them habituate to the tinnitus, from an emotional and perceptual perspective. Habituation is the process of retraining the brain from conditioned responses. In TRT the habituation process turn the tinnitus from a negative signal back into a neutral signal, diminishing any negative emotions towards the tinnitus. TRT is the clinical implementation of the neurophysiological model of tinnitus and was created by Dr. Pawell J. Jastreboff in the mid 1980s.

TRT reflects a general rule that we do not react to the absolute but to the relative strength of a stimulus compared with the background (Jastreboff & Hazell, 2008). For example, the fan of a ventilation system in a very quiet room will sound much louder than if that same fan is on in a crowded room with people talking and music on (e.g. a cocktail party), even though the intensity of the ventilation fan has not changed. The same holds true with tinnitus. If we increase the intensity of the background environment, and thus stimulate more background neuronal activity, then the tinnitus signal will not be perceived to be as strong, even though the tinnitus signal itself has not changed.

TRT also discusses in-depth the role of the limbic system and the autonomic nervous system (ANS) in regards to tinnitus. The limbic system is greatly connected to our sensory systems, and can elicit both positive and negative reactions depending on sensory input. This can strongly influence our emotional state.

The ANS, which is strongly connected to the limbic system (emotional state) is responsible for automatic body functions such as heart rate, breathing and hormonal levels. When put under extremes duress, where a fast reaction is required (e.g. fight or flight), the ANS is automatically stimulated and prepares itself for physical or mental activity. In regards to tinnitus, inappropriate stress is put on these systems due to the negative association of the tinnitus, which is often due to the fact that the person suffering doesn't understand what is happening to them, even though in most cases, the tinnitus itself is harmless. When these systems are highly stimulated, a vicious cycle involving the auditory system, limbic system and ANS takes place (Figure 3). One of the goals of TRT is to 'break' this vicious cycle, and sound therapy is often times a vital component of this treatment program.

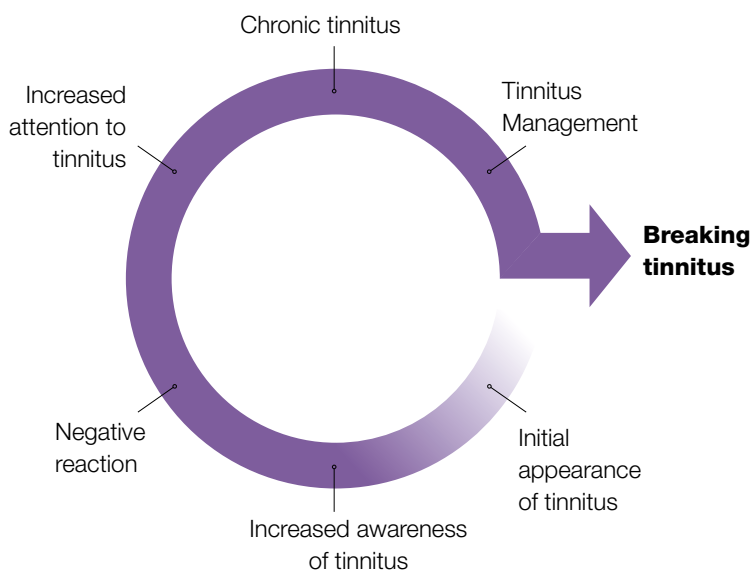


Figure 3: The vicious cycle of tinnitus

Within TRT, sound therapy can provide a weakening of the tinnitus signal by decreasing the contrast between the tinnitus signal and the background neuronal activity. This can facilitate perceptual changes to the tinnitus. However, there are strict rules as to what sounds should be used to increase the background environment.

Some of the abiding principles of sound therapy within TRT are:

- The external sound being used should not provoke any negative reactions, irritate or annoy the user
- It is important to maintain the perceptual characteristics of the tinnitus
- Sounds should not draw attention, interfere with other important signals of interest, such as speech, or affect daily activities
- Sounds should not fully mask the tinnitus (the tinnitus signal should be audible), as this will prohibit habituation from occurring (you can't habituate to something you can't hear)

TRT follows the rules that sounds used for sound therapy should have stable continuous amplitudes, as this is easier to habituate to than changing or fluctuating sounds. Users should also have the ability to control the volume of the sound to optimize habituation, and also provide some control, which may help in turn to make the sound more non-threatening and therapeutic. In addition, broadband noise is often suggested, as it stimulates a wide range of neurons with the auditory system. And lastly, with open-fit instruments, environmental sounds can enter the ear naturally, helping to enrich the sound environment.

