Canadian Hearing Report

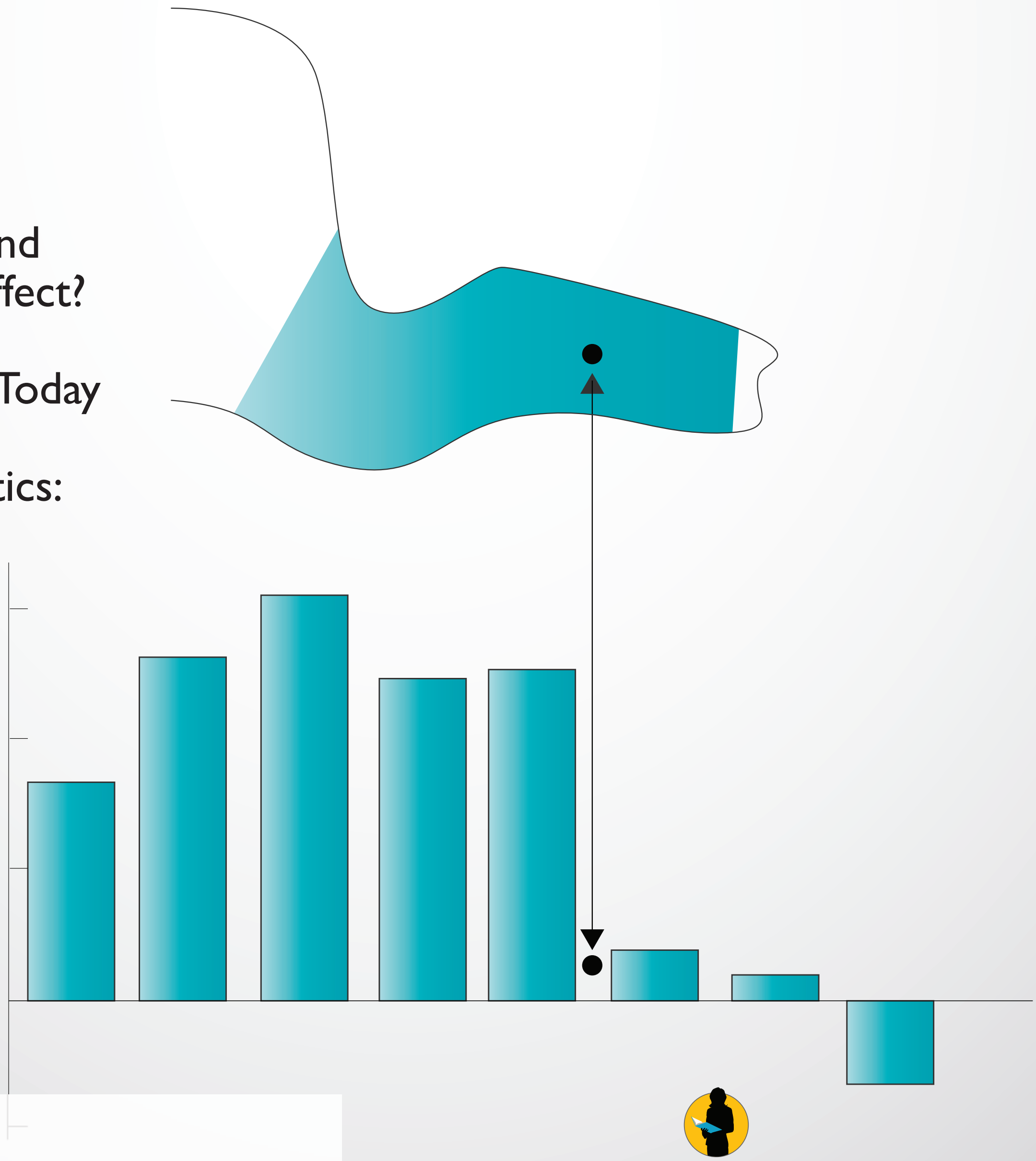
Revue canadienne d'audition

Vol. 9 No. 4
2014

How Near is the End of the Occlusion Effect?

