

## 7.9 Hearing Loss and Hearing Aids

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Ear damage generally occurs as a function of age; hearing loss can start as early as age 40 and by age 70, most people have lost some hearing. Hearing loss can occur from over-exposure to loud sounds and can also be caused by infections and other pathological causes such as diabetes. The person may lose hearing in the low frequency or high frequency range. This is often accompanied by tinnitus (ringing sound in the ear). Those who lose hearing in the low frequency range tend to hear a low, roaring or throbbing tinnitus, and those who lose hearing in the high frequency range tend to hear a high pitched whine. Contrary to numerous advertisements, there is no known cure or effective treatments for either hearing loss or tinnitus.

A damaged ear is more easily damaged than a healthy ear. Thus, those with hearing loss are painfully sensitive to loud sounds -- even moderately loud sounds that do not bother normal people can be painfully loud because they can cause further damage and damage generally causes pain. Therefore, if there is a hearing impaired person in the room, don't make the mistake of turning up the music thinking that they will hear it better. That is why hearing aid technology is so difficult -- you can't simply amplify all sounds. Soft sounds must be amplified but loud sounds must be attenuated, a process called "compression" in the hearing aid industry. Compressed sounds, especially music, sound terrible to most people so that patients with even the most expensive hearing aids costing over \$10,000.00 do not wear them unless necessary. Those with new hearing aids must go through a lengthy period of gradual acclimation to the compression. The audiologist slowly increases the compression over a period of weeks or months. Patients with hearing aids wear them in order to understand conversations, not for music which generally sounds better without hearing aids unless it is too loud or too soft.

The first thing that happens when hearing is impaired is that conversations become difficult to understand. The easiest and most common reaction to this is to stop communicating. Lack of communications will quickly cause the "communications part" of the brain to atrophy, which is the main reason for wearing hearing aids, to restore communications and delay the brain atrophy as much as possible. By the time a person needs a hearing aid, the brain usually has atrophied significantly so that the amplified background noises that are normally soft can flood the brain causing brain fatigue. This is very bothersome because the background noise bombarding the brain carries no useful information to the over-worked brain, giving the user another reason

for not wearing it. Clearly, today's hearing aids are not good solutions. For those with sufficiently severe hearing loss, cochlea implants appear to be a viable solution.

There is no method for diagnosing tinnitus except from the comments of the patient. For tests and treatments you need to see an ENT specialist (Ear Nose Throat). For non-pathological cases, ear damage is generally caused by exposure to loud sounds. Yet a few people exposed to very loud sounds, such as pianists who play every day for hours on concert grands, piano tuners who routinely use "pounding" during tuning, or members of rock bands, may not suffer hearing loss. On the other hand, some, who are exposed to less sound, can lose their hearing, especially with age. Therefore, there is a wide difference in susceptibility to hearing loss. However, there is a strong tendency for those exposed to louder sounds to suffer more hearing loss and tinnitus. It is likely that hearing loss by pianists and piano tuners (as well as rock band members, etc., and people who routinely listen to very loud music) is much more widespread than is generally reported; thus the rest of this article will use pianists as examples for discussion.

Tinnitus is present in essentially 100% of people 100% of the time, but is so soft in normal people that it cannot be heard unless the person is in a soundproofed room; that is, if you go into a well enough sound-proofed room, everybody will hear a tinnitus. It may be caused by spontaneous firing of the hearing nerves in the absence of sufficient stimulus. That is, the human hearing mechanism effectively "turns up the amplification" when there is no sound. There are many causes of tinnitus, and some even originate in the brain. Tinnitus is almost always an indication of the onset of hearing loss.

For those who do not have audible tinnitus, there is probably no need to avoid loud music, within reasonable limits. Thus practicing the piano at any loudness should be harmless up to about age 25. Those who already have tinnitus should avoid exposure to loud piano. However, tinnitus usually "sneaks up" on you, so that the onset of tinnitus often goes unnoticed until it is too late. Therefore, everybody should receive tinnitus education and wear ear protection after age 40 during piano practice. Ear protection is an abhorrent idea to most pianists but when you consider the consequences, it is definitely worthwhile. Before wearing protection, do everything possible to reduce sound intensity, such as soundproofing the room (adding carpets to hard floors, curtains to hard walls, etc.), voicing the hammers, and generally practicing softly (even loud passages -- which is a good idea even without possibility of ear damage).

Ear protectors (noise canceling) are readily available from hardware stores because many workers using construction or yard equipment need such protection. For pianists, an inexpensive unit or just headphones will suffice because you need to hear some music. Commercial noise canceling protectors completely surround the ear and provide a better sound barrier. Since protectors available today are not designed for pianists, they don't have a flat frequency response; that is, the sound of the piano is altered. However, the human ear is very good at adapting to different types of sound and you can get used to the new sound very quickly. The piano sound will also be quite different when you take the protection off (as you will need to do once in a while to see what the REAL sound is like). These different sounds can be quite educational for teaching us how much the brain influences what sounds you hear or don't hear and how different persons will interpret the same sounds. It is worthwhile to try ear protection just to experience these different sounds. For example, you will realize that the piano makes many strange (mechanical) sounds you never noticed before! The differences in sound are so startling and complex that they cannot be expressed in words. For lower quality pianos, ear protection will result in sound simulating a higher quality instrument because the undesirable high harmonics and extraneous sounds are filtered out!

