



UNDERSTANDING TINNITUS AND TINNITUS TREATMENTS

What is Tinnitus?

Tinnitus is a hearing condition often described as a **chronic ringing, hissing or buzzing in the ears**. In almost all cases this is a subjective phenomenon that can only be perceived by the person with the condition. In addition to the different types of tinnitus sounds (e.g., ringing, hissing, buzzing, "wooshing", high-pitched tone) the frequency or pitch as well as the loudness of tinnitus can vary from person to person. In some cases, a person may experience more than one type of tinnitus and they can also report that their tinnitus varies in pitch or volume within the same day, between days, depending on levels of stress, or their environment. Tinnitus can be described as being unilateral (left or right ear), bilateral, or in some cases it is described as being "within the head" or "outside".

Despite this, some tinnitus sounds are more common than others. **About 50% of tinnitus sufferers report having tonal tinnitus, with 25% reporting ringing, and about 20% reporting hissing tinnitus.**¹ The vast majority of tinnitus sufferers only report one type of tinnitus, and for those who do not, they will typically identify one type that is the most aggravating. At Sound Options, we focus on the three most common types of tinnitus.



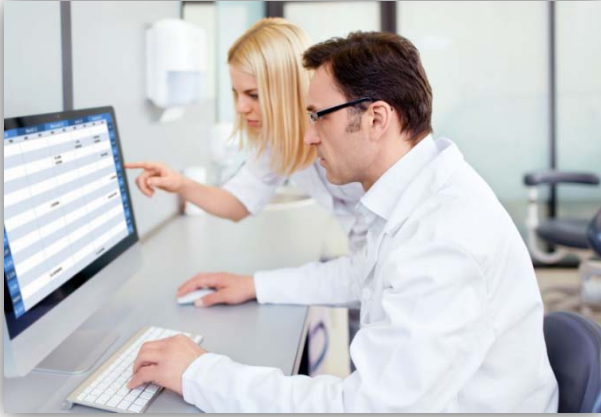
How Tinnitus Develops

In relatively rare cases the cause(s) of tinnitus can be identified by an Ear Nose and Throat Doctor and addressed through surgery. However, there are a range of causes that cannot be dealt with through surgery including hearing loss, side effects of certain medications, head and neck injuries, Meniere's disease, as well as stress and anxiety. While diagnosing these is challenging, a tinnitus sufferer should always first consult with their physician when they develop the condition.

By far, **the most common cause for tinnitus is hearing loss due to ageing or noise trauma** (e.g. from a work environment, music, or exposure to loud sounds). In these cases, tinnitus is thought to develop as a result of changes to the auditory brain as the brain attempts to compensate for hearing damage.² Our brains normally have the capacity to adapt and change. However, in some cases, they can change in ways that lead to undesirable outcomes. In the case of tinnitus it is believed that the **hearing brain becomes too excitable**^{3,4} leading to the perception of sound that is not caused by the outside world.

Tinnitus Treatments

Various tinnitus treatments have been developed over the last 20 years. There are important differences between these tinnitus therapy approaches.



Tinnitus reduction sound therapy - Recent research has led to a greater understanding of how tinnitus is related to changes in our hearing brain. This has allowed the development of sound therapies that can provide the hearing brain with the type of sound input it needs to reduce tinnitus over time. These forms of sound therapy must be customized to the individual tinnitus sufferer. **Sound Options** falls under this category and uses the most comprehensive customization by taking into account a person's hearing and tinnitus profile and making use a computational model of the hearing brain.

Tinnitus masker - A masker is a type of sound therapy for tinnitus that attempts cover up or mask a person's tinnitus by a different sound. These can include, white noise, chimes, random tones or similar sounds. The idea is that if a person can be distracted from their tinnitus or have it covered up, they will learn to not pay as much attention to it in general. Unlike retraining therapies, maskers are not necessarily looking to reduce the tinnitus itself, but rather to reduce attention paid to the tinnitus.

Counselling - Various forms of counselling have been shown to benefit tinnitus sufferers in terms of reducing the impact that tinnitus has on their life. These include cognitive behavioural therapy and tinnitus retraining therapy. Research also indicates that there are benefits to combining educational and counselling approaches with sound therapies.