Real Ear Measures Today

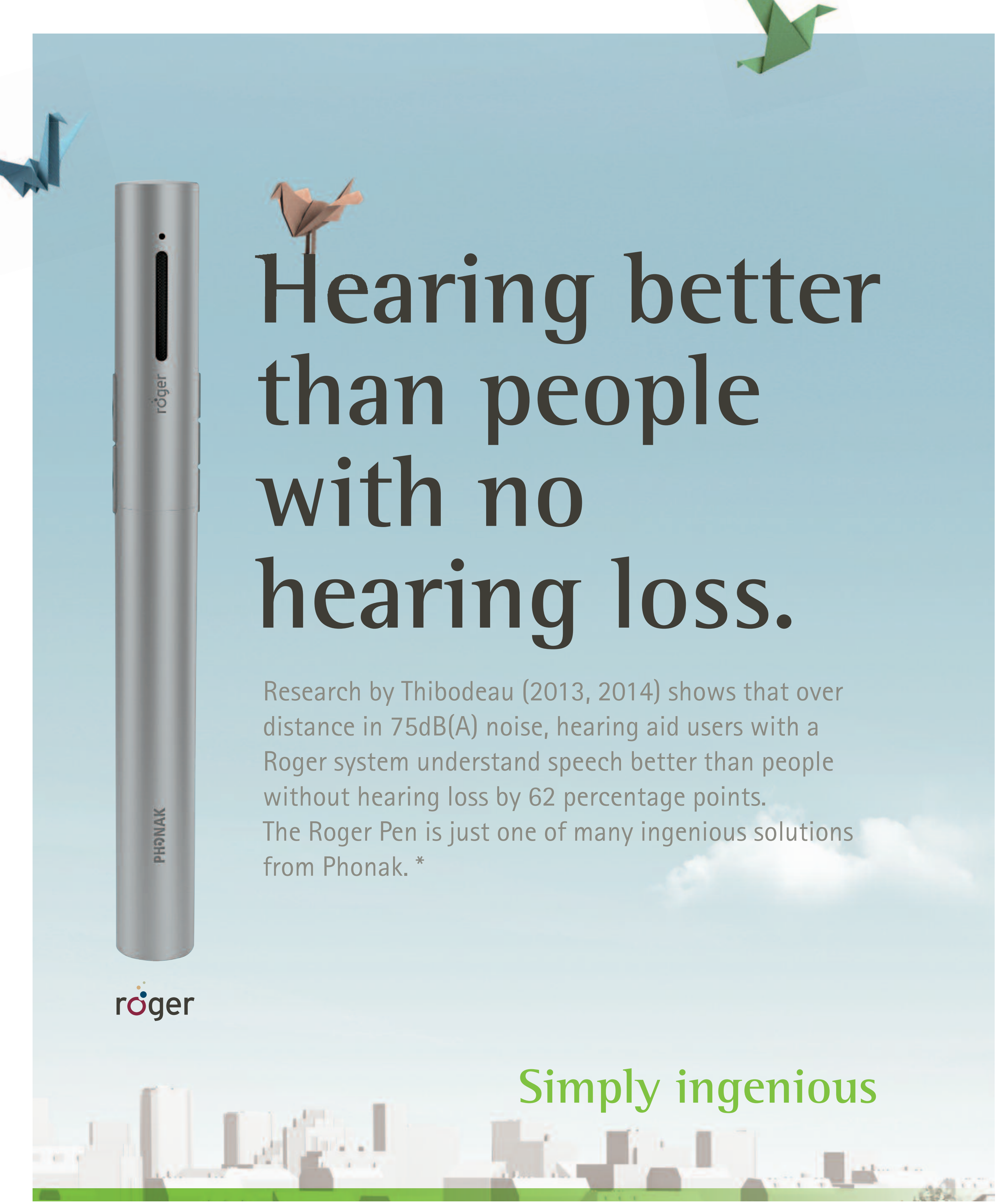
Vestibular Diagnostics: For All of Us



Peer Reviewed

Publications Agreement Number 40025049 | ISSN1718 1860

Published by
ANDREW JOHN
PUBLISHING INC.
andrewjohnpublishing.com


roger
PHONAK
Hearing better than people with no hearing loss.
Research by Thibodeau (2013, 2014) shows that over distance in 75dB(A) noise, hearing aid users with a Roger system understand speech better than people without hearing loss by 62 percentage points.
The Roger Pen is just one of many ingenious solutions from Phonak. *
roger
Simply ingenious

Introducing Canadian Hearing Report's New Editor-in-Chief Ted Venema

The audiologist and the hearing instrument practitioner (HIP) both serve hearing health care to the general public. In keeping with this fact, Canadian Hearing Report (CHR) will strive to reinforce the knowledge bases common to both of these hearing health care providers.