Many of these requirements can be addressed by using the broadband white noise TSG feature within ReSound AleraTS™. For those users who do not enjoy the sound of white noise, wireless streaming allows you to use any type of continuous, stable sound (i.e. pink, red, blue, violet, steady nature-like sounds, etc.), offering flexibility to address the unique needs and preferences of each tinnitus sufferer. It also provides numerous options to maximize the requirements of TRT and increase the chances of successful outcomes.

Progressive Tinnitus Management (PTM)

Similar to TRT, Progressive Tinnitus Management (PTM) uses sound, as well as counseling, as a vital role in helping to achieve the goals of the management plan. PTM is a patient-centered approach to tinnitus management, which uses specific evaluation procedures, emphasizes the appropriate use of sound, encompassed within a five-step hierarchical plan. Although it has a structured approach on how to use sound, it is very flexible in regards to what sounds can be used within the management plan.

The five levels of management with PTM are as follows (an individual can go through one level or all levels according to their needs):

1. Triage - making the appropriate referrals according to the needs and concerns of the individual
2. Audiologic Evaluation - relevant diagnostic testing, including hearing aids if appropriate
3. Group Education - discussion of self-management strategies within a group setting
4. Tinnitus Evaluation - provides an in-depth interview to determine if further individualized management is necessary
5. Individualized Management - a customized tinnitus management program

It is not the intention of this paper to discuss the five levels in great detail, but rather to help you better understand the structure and flow of the PTM program.

Educational counseling, including appropriate use of sound, is provided during Level 3 - Group Education and Level 5 - Individualized Management with PTM. At these points, there are 3 classifications of sound discussed in regards to tinnitus treatment.

- Soothing sounds - these sounds help produce a sense of relief from the stresses of the tinnitus
- Background sounds - these sounds help in reducing the contrast between the tinnitus and the background acoustic environment. In addition, these sounds aid in passively diverting attention away from the tinnitus.
- Interesting sounds - in contrast to background sounds, these sounds aid in actively diverting attention away from the tinnitus.

Within the three classifications of sounds three assortments of sound are recommended for optimal results. Environmental sounds, such as nature sounds, appliances, fans, and broadband noise as in TSG devices; Music of all sorts can be used, and Speech of all varieties is also acceptable. From here patients are instructed to recognize the situation where their tinnitus is most bothersome and construct a sound plan to manage that situation.

The plan can be modified as needed to achieve maximum results. As time passes on, and greater comfort using these sounds has been achieved, patients can apply these strategies to other troublesome situations (Henry et. al, 2008).

One of the key elements of PTM is that the patient plays a very active role in identifying problems and contributing input on ways to best manage these concerns. They take a very hands-on approach to any lifestyle changes and what sounds are best for them in helping them to alleviate their tinnitus. Having the capability to wirelessly stream the sounds they feel are most therapeutic and beneficial to their progress, puts the user in control, which is consistent with the practices of PTM.

Most ear-level devices only offer white noise or proprietary sound files that may not always be preferred by a user, or be an appropriate sound source for a particular tinnitus management plan. By having the ability to wirelessly stream different types of Environmental, Music or Speech sounds using ReSound AleraTS™, combined with the ReSound Unite™ Mini Microphone, users can truly customize and optimize the PTM management program.

Conclusion

It is important to note that there are multiple effective programs to treat tinnitus. It is not the intention of this paper to recommend one treatment program over another, but rather offer insight to the role sound plays in these different treatment programs, and how wireless streaming capabilities offers a unique flexibility never seen before. Note that the requirements of using sound can vary greatly from treatment to treatment, but the ability to wirelessly stream different sound signals, allows you to maximize any treatment program to accommodate the unique needs of each individual tinnitus patient. ReSound AleraTS™, combined with the ReSound Unite™ Mini Microphone offers the flexibility to accommodate any tinnitus management plan.

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