

# ConnectClip: A Guide to Better Communication

## ABSTRACT

The lives of individuals with hearing loss have changed significantly over the past ten years. Contributing to this change is the development of better hearing device technology, including the introduction of accessories with wireless connectivity. Individuals with hearing loss now have more access to technologies and sound experiences which those with typical hearing enjoy. Research and clinical findings have shown that for people who wear hearing devices, these accessories enhance their communication. Benefits include improvements in hearing their own voice, improved access to speech while driving and walking, and enhanced hearing while using the phone.

ConnectClip is Oticon's newest hearing accessory designed to help optimize everyday communication activities. When paired with any of the Opn family of hearing aids, ConnectClip gives people with hearing loss a high-quality audio experience. This experience includes "hands free" calling with your smartphone, streaming audio and music, a remote control for your hearing aid, and a remote microphone to improve distance and noise hearing.

In this paper, we discuss the design and functionality of the ConnectClip, its applications, and its benefits for individuals with hearing loss. Special attention will be given to the ConnectClip as a remote microphone system (RMS).

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### **Wireless Technology is Changing the Lives of those with Hearing Loss**

We live in an era where we have witnessed the development of wireless and portable technologies that allow us to connect globally. These hearing advancements essentially change our perception of the world and the way we communicate in it. Those with hearing loss now have access to sound experiences that people with typical hearing enjoy along with better options to manage complex listening environments. Attending business meetings, participating in conversations at a restaurant, and talking on a mobile phone are a reality with new hearing technologies.

One of these advancements—the availability of Bluetooth connectivity in hearing aids—is now considered an essential element for hearing devices. Benefits of this technology for individuals with hearing loss were documented in the research of Smith and Davis (2014). Their study looked at the effects and outcomes of using Bluetooth accessories for patients who wear hearing aids. While they noted that each patient had unique training requirements to use the Bluetooth accessories, participants all felt that these technologies enhanced their communication abilities. For example, quality of voice, improved access to speech while driving and walking, and hearing over the phone were all noted as areas of improvement.

Today Bluetooth connectivity is an essential part of a hearing device. The innovations and benefits of better hearing technology also have importance for children with hearing loss. This is because essential to a child's overall development is the accessibility to sound for word learning and language development (Tomblin, Walker, McCreery, Arenas, Harrison, & Moeller 2015).

### **Remote Microphone Systems: Still Relevant in Our Technological World?**

Remote microphone systems (RMS) are a technology that has successfully been used with individuals with hearing loss for over thirty years. The principle behind all RMS is essentially the same. By placing a body-worn microphone close to a speaker's mouth, their voice is transmitted to a receiver worn by a person with hearing loss. Because the acoustic signal is picked up by the microphone placed close to the speaker's mouth, a favourable signal-to-noise ratio is created. This helps to overcome the negative effects associated with background noise, reverberation, and distance. Research has shown background noise, reverberation and distance in elementary school classrooms interfere with verbal communication between the teacher and student. Inability for children in hearing their teacher impacts their ability to learn new concepts (Chisolm, Noe, McArdle, & Abrams, 2007; Bradley & Sato, 2008). The American Academy of Audiology (2008) has developed an evidence-based clinical practice guideline for the management of children and adults with hearing loss. As part of this guideline, they have endorsed the use of RMS as a solution to challenging listening environments.

Chisolm et al., (2007) investigated RMS and adults to explore its efficacy. They found that training and coaching on the use and care of the RMS was crucial for participants. Their research showed that the use of RMS was useful technology for most participants, particularly in complex listening environments where listening with the hearing aid alone was not optimal. Boothroyd (2004) also noted that use of RMS benefitted adults wearing hearing aids as it reduced the negative effects associated with distance and noise, and improved speech understanding.