Pharmaceutical treatments - At this point in time, no clinically-validated pharmaceutical treatment for tinnitus has been developed. While tinnitus sufferers may have read claims made about drugs or even supplements that can treat tinnitus, these claims are not supported by clinical testing.

QUICK FACTS

- Many tinnitus sufferers will prefer to start with a more affordable option as long it has been clinically validated
- Tinnitus sufferers have been told to "live with it" and may not be aware of treatment options



About Our Tinnitus Treatment

Sound Options builds a novel sound therapy that effectively treats tinnitus by incorporating a computational model of the hearing brain into software. This computational model simulates brain changes associated with the development of tinnitus. The software then predicts and creates a custom-built sound therapy that can minimize or undo these changes.

Treating tinnitus is easy as listening to music: The sound therapy is embedded in music to provide a relaxing and enjoyable experience.

While there are many potential causes of tinnitus, the most common contributor to tinnitus is the abnormal activity in the hearing brain.^{3,5} This type of activity can result due to factors such as hearing loss.

Hearing loss and tinnitus

Hearing loss can initiate a process wherein the auditory cortex (the highest region of the hearing brain) attempts to compensate for reduced input.² **Our brain has the power to change and adapt, and the hearing brain is no different.** The problem is, that in some cases, the adaptation can make the hearing brain overactive, even when no external sound is present. This can contribute to the development of tinnitus.

Unfortunately, it is not just a matter of too much activity. The way the hearing brain processes information can also change.³ In addition, there are still other changes that have been linked to tinnitus. What makes tinnitus so challenging to treat is that the changes can vary from person to person. This is indicated by differences in what their tinnitus sounds like.

Custom-built to Maximize Effectiveness

By incorporating a computational model of the hearing brain, Sound Options can integrate the most up-to-date research on tinnitus and the brain into the software. **This allows us to predict the underlying brain changes based on each tinnitus sufferer's hearing and tinnitus profile.** And because of this,

we are able to customize a sound therapy specifically for that patient. As more research comes out, Sound Options works to improve this process and the software's ability to predict what sound therapy should work best.

What Happens When a Hearing and Tinnitus Profile are Submitted?

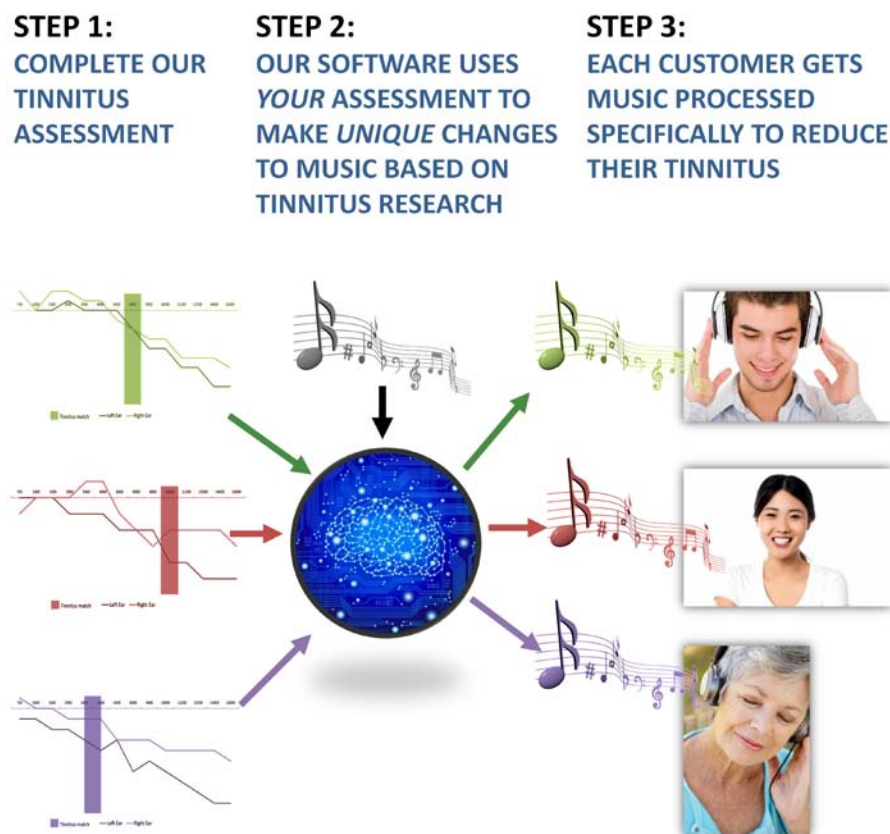
The results of the audiogram and tinnitus pitch match are loaded onto our software. **This allows the software to create a profile of the tinnitus sufferer's peripheral auditory system as well as changes that may have occurred in their auditory brain.** Once this is done, the software has a baseline "tinnitus brain" for that tinnitus sufferer. At this point the software will take music and run it through various algorithms (basically, ways to change the music).