As we move toward the future, two things will become unique about CHR: (A) we will focus upon the issues in our disciplines that we have in common, and (B) we will re-examine common clinical encounters with a fresh approach. Each issue will address at least one thing we as clinicians might think that we know but then again, upon a closer look, we really don't know it as well as perhaps we should.

Isn't it great when someone can take a difficult concept and make it easier to digest and understand?

The audiologist and the hearing instrument practitioner (HIP) both serve to render hearing health care to the general public. *Canadian Hearing Report (CHR)* thus seeks to bolster and reinforce the knowledge bases common to both of these hearing health care providers. As we move toward the future, two things will become unique about CHR: (A) we will focus upon the issues in our disciplines that we have in common, and (B) through articles authored by leading authorities in hearing health sciences, we will re-examine our common clinical encounters with a fresh approach.

Each new issue *Canadian Hearing Report* will address at least one thing we as clinicians might think that we know but then again, upon a closer look, we really don't know it as well as perhaps we should. Isn't it great when someone can take a difficult concept and make it easier to digest and understand?

It is hoped that *CHR* will take on its own unique bent, by answering these kinds of questions; questions like: Why are our outer ears shaped *exactly* as they are? If the middle ear adds 30–35 dB to incoming sound pressure, then how can a conductive hearing loss be *greater* than this? If tympanometry measures SPL bouncing off the eardrum as a function of air pressure changing from positive to negative, then why does the Y axis read in terms of "compliance," and *not* in "amount of dB SPL bouncing off the eardrum?" Why do we *really* have acoustic reflexes? Does Carhart's Notch really represent SNHL at 2 kHz; why or not? Why does Meniere's disease present with a *rising* SNHL audiogram? Why does NIHL improve again at 8000 Hz? We could keep going, but we've got to keep at least a few surprises.

"Czech" it out! In this issue, we have several completely different articles, each quite catching from its very own corner. In a very readable article with historical references, Chester Pirzanski educates us about the common encounter of the occlusion effect (OE). The OE is something we all encounter in clinical practice, but can each of us verbally explain why it takes place? What's also interesting are the specifics he shows in the relationship between depth of hearing aid insertion and resultant degree of OE. Gael Hannan serves up a true slice of history by opening a booklet called *80 Years of Looking & Learning*. Options in Toronto for the Hard-of-Hearing (HoH) had their unique development in the 20s and 30s, but the punchline of her article has got to be the prayer of the HoH, something we should all read for ourselves.

From here we'll veer sharply south to Mark Caffrey's world of vestibular testing in the US, where he writes about the hesitance toward vestibular testing from the American audiological community. Vestibular testing has at times been an area of discussion amongst audiologists in Canada. I recall well doing vestibular testing in the clinic at Western Washington University where I began my own studies in audiology. To the best of my knowledge, vestibular testing is not a specific focus in Canadian audiology programs, at least it wasn't when I taught at Western in Ontario. Still, his article takes you for a ride, and makes for a really good read.

With his blog covering steps "one, two, three, solve!" Bob Martin from HearingHealthMatters.org weighs in with his own brand of Tennessee common sense. There's nothing like a systematic and logical approach to our clinical world where we spend a good part of our day "putting out fires."

I sincerely hope you find this issue of interest and relevance. One thing we'll always strive to avoid is being "a drag and a bore." Just for fun, say that phrase rapidly and repeatedly…

Ted Venema, Editor-in-Chief

Canadian Hearing Report 2014;9(3):3.