### **Remote Microphone Systems for Children: Use at School and Home**

Today's classrooms are primarily auditory-verbal environments where the assumption is the teacher will lead the lesson using oral, spoken language, and that all students in the classroom can hear them. However, this may not be the case, particularly for those children with hearing loss. The classroom acoustics may interfere with the access to good speech understanding and impact learning. Research has shown that children need quieter conditions and better signal-to-noise ratios than adults to have good speech understanding (Bradley & Sato, 2008). Mental energy and listening effort are also much higher when poor acoustic conditions exist (Bess, Gustafson & Hornsby, 2014). Studies have shown that an inability to understand the teacher because of poor listening conditions directly impacts the learning of new concepts (Yang & Bradley, 2009; Leibold, Hillock-Dunn, Duncan, Roush, & Bess, 2013).

While there have been advancements in hearing technology such as sophisticated directional microphones and signal processing, the use of RMS with hearing devices continues to provide superior speech understanding compared to the use of a hearing device alone (Wolfe, Schafer, Heldner, Mulder, Ward, & Vincent, 2009). Hagen et al. (2004) completed a study whose aim was to measure the experiences of school-aged children with hearing loss and RMS, and their perspective on being in a classroom with and without acoustic treatments. They found that the use of RMS was critical to support the students and their good classroom listening. In addition, RMS also contributed to the student's learning and helped to reduce stress among both students and teachers (Hagen, Hemmer-Schanze, Huber & Meis, 2004). Benefits of RMS have also been documented for preschool children with hearing loss. In studies in the United States and the United Kingdom, educators reported that the use of RMS enhanced preschool-aged children's academic performance, speech and language development, behaviour, and attention (Nelson, Poole, & Munoz, 2013; Mulla & McCracken, 2014).

While the use of RMS and its applications has primarily focused on those environments where distance and background noise are most prevalent (e.g., school classrooms), there is a small body of research that has looked at use of RMS in home environments. Although the number of studies is small, results with RMS use at home have been encouraging. Parents and caregivers noted several positive outcomes for their children with hearing loss. This included improvements in overhearing, incidental learning, and clarity of speech, as well as an increased number of imitations (Flynn, Flynn, & Gregory, 2005; Mulla & McCracken, 2014). Benitez-Barrera and colleagues also investigated the impact of remote microphone use at home but looked at how it affected access to caregiver talk (Benitez-Barrera, Angley, & Tharpe, 2017). The results of their study found that when an RMS was worn by the parent or caregiver in the home, children with hearing loss had access to about 42% more talk of their parents or caregivers.

### **Oticon's Commitment to Sound Accessibility and Better Communication: ConnectClip**

Oticon has a deep-rooted history in the development of high-quality hearing technology that include RMS. This dedication to research and development has spanned over thirty years. The Oticon Amigo family of transmitters and receivers along with the Oticon Streamer and Connectline have been essential components in the better hearing of individuals with hearing loss. ConnectClip is Oticon's latest innovation designed to help optimize communication for those with hearing loss. ConnectClip uses the ground-breaking Velox chip for fast sound processing and is inspired by the technology of the OpenSound Navigator, enabling precise analysis of the sound environment. For better battery efficiency, ConnectClip uses Bluetooth Low Energy (BLE). ConnectClip is a solution that delivers a clear speech signal and complements the outstanding technology in the Oticon Opn family of hearing aids. However, what sets ConnectClip RMS apart from its competitors is its stylish sleek design. It is smaller and lighter than traditional RMS, and it is a cost-conscious solution.

Once ConnectClip is paired, the person with hearing loss is provided with a high-quality audio experience. Here, we will focus on four modes for hearing device users, and their own unique functionality. The multicolored LED lights on the top of ConnectClip provide a wide range of alerts and notifications, including which mode they are in (figure 1).



Figure 1

The first mode is ConnectClip as an interface for “hands free” phone calls with your Android or iPhone smartphone. It streams voice, music and other sounds wirelessly to both ears. The microphone on the ConnectClip picks up the voice of the person with hearing loss, providing a true “hands free” operation. The smartphone ring will be heard through the user’s hearing aids and may be answered using the multi-button on the ConnectClip. ConnectClip will also stream music from your smartphone in stereo.