Each algorithm will be used to alter the music; the software will simulate this altered music and how it can help the person's **tinnitus brain**. If the software predicts that this algorithm altered the music so that it can gradually reduce the brain changes causing

that person's tinnitus, the music track is produced as part of that person's sound therapy package. If the algorithm was not found to make appropriate changes to the music, a different algorithm is tested through the same process.

The algorithms tested by our software are proprietary trade secrets but involve making changes to the music frequencies and amplitudes in different ways that may stimulate brain retraining based on the hearing and tinnitus profile.

Once the above process is repeated for a sufficient number of music tracks, the tracks are assembled into a sound therapy package that can be listened to on any music-playing device.



1. Sound Options tinnitus assessment database.
2. Noreña AJ. An integrative model of tinnitus based on a central gain controlling neural sensitivity. *Neurosci Biobehav Rev.* 2011 Apr;35(5):1089-109.
3. Eggermont JJ, Roberts LE. The neuroscience of tinnitus. *Trends Neurosci* (2004) 27:676–82.
4. Chrostowski M, Yang L, Wilson HR, Bruce IC, Becker S. Can homeostatic plasticity in deafferented primary auditory cortex lead to travelling waves of excitation? *J Comput Neurosci.* 2011 Apr;30(2):279-99. doi: 10.1007/s10827-010-0256-1.
5. Roberts LE, Eggermont JJ, Caspary DM, Shore SE, Melcher JR, Kaltenbach JA. Ringing ears: the neuroscience of tinnitus. *J Neurosci* 2010 Nov 10; 30(45):14972-9.

Common Questions - Healthcare Professionals

1. What do I have to do with the patient?

The healthcare professional completes the hearing test, which is then provided to Sound Options through an online portal. The online portal also requires the patient to complete a simple tinnitus pitch assessment (requires about 10 minutes to complete). The mechanisms of our sound therapy can also be discussed with the patient.

2. What support does Sound Options provide?

A Sound Options representative can visit your clinic or provide training and tinnitus information by phone to give you a greater comfort level with tinnitus sufferers. We will provide you with all of the information needed to be able to provide our customized sound therapies through your clinics.

We are available for direct contact via our toll-free number **1-866-688-3772** and by e-mail **info@soundoptions.ca**

3. How and when does the patient get their treatment?

Once the treatment is ordered and the patient has made a payment in the clinic, we design the customized sound therapy using our software. The completed treatment is uploaded or loaded onto CDs (patient's choice). The link to the music or CDs are provided to the clinic, and the clinic dispenses either option to the patient.

When the order is placed, the treatment requires 24-48 hours to be designed and uploaded or shipped on CDs.

4. How should a patient use this sound therapy?

The patient will listen to the sound therapy on their own music-playing device. We recommend that the patient listens via headphones that are of medium quality or better. It is important that they listen at a comfortable listening level, since having the volume too high could damage their hearing or possibly aggravate their tinnitus.

We recommend listening for a total of 1.5 to 2 hours a day; listening can be broken up into 30-minute blocks. Patients can listen while doing other things, as long as the activities are not loud (such as watching television).

