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Sound sources contributing to the sound pressure in the ear canal

News from Audiological Research and Communication

Introduction

When using a hearing aid, it is clear that most of the sound the hearing aid user will hear comes from the hearing aid itself. When the amplification of the hearing aid is changed, we expect to be able to hear the same amount of change in the sound of the hearing aid in use.

But why is this not always the case? One reason may be that the sound pressure level is below the user's hearing threshold. Another may be that the sound from the hearing aid is not the only sound source in the ear canal. Figure 1 shows potential sound sources contributing to the sound pressure in the ear canal.

The three potential sound sources

In addition to the sound coming from the hearing aid, some sound enters the ear directly through a vent (ventilation channel) or leakages around the earmould. Another sound source is when the user of the hearing aid is talking or eating. In this case sound enters the ear canal directly through tissue and bones. Put simply, two sound sources originate inside the ear canal itself (the sound from the hearing aid and the bone/tissue conducted sound) and one sound source originates from outside of the ear canal.

Sound from the hearing aid

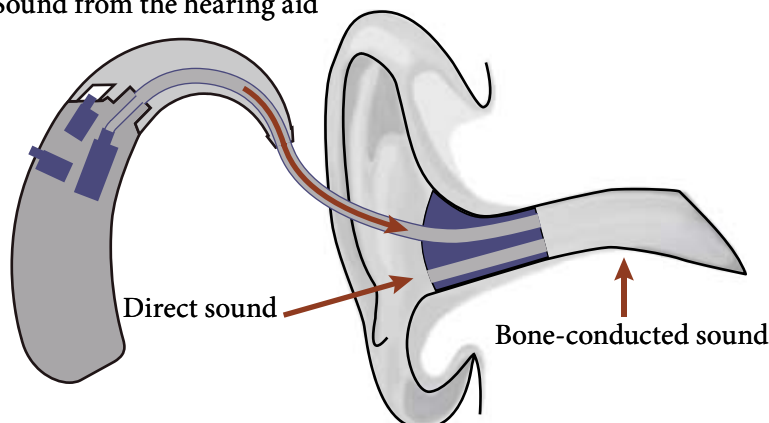


Figure 1: Three potential sound sources present in the ear canal.

The only sound source the hearing aid directly controls is the sound from the hearing aid. The sound level produced by the hearing aid is controlled by the hearing aid gain. It is also influenced by the mechanical design of the earmould and the ear canal. Factors such as vent dimensions should therefore be examined to be able to set the appropriate gain in the hearing aid for the individual user.

Direct sound can only be controlled by changing the earmould design or hearing aid fit in the ear canal. Another sound source that depends on the mechanical design, i.e. vents, is bone-conducted sound, which is the source responsible for the occlusion effect.

Because of the three different sound origins, the effect of a vent on each of the sound sources will also differ. In the figure below, you can see the hearing aid sound and the direct sound as they are when you add a vent of different sizes (diameter) in the earmould. The graphs show that the low frequency content of the direct sound is increased with increasing vent size, whereas the low frequency content of the hearing aid sound decreases with increasing vent size.

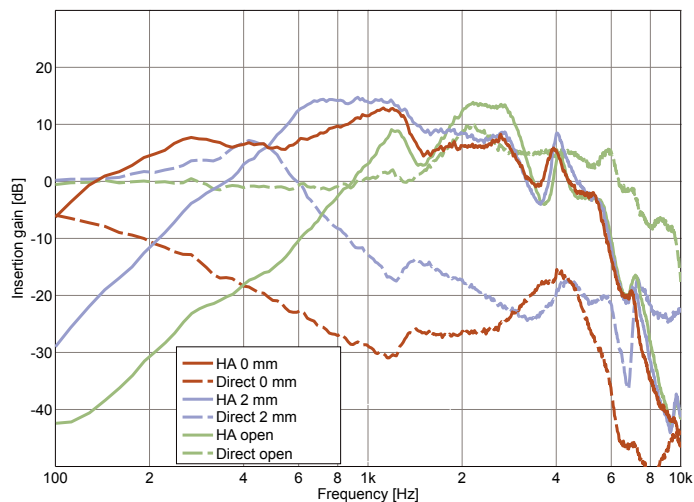


Figure 2: Frequency spectrum of direct sound entering the ear canal through the vent and the sound originating from the hearing aid as a function of the diameter of the vent.

Summary

The effect of the vent diameter on the sound pressure level in the ear canal depends on the origin of the sound. The hearing aid sound, direct sound and bone-conducted sound are influenced by the mechanical design of the earmould and the ear canal. Only the hearing aid sound is controlled by the gain in the hearing aid.

In most situations, the three sound sources will be mixed in the ear canal. Read more about this topic in the bulletins “The vent effect - an introduction” and “Mixing sound sources in the ear canal”.