In the second mode, ConnectClip can be connected to tablets and computers. Its Bluetooth connection allows connectivity to a wide variety of brands and levels of computing technology through its own Bluetooth or with the BT-D-800 USB dongle. Both options are excellent for using programs such as Skype or Lync.

In the third mode, ConnectClip can work as a remote control. This allows the user to adjust hearing device volume, change programs, and mute audio. This is done easily, discreetly, and with the press of one button.

The fourth mode is ConnectClip as an RMS. With the ConnectClip RMS, users may overcome the difficulty with distance listening and hearing in noise. The RMS will allow them to hear a speaker wearing the microphone up to 20 meters (65 feet) away, and like traditional RMS, ConnectClip can be used with Oticon hearing device users who are fit monaurally or binaurally. Volume of the ConnectClip RMS is controlled by the + and - buttons on the device or by using the Oticon ON App.

### Transparency Measures with Oticon ConnectClip Remote Microphone System

In 2008, the American Academy of Audiology released a clinical practice guideline for the use of RMS for children and adults with hearing loss. This document outlined considerations for candidacy, selection, fitting, and verification or transparency measures of these devices. As Eiten and Lewis (2010) noted, transparency measures for RMS and hearing aids are a crucial part of obtaining optimal amplification for those with hearing loss. This is because like hearing aids, RMS are technologically advanced pieces of equipment. The intent behind carrying out transparency measures with these combined systems is to confirm that the hearing aid is managing speech from the RMS as expected, and audibility and comfort are preserved for the individual. Volume or gain of the RMS can be adjusted to achieve an equal output for speech at the hearing aid microphone and the RMS. This allows for the balance of hearing the speaker with the RMS while still hearing yourself and others around you with your hearing aid (Eiten and Lewis, 2010).

Transparency measures with RMS can be completed two ways using your hearing aid verification system. The first method is using the 2cc coupler and running simulated measurements with recorded speech. In this setup, the patient does not need to be present for the test. The second method is using “On Ear” or “Real Ear” measures with the patient present and using recorded speech. For the ConnectClip, using 2 cc coupler measures are not applicable because the ConnectClip and its internal microphones were calibrated on the speaker’s chest to optimize sound quality and consider body baffle. Therefore, transparency must be measured using “On Ear” or “Real Ear” probe microphone measurements with the ConnectClip worn on the patient’s body.

### Procedure with Audioscan Verifit and Interacoustics Affinity

#### A) Preparation:

- Ensure that all acoustic parameters in the Genie2 software are selected to match with the patient's current hearing aid fitting (e.g., ear mold, venting, ear hook damping) (figure 2).



Figure 2

- Hearing aid microphone directionality should be set to "Pinna Omni" (figure 3)



Figure 3

- Calibrate Verifit or Affinity for "On Ear" real ear measures.
- Select type of hearing aid (BTE or Open Hearing aid where applicable).
- Prepare patient for On Ear measure with probe tube insertion and hearing aid with their ear mold or dome (figure 4).
- Patient is seated about 3 feet or 1 meter from the speaker.

#### B) On Ear Measures

- Run measurement: hearing aid alone, input with average speech (65 dB SPL).
- Pair Opn hearing aid with ConnectClip, select remote microphone (magenta led light). Attach the Connect Clip to the body, 6 to 8 inches or 15 to 20cm below the mouth.
- Place putty over Opn hearing aid microphone (figure 4).
- Run measurement: ConnectClip, input with average speech (65 dB SPL) (figure 5 and figure 6).
- If necessary, increase or decrease volume on the ConnectClip (+ and -) to achieve transparency between the two curves. (Figure 5: Green curve is hearing aid alone; yellow curve is hearing aid and ConnectClip remote microphone. Figure 6: Green curve is hearing aid alone; purple curve is hearing aid and ConnectClip remote microphone).