MAKE "LOOK, LISTEN, EVALUATE, AND SOLVE" YOUR STANDARD OPERATING PROCEDURE

By Bob Martin

Most patients have some problem or a concern about their hearing aids when they return to our office for a follow-up visit. Sometimes, we can quickly remediate their problem by unplugging a sound tube or changing a battery. Other times there is something in the fitting that needs adjusting or we can help the patient hear better by adjusting the technical aspects of the hearing aid.

Today I want to describe a basic protocol that I follow every time I see a returning patient. This protocol is: Look at everything carefully, listen to the aid, and make sure that the amplification is set at the proper level. Then, having evaluated the patient's ear, hearing aid, and hearing, study and solve the patient's problem. In simple language, these four steps are: look, listen, evaluate, and solve.

Now, suppose for a moment that you do not follow these four steps. You may be the kind of person who goes directly to the problem and attempts to "fix it." Or maybe you have a very social personality that places the importance of interpersonal relationships above professional issues. In either of these cases, you might tend to interact with patients without first looking in their ears and listening to their hearing aids.

In my opinion, this is a serious mistake. In the hearing aid business, we constantly see patients whose ear canals are impacted with debris and we find many hearing aids that are functioning poorly. Only a careful, systematic, comprehensive inspection of a patient's ears and hearing aids will ensure that we get to the root of the patient's problem.

ONE…

The first step in this protocol is to look in the ear with a fiber-optic otoscope. I also use the scope to look into the sound opening of the hearing aid and the opening to the microphone. Debris in these openings degrades the amplified sound.

TWO…

Step two is to use a listening scope and listen to the hearing aid. I then place the hearing aid in the test box and run a frequency response curve. By going through this sequence (listening to the hearing aid, evaluating it on a test box…) you train your ears. With practice, your own ears become your most valuable professional tool. I can quickly determine how properly or poorly a hearing aid is working by listening to it.

THREE…

The next item in this protocol is to evaluate the clarity and volume of the hearing aid's performance. This is part of the preceding step, only now you need to check what you find against the patient's audiogram. You also need to interact with the patient to make sure he or she is getting adequate amplification.

To evaluate the fitting you answer questions like these: Is the amplification adequate? Is the spectral balance correct, i.e. is there adequate gain in the lower frequencies as well as in the higher frequencies? Is the amplified sound distorted? Will the output regulators (output and automatic gain control settings) hold the amplification below the patient's "uncomfortable level"?

SOLVE!

Once you have gathered all this information, you are in a position to solve the patient's current problem. What's more, you have also gained a better understanding of this patient's long-term amplification needs, which helps you ensure that he or she will be a successful hearing aid wearer.

Reprinted with kind permission from hearinghealthmatters.org

Canadian Hearing Report 2014;9(4):7.

Canadian
Hearing Report
Revue canadienne d'audition
Vol. 9 No 4 • 2014

Canadian Hearing Report is published six times annually by Andrew John Publishing Inc. with offices at 115 King Street West, Dundas, On, Canada L9H 1V1.

We welcome editorial submissions but cannot assume responsibility or commitment for unsolicited material. Any editorial material, including photographs that are accepted from an unsolicited contributor, will become the property of Andrew John Publishing Inc.

FEEDBACK

We welcome your views and comments. Please send them to Andrew John Publishing Inc., 115 King Street West, Dundas, ON, Canada L9H 1V1.

INDIVIDUAL COPIES

Individual copies may be purchased for a price of $19.95 Canadian. Bulk orders may be purchased at a discounted price with a minimum order of 25 copies. Please contact Ms. Brenda Robinson at (905) 628-4309 or brobinson@andrewjohnpublishing.com for more information and specific pricing.

contents

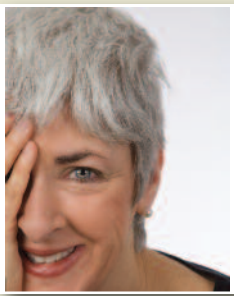
Follow us on Twitter @chr_info

Publications Agreement Number 40025049 • ISSN 1718 1860

Return undeliverable Canadian Addresses to:
Andrew John Publishing Inc. 115 King Street West,
Dundas, ON, Canada L9H 1V1

Being Hard of Hearing in 1921

By Gael Hannan
hannangd@gmail.com



About the Author
Gael Hannan is a writer, actor, and public speaker who grew up with a progressive hearing loss that is now severe-to-profound. She is a director on the national board of the Canadian Hard of Hearing Association (CHHA) and an advocate whose work includes speechreading instruction, hearing awareness, workshops for youth with hearing loss, and work on hearing access committees.

