

## **Digital Hearing Aids & Open Fittings: a worthwhile combination?**

Every hearing aid manufacturer and hearing care dispenser strives to be 'open' to the problems of hearing aid users. However, a common initial complaint among hearing aid users stems from the new sensation they encounter because their ears are now feeling 'closed'. They may not know the word "occlusion", but they can verbalize the effect.

This article discusses the challenges and potential benefits of open fittings with digital instruments – with particular focus on earmoulds. We will discuss the range of mechanical connections of these systems to the ear, including both ITE shells and BTE earmoulds.

### **Occlusion effects - and solutions**

While hearing aids offer many benefits, occlusion can be a source of immediate and even lasting annoyance. This can range from the perceived – such as the sound of one's own voice or a sensation of blockage in the ear, to the physical - such as itching and skin irritation. The loudness of sounds generated when chewing or swallowing can also be a problem. Any of these can result in rejected instruments.

In order to overcome problems with occlusion, experienced dispensers have used the 'open fitting' strategy, which attempts to minimize ear canal blockage. By rearranging the components into the helix of an ITE instrument, the signal can then be transmitted through a small tip into the open ear canal.

In BTE instruments the earmould was traditionally used to seal the amplified signal in the ear. Dispensers looking to keep the ear canal as open as possible were quick to realize that the earmould could simply be used as a 'tube holder'. Today, several cosmetically attractive earmould solutions are now available.

### **Users recognize the benefits**

Hearing aid users who have experienced the change to open fittings express their excitement about the benefits offered: no 'stuffy' pressure in the ear, no skin irritation. The sound of one's own voice - instead of being intrusive - becomes more natural, and music becomes more

enjoyable to listen to. In quiet situations users may even report being less aware of their hearing aids, as the instruments disturb them far less than before.

### **Open fittings and feedback**

But as open fittings in practice can be rather problematic, they are rarely used. One of the main difficulties encountered is feedback. In fact, many dispensers have ceased working with large vents because of it. The vented fitting is generally believed to be the primary cause, but this is not always the case. The real culprit may actually be the instrument itself.

By virtue of their internal construction, some hearing aids are produced in a way that they function close to their threshold of feedback. Even the slightest alteration to the electro-acoustical construction can cause internal or external feedback. If hearing aids have this tendency, then the earmould is used to 'plug up' the ear to eliminate this additional risk.

Audiologically oriented engineers will provide for the inclusion of a vent when looking at the overall control of feedback. Producing a 'feedback-free' instrument requires considerable effort, and so the more technically oriented developers may choose to redefine the fitting by recommending closed earmoulds. Against the advice of experienced hearing aid users and dispensers, more and more manufacturers are now suggesting closed fittings in an attempt to eliminate the whistling. This approach may overlook the actual need of the user, who expects a natural hearing experience.

### **Balancing the Low Frequencies**

If the earmould is opened, the low frequency energy tends to dissipate, resulting in a loss of certain low frequency elements. This is normally accepted without question, and is in fact acceptable when there is normal hearing in the low frequency region. If the volume between eardrum and mould is very small, very little acoustic energy is required to transmit low frequency sounds to the ear. If the space is larger – as in an open fitting - the prescribed gain of the instrument then becomes insufficient to transmit the low frequency sounds that may be required for optimal speech intelligibility. Since these vowel-type sounds require considerable energy to amplify, many instruments can only reproduce them with a closed earmould.

The traditional opinion has often been that a closed earmould is essential to avoid a sensation of 'thin' sound - especially for more severe losses. The question here is not 'how much gain can

you produce?’ but rather ‘how effectively fitted is the receiver system for this amount of gain?’ Since the trend is to manufacture the smallest instruments possible, very small receivers are required. They are often so small that they are only effective at the coupler, and when connected to the instrument with the closed mould. If an open fitting is used, the instrument suddenly seems too soft. To avoid this, an amplifier system with sufficient power reserves must be used.

### **Digital Processing Time**

Some engineers may claim that the benefits of digital technology can only be optimally achieved via closed fittings. Must this be accepted? As suggested earlier in this article, a digital feedback cancellation system should be effective, even when combined with open venting. But there are other issues to consider as well.

One of these is that digital instruments do not work in absolute ‘real time’. Digital processing takes time to work on the signal. If this period is very short, the user will hardly notice it. If the time lag is longer, however, the sound of the user’s own voice becomes irritating. In the case of binaural fittings, it can even lead to dizziness. An echo is not uncommon when the signal is initially heard through the vent before being heard through the hearing aid itself. This time difference is not extremely obvious, but the user cannot fail to notice the effect caused by the minimal delay.

This echo-sensation is another reason why some manufacturers may recommend closing the earmould. If the signal is only heard through the instrument rather than through the vent as well, the echo-effect is eradicated. However, the dizziness is not eliminated. This can only be achieved by working on the microchip to shorten the calculation time. An open fitting will then reveal whether the processing time is actually short enough.

### **Noise reduction strategies**

Noise reduction is another argument against open fitting. Naturally, from the viewpoint of an engineer, it is easier to reduce noise when the ear is blocked by an earmould. And the tighter the fit is, the better. Subsequently, very simple measures can be taken - such as the reduction of low frequencies – to accomplish further reduction of noise. But this approach fails to take into account the fact that hearing aid users do not live their lives in constantly noisy surroundings.

They want to be able to enjoy natural sounds from the world around them all the time, and this is best achieved through an open fitting.

An open fitting can therefore also be a measure of the quality of digital instruments - instruments which can be prescribed with large venting, becoming possible through the use of effective feedback cancellation and noise reduction systems. Speech understanding has to be achieved through the implementation of the algorithms on the chip, not through the elimination of noise via the earmould.

### **Meeting User Expectations**

Hearing aid users have clear expectations of advanced digital instruments. Users expect a natural listening experience. Certainly they don't expect side effects like occlusion. In quiet situations they don't want to be disturbed, and they want to be able to hear well when there is background noise. Using open fittings will satisfy the first three points. Improved speech understanding is determined by the quality of the signal processing.

Development in the field of digital hearing instruments is progressing rapidly. It should soon be possible for dispensers to realise a longstanding dream and be able to offer almost everyone the benefits of open fitting. Then they can really say, "I have open ears for you!"