5. How long will it take?

Typically, tinnitus sufferers will report benefits within 3 to 6 months. While this is a commitment that requires patience, the time required is still less than other tinnitus therapy approaches.

6. What kind of music do you use?

We currently design the treatment inside of classical music. Classical music is the most acoustically rich, and provides more stimulation than other types of music. Because classical music can also be relaxing, it helps the patient use the treatment regularly. The limbic system (important for emotion processing) is involved in tinnitus, and classical music can provide benefits by engaging this system in a positive way.

7. Are there any side effects?

When a person listens to music through headphones, it is very important that they listen at comfortable sound level (i.e., not at a high volume level) and not fixate on their tinnitus too much. This is true for any music, not just a sound therapy.

With some sound therapies, patients have reported occasional increases in their tinnitus. In the literature, these seem to be temporary, however, we always caution patients to take care if they experience anything like this, and to speak to their healthcare professional if it continues. In the event this does happen with our treatment, we would recommend that the user stop using the treatment for a period of 10 days, and then try again with a softer listening volume.

Common Questions - Tinnitus Sufferers

1. Will my tinnitus go away completely?

No treatment guaranteed to completely eliminate tinnitus exists right now. What we can tell you is that for some, their tinnitus did seem to go away or it required a lot of focus to notice. In general, we aim to reduce the tinnitus or to make it more manageable as you continue to listen to the sound therapy. The reduction will vary from person to person and how long they listen, but for severe tinnitus sufferers we have seen on average, a 40-50% reduction in tinnitus.

2. What kinds of headphones do I need?

Most headphones specify their frequency response (i.e., what is the range of frequencies they can produce), and we prefer those with a top range of at least 18 kHz (18,000 Hz), but at minimum 16 kHz (16,000 Hz). This is usually specified on the packaging or online under “details” or “specifications”. People using our sound therapy have used all types of headphones (in-ear, ear buds, around the ear, over the ear) with benefits. **Never listen on headphones when your safety is affected** (such as while driving or being in a situation when you need to hear your environment).

3. What volume should I set my device to?

For our sound therapy, the key is to listen at a comfortable sound level. If you begin to listen and find it to be too loud or bothersome, you should reduce the volume. The idea is not to set the music so loud that it immediately masks out your tinnitus. It is always important to protect your hearing first and foremost by listening at a comfortable volume.

4. What if I have poor hearing in one ear?

In general, you should listen to the music at a level that is comfortable overall. At the level of the auditory brain, we receive information from both ears. Therefore, even if you can only hear the music through one ear (for example, the left one), the brain retraining that would occur over time, should still happen. The issue with having the volume up too high, even if it sounds “okay” for one ear is that loud volumes would be counterproductive (even more so for your better ear).

5. How should I listen each day?

We recommend listening for at least 1.5 to 2 hours per day in total (so you can break it down into multiple sessions as long as it totals to at least 1.5 to 2 hours per day). The order in which you listen to the tracks or even repeating particular tracks does not matter. You can listen when it is convenient for you, but the key recommendation is that it should be the main sound coming in, which means you should not listen in loud environments, such as while watching TV.

6. How are you different from “notched” sound therapies?

In a notched sound therapy, the frequencies around your tinnitus pitch/frequency are taken out of the music. The theory is that this way, your brain will not focus as much on your tinnitus pitch. This concept is based on a research paper out of Germany. However, in that paper, the sound therapy was intended for a particular type of tinnitus (tonal) within a certain pitch range.

Our software incorporates a computational model of the hearing brain that allows the software to predict how a person's tinnitus (tonal, ringing or hissing) may have developed, and how music can be altered to reduce their tinnitus. The way we alter music is not simply “notching” as there is more that can be done. In addition, unlike notching therapies, we also take into account a person's hearing. Our clinical study (done at McMaster University) compared our customized music to regular music and we found that while those listening to regular music saw no meaningful benefits, those listening to music with our embedded sound therapy saw **benefits within 3-4 months**; with additional benefits over 12 months.

MORE ANSWERS TO YOUR QUESTIONS: www.soundoptions.ca/faq

www.soundoptions.ca

info@soundoptions.ca

TOLL FREE: 1-866-688-3772