Gael is a sought-after speaker for her humorous and insightful performances about hearing loss. Unheard Voices and EarRage! are ground-breaking solo shows that illuminate the profound impact of hearing loss on a person's life and relationships, and which Gael has presented to appreciative audiences around Canada, the United States and New Zealand. A DVD/video version of Unheard Voices is now available. She has received several awards for her work, including the Consumer Advocacy Award from the Canadian Association of Speech Language Pathologists and Audiologists.

Never judge a book by its cover – even an inexpensive photocopied one – because what's inside might be jaw-dropping.

This week, sorting through 20 years' accumulation of hearing loss material, I was about to pitch out a spiral-bound booklet called *80 Years of Looking & Learning*. I opened it and was mesmerized. Compiled in 2001 by the early lip reading advocate Dorothy Scott, the mimeographed pages not only tell the story of the Toronto Hard of Hearing Club formed in 1921 – but they also give an amazing, humorous look at life with hearing loss over the past 100 years. Thank you to the existing members of the Toronto Hard of Hearing Club for sharing this written history.

Note: The following is taken directly from the booklet with only minor grammatical changes and notes. Some terminology may be considered politically incorrect by today's standards.

1921 – A small group in a then rather small Toronto got together to form the Toronto Lip Reading Club – the "First in the British Commonwealth".

Who started it? Why then? Who had hearing loss in 1921?

The Hard of Hearing populace then, as now, included those born with defective hearing or who developed a loss in infancy, but with impairment mild enough to enable the child to learn to communicate through speech and hearing.

[In addition], a couple of years before, the 'War to End All Wars" had dragged to its exhausted end. The lads had come home with their memories – of mud and pain and gas and the screams of dying comrades. Some had a constant reminder – they had to learn to live with Hearing Loss. Gunfire, wounds, shock, meningitis and ear infections had changed their lives forever.

Hearing loss was not confined to veterans. In the day before antibiotics, immunization and middle-ear surgical correction, those who suffered from partial deafness were often children and young adults. In the early years of the century, young Alec of Dundee developed scarlet fever. He did recover, but with ever-increasing deafness. In school, the top children sat at the front of the class. If your grades deteriorated, you were moved back and back until you sat with the failures in the rear, where poor confused Alec, who had confidently hoped for university, eventually found himself.

There were lots of Alecs in Toronto. There was no way of diagnosing partial deafness in early childhood until defective speech gave some clue. Even if you did find out that the problem was poor hearing, not mental incapacity, what could you do?

One option for children over 7 was the School for the Deaf and Dumb in Belleville [now Sir James Whitney School for the Deaf], founded in 1907, which ran a 9-month, no-holiday term designed to prepare the child for non-verbal workplace activities – printing, saddle-making, domestic service, etc. The brochure stated, "It is not desirable that parents come often (to visit) or remain long." But although it was a good school, at the forefront of deaf education, many deaf children were kept at home by their parents.

With the returning soldiers came new wives, often accompanied by 'unmarried sisters.' And so K. Grace Wadleigh came to Toronto. She was a trained Teacher of Lipreading and Education of the Deaf and little was known about her except that she was Terrific. The Toronto School Board of the time had no place for her in her chosen field, although she did later work with them. But that didn't stop Miss Wadleigh. She became the founding teacher of the Toronto Lip Reading Club, formed in February 1921.

The annual membership fee was $1.00; by making the annual fee very small it was hoped no one would be prevented from joining. Meetings were held at the YMCA Thursday evenings and Saturday afternoons with teachers Miss G. Wadleigh, (the "First Teacher Of Lip Reading To Adults In Canada"), Miss G. Tuller and Miss M. Faircloth, both teachers of the deaf. What kind of training would these ladies have had? Certainly they all had their teaching certificate and probably were hard of hearing. By 1923 there were 73 members and the annual fee had doubled to $2.00. "Silver teas" were held to raise money, whereby participants left donations in a strategically placed bowl.