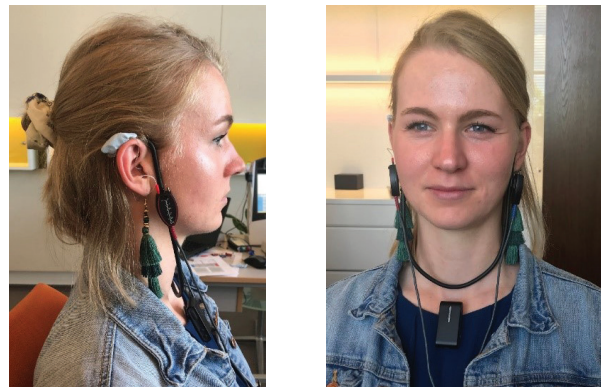


Figure 4

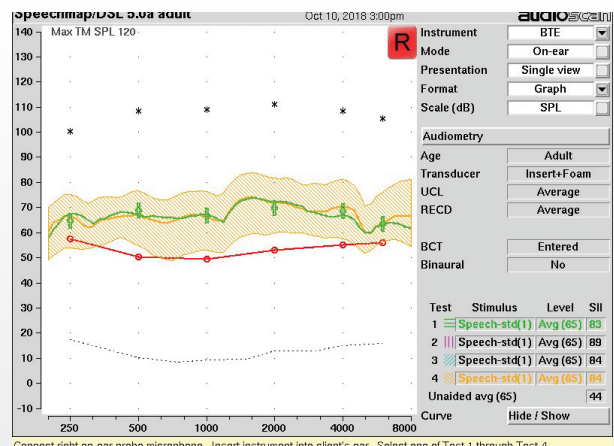


Figure 5

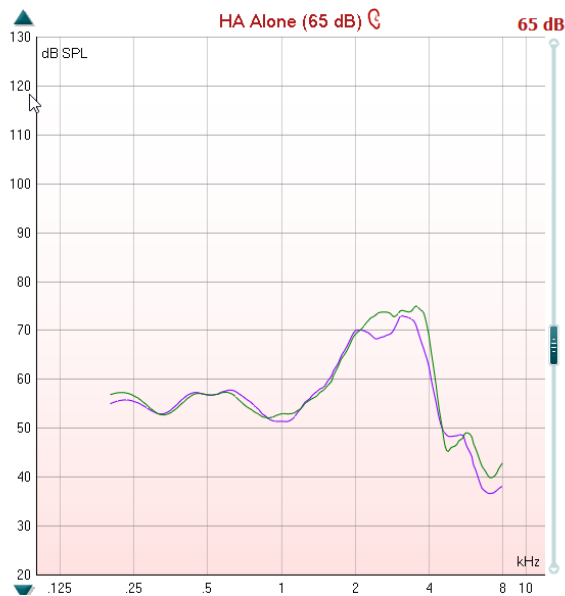


Figure 6

According to the American Academy of Audiology Clinical Practice Guidelines (2008) for RMS, transparency measures should consider frequencies at 750 Hz, 1000 Hz, and 2000 Hz. Transparency measures are only a starting point for RMS fittings. It is recommended that after following these transparency measures, validation or outcome measures are completed to fine tune the volume setting of the ConnectClip remote microphone to a patient's listening needs and preferences. Outcome measures in and outside the sound booth are critical to confirm the individual's functional hearing with the combined systems.

### Field Study

A field study was set up to evaluate the classroom listening experiences of tweens and teens who use Oticon Opn hearing aids and their classroom teachers who wore the ConnectClip. The aim of the field study was to evaluate the RMS component of ConnectClip. Twelve Canadian tweens and teens with hearing loss (five male and seven female), aged ten to fifteen, participated in this field trial, which lasted eight weeks. This field study used surveys with the tweens and teens and interviews with the teachers. Six classroom teachers wearing ConnectClip were interviewed and provided feedback to the school's educational audiologist or teacher of the deaf and hard of hearing.