The brain automatically processes any incoming data, whether you want it to or not. This is, of course, part of what music is -- it is the brain's interpretation of incoming sounds, and most of our reaction to music is automatic. Thus when you wear ear protection, much of this stimulus disappears, and a large amount of the brain's processing power is freed to do other jobs. In particular, you now have more resources to apply to your piano practice. Thus you may find that progress is faster when wearing ear protection! In the near future, most piano students will probably wear ear protection (or turn the volume down for digital pianos), just as many athletes and construction workers use helmets today. It doesn't make any sense for us to spend the last 30 or more years of our lives without hearing -- a most important lesson Beethoven taught us.

How does piano sound damage the ear? Clearly, loud sound containing many notes should be most damaging. Thus it is probably not an accident that Beethoven became prematurely deaf. This also cautions us to practice his music with ear damage in mind. The specific type of piano is also important. Most uprights that do not produce sufficient sound are probably least damaging. Large grands that transfer energy efficiently into the strings with long sustain probably do not cause as much

damage as medium quality pianos in which a large amount of energy is imparted into the initial, instantaneous bang associated with the hammer striking the strings. Although much of this damaging sound energy may not be in the audible range of the ear, we can detect it as an unpleasant or harsh sound. Thus the medium size grands (about 6 ft) may be most damaging. In this regard, the condition of the hammer is important, since a worn hammer can produce a much louder initial bang than a properly voiced hammer. This is why worn hammers cause more string breakage than new or well voiced hammers. With old, hardened hammers, probably most pianos can cause ear damage. Thus proper voicing of the hammer may be much more important than many people realize, for pianissimo, playing musically, technical development, and protecting the ear. If you have to close the lid of a grand in order to play softly, or to reduce the sound to a pleasant level, the hammers probably need voicing.

Some of the loudest sounds are produced by those ear phones used to listen to music. Parents should warn their youngsters not to keep turning up the volume, especially if they subscribe to the culture that plays loud music. Some youngsters will fall asleep with their ear phones blasting; this can be very damaging because the damage is cumulative. It is a bad idea to give gadgets with ear phones to youngsters -- postpone it as long as possible. However, sooner or later, they will end up with one; in that case, warn them before they suffer ear damage.

Except for some special cases of tinnitus (especially those in which you can alter the sound by moving your jaws, etc.), there is no cure yet. Large doses of aspirin can cause tinnitus; in that case, stopping its use can sometimes reverse the damage. Small amounts of aspirin taken for cardiac purposes (81mg) apparently do not cause tinnitus, and there are some claims in the literature that these small amounts may delay the onset of tinnitus. Loud tinnitus can be extremely debilitating because it cannot be changed and is present all the time, and it only increases with time. Many sufferers have been driven to thoughts of suicide. Although there is no cure, there are remedies, and all indications are that eventually, we should be able to find a cure. There are hearing aids that reduce our perception of tinnitus, for example, by supplying sufficient background sound so that the tinnitus is masked, it causes the brain to turn down its automatic gain control (amplification), or the person is distracted from the tinnitus. Because the brain automatically turns up the amplification when there is no sound, absolute quietness can cause the tinnitus to become annoyingly loud. On the other hand, amplified background sounds from daily activities can drive the brain into extreme fatigue because the brain processes

every auditory input instantly and automatically in order to protect against sudden surprises such as car accidents or an attacking enemy.. Even the best hearing aids amplify such sounds which can be debilitation to the user.

One approach to treating tinnitus is to train the brain to ignore the tinnitus. The brain is amazingly trainable, and part of the reason why tinnitus causes suffering is the inappropriate brain response of the person. The brain has the ability to either concentrate on the sound, thereby driving you crazy, or to ignore it, in which case you won't hear it unless you are reminded of it. Thus the treatment starts with teaching the patient that others have succeeded in living with it with minimal discomfort. Then the patient receives ear training in such a way as to be able to ignore the tinnitus. Fortunately, the brain is quite adept at learning to ignore a constant sound.

If you read enough stories about tinnitus suffers and hearing loss, you will probably follow the advice to wear ear protection after age 40 when practicing the piano, at least when practicing loud passages for long periods of time. At the first hint of tinnitus, it is imperative that you start ear protection procedures because once the tinnitus starts, ear deterioration can proceed rapidly with exposure to loud sounds, with significant deterioration every year. Use of a digital piano and turning the volume down is one solution. Look for an ENT specialist immediately, especially one experienced in tinnitus treatments. Ear protection applies to other members of the household exposed to loud piano practice; therefore, if at all possible, isolate the piano room acoustically from the rest of the house. Most quality (glass) doors will be sufficient. There are a few herbs and "natural" medications that claim effectiveness against tinnitus. These do not work, and the ones that seem to benefit some people have dangerous side effects.

**Conclusions:** As soon as you hear tinnitus, you should avoid loud sounds and start wearing ear protection in loud environments. Loud sounds damage deteriorating ears more readily than healthy ears because they are already weakened by damage like a cracked glass. Moderately loud sounds that are harmless to normal people can be painfully loud to those with hearing loss. Hearing aids must not only amplify soft sounds, but must also attenuate loud ones, a process called compression. Hearing aids are needed to help people communicate with each other and to prevent brain atrophy from lack of auditory stimulation (deaf babies will grow up retarded unless proper stimulation is provided). Hearing aids are not as effective solutions as one might imagine because of compression and require extended periods of ear training for general acceptance by gradually increasing the compression. Compressed sounds are so different from normal sounds that most people with hearing loss prefer not to use hearing aids. Another problem is amplified background noise that can strain the automatic brain responses to sound inputs. Therefore, make sure that you can return the hearing aid and get a full refund before purchasing one.