By the 1930s, things were beginning to hum in the hearing field! Universities and teaching hospitals were setting up Deaf and Hearing research facilities. Although the 4A Phono-Audiometer was introduced in 1926 to screen hearing, findings were pretty subjective. Most testing was still the old *"Can you hear my watch?"*

The Hearing Eye was the "Official Publication of the Canadian Federation of Lipreading Organizations", formed in 1933. L.M. Montgomery, the author of Canada's beloved Anne of Green Gables, was a frequent contributor and in 1935 she gave a talk to the club. She stood on a wobbly platform with a lamp shining on her face so that it would be visible. *"She enunciated so clearly that lipreaders were well repaid.'* The same year, the Toronto Lip Reading Club was divided into three departments – Women, Men and Young People – and the first Theatre Amplifier was introduced in six movie theatres. This service involved sitting in a pew at the front using a telephone-like device. Only the boldest allowed themselves to be so helped – to be hard of hearing was still thought slightly shameful.

What a brilliant slice of hearing loss history! The booklet continues on with events through next 80 years, but you are probably more interested in hearing how things turned out for poor young Alec. Well, he studied course notes from a friend who went to engineering college, and he went on to build up a successful family business in custom engines. He also built himself a hearing aid from radio components. The microphone was in a lamp, the amplifier in a desk drawer and he interviewed clients leaning casually on his hand which held the receiver. Few realized that the man had disabilities, least of all himself.

The booklet ends with the ***Lipreader's Prayer:***
From Mouthers and Shouters
And Stiff Upper-Lippers
And people with pipes in their mouths,
Good Lord, deliver us.

Note: The above blog is reprinted with permission from HearingHealthMatters.org. Each week, Gael Hannan writes the Better Hearing Consumer, a widely-read blog about living with hearing loss.

Canadian Hearing Report 2014;9(4):8-9.

What's the Harm in a Little Fun?

By Cammie Kaulback, Manager of Hearing Services, Deaf & Hear Alberta

A few years ago my sister-in-law sent my son a birthday present in the mail. The rather large package turned out to be a toy weed-whacker. It was eerily similar to the one in my garage and from 10 paces it could have been mistaken for the real thing. Not only did it look like a real garden trimmer, but when you powered it up it made the same indisputable roar. So realistic was the sound that once you heard it you instinctively clamped your hands over your ears to protect your hearing.

The weed-whacker was sent by my sister-in-law partly as a joke and partly out of revenge. A few years earlier I had sent my nephew a shiny red fire truck with a siren that was also ear splitting. Like many parents we found the noisy toys annoying, but I don't think we understood how dangerous they were to our child's hearing health.

Every day, children experience sound in their environment. Normally, these sounds are at safe levels that don't damage their hearing. However, repeated and extended exposure to loud noise is one of the most common causes of noise-induced hearing loss. Parents need to realize that every time a child holds a loud toy to his ear he may be permanently damaging the delicate hair cells in the inner ear. The damage might not be noticeable right away, but over time our children's hearing is being impacted by a noisy world that also includes traffic noise, thundering sporting events and loud music from personal music players. Is it any wonder that it is now estimated that one in five children between the ages of 12 and 18 has some level of hearing loss?

The consequences of hearing loss can be devastating, but particularly for children. The Centers for Disease Control and Prevention report that even a small degree of hearing loss can affect a child's speech and language comprehension. Hearing Loss can also impact a child's classroom learning and social interaction with her peers.

In Canada, regulations under the Canadian Consumer Product Safety Act state that a toy "must not make or emit noise of more than 100 dB (equivalent to the noise of mowing your lawn with a gas-powered lawn mower) when measured at the distance that the toy would ordinarily be from the ear of the child who is using it." The obvious problem with this is that children don't always play with toys in their intended manner.

Young children, in particular, will often bring toys close to their face and ears as part of play. This means that the danger of noisy toys is even greater than the 100 decibel level implies.