Tween and teen participants answered thirty survey questions. The first fifteen survey questions related to their experiences with their current hearing aids and RMS. The second fifteen questions related to their experiences with Oticon Opn and ConnectClip RMS. Participants were asked to compare Opn and ConnectClip with their previous hearing aids and RMS. Sample questions included: If you do use Connect Clip microphone at school, what listening situations are important? Overall, how satisfied were you with the Connect Clip microphone? How did it compare with your old FM system?

Eight of the twelve students used the ConnectClip RMS. Four students were excluded as they did not use RMS at school. 100% of the participants using RMS, used it at school only. When asked about the most important application of their RMS, 100% reported that it was hearing the teacher. Survey results for questions pertaining to RMS were collapsed, and placed into categories of sound quality, design and comfort, and functionality (Figure 7).

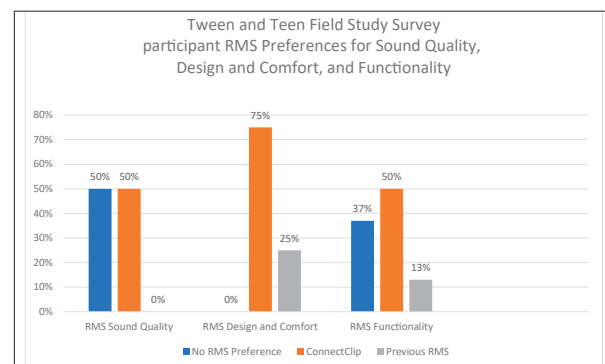


Figure 7

### Sound Quality

While 50% of participants had no preference, 50% of participants showed a preference for the sound quality of ConnectClip. Prior to answering the second half of the survey which dealt with ConnectClip, two students did report experiences of lower sound quality. In these cases, a follow up meeting with the teacher confirmed that the teacher had been wearing the ConnectClip RMS incorrectly: the ConnectClip had been placed on a very long lanyard that positioned the device well below their mouth. When the teacher was provided with the correct instruction on wearing the ConnectClip, and it was adjusted to the correct placement, concerns around sound quality ended. A grade eight student commented; "For me, ConnectClip is much better than my other FM system. It sounds great and there is no static."

### **Design and Comfort**

Classroom teachers who wore the ConnectClip RMS and provided feedback were very enthusiastic about the device. They commented on its stylish design and that compared to another RMS they had used, it was light-weight and very comfortable to wear. A grade six student stated; "My teacher really loves ConnectClip. She loves how light and small it is, and that it is not banging into kids as she moves around our class." Many of the tweens and teens in the field study who used ConnectClip at school also liked its size and design. Most (75%) noted that it was very discreet, compact, and easy to transport from classroom to classroom.

### **Functionality**

Last, we asked the tweens and teens to consider the functionality of their RMS. The tween and teen participants in this field study really appreciated the flexibility of the ConnectClip RMS. Survey comments highlighted the importance of the teachers' ability to adjust the volume of their voice with the ConnectClip RMS. 50% of the participants identified this as being very important, as some teachers spoke in a loud voice, while others spoke more quietly. For participants being able to customize the listening level of the teacher's voice was essential to all-day classroom listening. A grade six student commented; "It is really great to adjust the volume of the teacher's voice! It makes listening much more comfortable." Tween and teen participants were also very excited about the media streaming opportunities with the ConnectClip. They stated that they used the ConnectClip to stream sound from laptop computers in the classroom, and to listen to podcasts from their smartphone.

### **The ConnectClip Advantage**

Today's acoustic environments are constantly changing and becoming increasingly more complex. For those with hearing loss, access to technologies that can work with their hearing devices to address these challenging listening situations is crucial for good communication and social engagement. As a hearing technology leader, Oticon is dedicated to developing and offering a wide range of innovative hearing solutions and connectivity options to help improve the lives of people with hearing loss. ConnectClip represents another thoughtful, innovative, and state-of-the-art development by Oticon. When used with the Oticon Opn family of hearing aids, the stylish and sleek ConnectClip is a multi-functional accessory that eliminates the need for numerous add-ons. With OpenSound Navigator inspired technology and a Velox chip, individuals are provided with a superior listening experience, while seamless options for streaming, hands-free phone calls, remote control, and a remote microphone system are at the user's fingertips. Simply stated, with the ConnectClip by Oticon, we continue our philosophy of promoting sound accessibility and better communication for those with hearing loss.