A toy which exposes a child to 100 decibels when played at arm's length can expose her to 120 dB of sound when held to her ear. That's equivalent to the sound of a jet plane taking off. Back in 2006 the Canadian Association of Speech-Language Pathologists and Audiologists started to lobby members of parliament and Health Canada to lower the 100 decibel limit. They also created a public awareness campaign which highlighted the dangers of noisy toys to the hearing health of children. Their valiant efforts to move the needle of this issue raised awareness, but ultimately it did not change the government's 100 dB rules for manufacturers, importers or distributors of toys in Canada.

So where does that leave us in 2014? It means that parents, grandparents and caregivers have to be increasingly vigilant and educate themselves about the dangers of noisy toys and act accordingly. We need to recognize that Health Canada's guidelines as to which toys have safe noise levels do not take into account how toys are actually used in the hands of a child.

Parents, grandparents and caregivers need to rely on their own common sense to protect children's hearing. Here are some hints to help keep things safe:

1. Listen to a toy before you purchase it. If a toy sounds loud in the store, it will be loud at home.
2. Consider downloading a decibel meter app to your smart phone and get a reading on a toy before you head to the checkout. Reconsider anything that reads over 85 dB. (There are several good decibel apps out there, but I like Decibel Meter which you can download for free.)
3. Look for toys with volume controls and on/off switches.
4. Supervise your children when they are playing with a toy that emits sound and teach them how to do so safely. Teach them not to place the toy near their heads and ears.
5. Remove the batteries from a noisy toy.
6. If all else fails, get out the duct tape.

My son's infamous weed-whacker was tamed by affixing a piece of foam and some duct tape over the toy's speaker. It may not have looked pretty, but my do-it-yourself modification meant he could continue to play with the now much quieter toy.

Real Ear Measures Today: Do We Truly Follow Fitting Methods?

By Ted Venema, PhD

About the Author

Ted Venema taught at Conestoga College in Kitchener, Ontario, and was the founder and director of its program for hearing instrument specialists. He has a PhD in audiology from the University of Oklahoma. Ted frequently gives presentations on hearing, hearing loss and hearing aids and is author of the textbook **Compression for Clinicians**, *published by Cengage and now in its second edition.*

In the beginning was Functional Gain. Real-Ear measures did not exist. All hearing aids were linear. These lines sound like they come from an ancient narrative of the origins of life, but things in our hearing aids world truly had to begin somewhere, and they did.

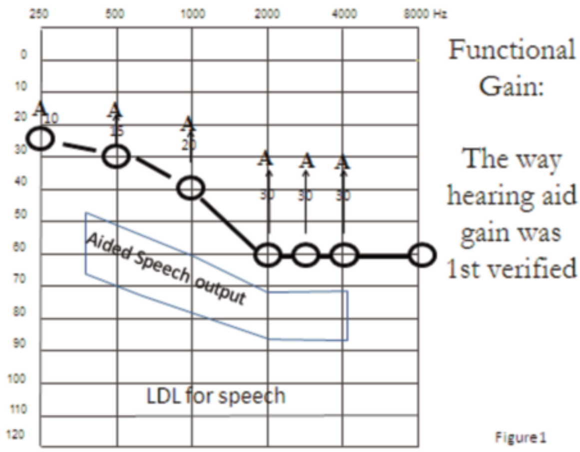
Today's hearing aid fitting methods really go back to Sam Lybarger, back in 1944. He'd stand a Texas yard away from the listener who wore the hearing aid, he'd speak in a normal conversational voice, and ask the client what sounded comfortably loud. With good old empirical "check it out" methodology, he found the listener wanted or preferred gain that was close to about ½ of the client's hearing loss at each frequency. Lybarger knew this made sense; with sensorineural hearing loss (SNHL), one's hearing thresholds increase but loudness tolerance does not increase by much, if at all. In other words, the "floor" is raised but the "ceiling" is not. Lybarger also knew that *input plus gain equals output*. For most clients with SNHL, an input of conversational speech intensity, plus amplification by the total amount of the client's hearing loss, would make the resultant output far too loud to tolerate. Thus the "½ gain rule" hearing aid fitting method was born.