### **Looking to the Future of Wireless Connectivity**

Millions of people with hearing loss rely on Oticon's dedication, innovations and collaborations that provide them the best opportunities to connect with their world of sound. As Einhorn (2017) stated, "To be a functioning citizen in the 21st century - to work effectively, to be a student, to travel, to enjoy modern performing arts and entertainment, even to attend a place of worship, it is essential to hear sound." That is why the next generation of hearing instrument accessories must be an extension of the person; an interface that is multifunctional, intuitive, and adaptive, customized to the individual's personal and professional world. Our goal, is clear - continue with amazing technological advances in hearing device technology and wireless connectivity to further reduce the gap between the listening experiences of those with hearing loss and those with typical hearing.

### ConnectClip: Twenty Frequently Asked Questions

1. What is the transmitting distance of the ConnectClip remote microphone?  
*20 metres or 65 feet.*
2. How long is the battery life?  
*Battery life when using the remote microphone is 8 hours. Battery life for other modes will vary on the type of streaming you are doing.*
3. Can I mute the ConnectClip remote microphone?  
*There is no mute, but the microphone may be muted by changing programs or by simply turning off the device.*
4. How should the ConnectClip remote microphone be worn?  
*It can be worn on the lapel of your clothing or on a lanyard. For optimal speech transmission, it should be 15 to 20 cm (6 to 8 inches) below the mouth.*
5. Can I verify the ConnectClip in my hearing aid test box?  
*Verification may be completed with your real ear measurement equipment.*
6. How long does it take to charge the ConnectClip? A quick one-hour charge will give you approximately 3 hours of use. A cycle of about 4 hours will fully charge the ConnectClip.
7. Can the ConnectClip remote microphone be used as a table microphone?  
*No, it is meant to be worn by the speaker.*
8. How many individuals can be paired to the ConnectClip?  
*Only one individual may be paired to each ConnectClip.*
9. Do I have to pair hearing aids to the ConnectClip every time I use it?  
*Pairing only needs to be completed one time.*
10. Are the hearing aid microphones active when using the ConnectClip remote microphone?  
*Yes. To allow the listener to hear the environment around them, the hearing aid microphones are active.*
11. What do the different LED lights mean on the ConnectClip?  
*Our smart LED lights let you know what mode you are in, the status of your battery, and when you have successfully paired the hearing aids to the ConnectClip. Refer to IFU or ConnectClip quick guide for more detail.*
12. What is the purpose of the buttons on the side of the ConnectClip?  
*The larger button functions to select a mode; the two smaller buttons adjust volume.*
13. Does the ConnectClip work with all Oticon hearing aids?  
*The ConnectClip works with the Opn family of hearing aids.*
14. Do I need to use Genie when setting up ConnectClip?  
*No—you do not need to do programming in Genie to use the ConnectClip.*
15. What version of Bluetooth does ConnectClip use?  
*The ConnectClip uses Bluetooth Low Energy (BLE) for better battery life.*
16. Does the ConnectClip work with all smartphones?  
*The ConnectClip works with iPhone and Android phones.*
17. Is it possible to stream audio or make a phone call or when ConnectClip is in remote microphone mode?  
*No, when using the RMS, there will be no connection to the mobile phone.*
18. Which computers can be used with the ConnectClip?  
*We recommend using a BT-D 800 USB dongle for the most stable connection with the ConnectClip.*
19. Can the battery in the ConnectClip be replaced?  
*Yes, the battery can be replaced by your Oticon service department.*
20. Will the ConnectClip hold its battery charge if not in use?  
*Yes, if it is fully charged, it will hold its charge for several months.*



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