The purpose of this article is not to sketch out the development of fitting methods; that has been done time and time again and readers know where and how to find that information. Rather, it is of interest here to describe the evolution of *measurements used to apply fitting methods*, because these measurements frame how clinicians "see" the results of their fitting methods. In the old days clinicians had to imagine the end outcomes. Our present Real Ear method involves the literal mapping of aided speech on to the client's audiogram. The results of the fitting are splayed out there on the client's residual dynamic range, as seen on a computer screen. If Lybarger could only have seen this!

FUNCTIONAL GAIN MEASURES WERE FIRST

The development of hearing aid fitting methods can largely be described according to what was being measured, and how this was being measured. *Functional gain* came first, then came Real Ear and *Insertion gain*, and finally today we use Real Ear measuring *In Situ Output*. Functional gain means behaviourally measured gain, or gain that is measured as a voluntary response of the client. This is how we did it, from the 1940s all the way to the mid 1980s. A client's aided thresholds in a sound field with a hearing aid (yes, usually just one) at a comfortable volume control setting were compared to his or her unaided thresholds measured with headphones.

Aided thresholds were always measured with "warble tones," and this was done in order to reduce any possible reverberation in the sound field of the sound booth. I remember well presenting warble tones in a sound field.



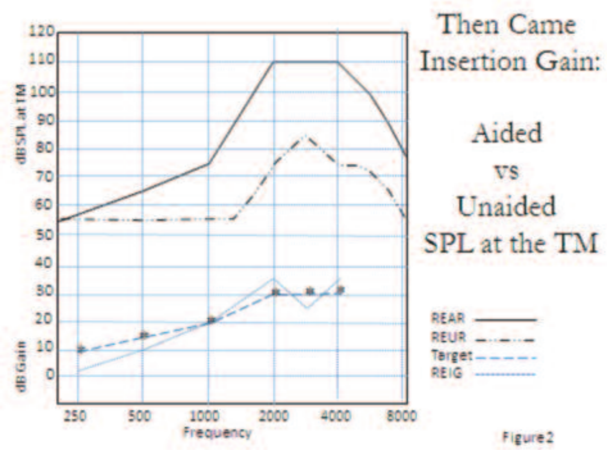


Figure 1. The A's stand for "aided thresholds." The goal was to raise the thresholds by roughly ½ (and less than ½ in the lows to reduce the upward spread of masking). This way, speech inputs, plus the ½ gain, would produce aided speech outputs that sat within the dynamic range and did not exceed LDLs.

Figure 2. Note that the #'s for the Real-Ear targets (asterisks) here are identical to those for the A's on the Fig. 1 audiogram. Real-Ear Insertion Gain measures, however, are non-behavioral and faster. Note also that *the audiogram is nowhere to be seen.*

I felt like I was playing an organ, especially with the low-frequency tones. Just like measuring thresholds under headphones, the client would raise a hand when the aided tones were audible. A successful fitting was signified by little letter A's written across the audiogram, showing a lift of thresholds about halfway up toward the 0 dB HL line. The idea was that average speech inputs, plus the hearing aid gain, would give an output that fell within the client's dynamic range (Figure 1).

Fitting methods continued to evolve in the late 1970s and 80s from various different philosophies (Berger, POGO, Libby, NAL), and so exactly where you'd want the little letter A's to appear on the audiogram would differ slightly from method to method. All fitting methods however, had the ½ gain rule as their spinal cord.

What functional gain all too often left unstated and unillustrated, however, was the goal of the ½ gain rule; namely, *that the aided speech output (Figure 1) would thus be placed within the client's residual dynamic range!* The outcome of aided speech output was almost never described or pictured as it would appear on an audiogram. Speaking for myself, I think this was always a missing step in terms of my own understanding of hearing aid fittings. My professors had never described it to me like that, but in hindsight, I sure wish they had. It surely would have made it easier for me to digest the DSL fitting method and the mapping of aided speech when these came around.

THEN CAME REAL EAR AND INSERTION GAIN

Then, in the late 1980s, came Real Ear and Insertion gain. At the time, I was a new audiologist at the Canadian Hearing Society. Inside each of their four sound booths there was a new Real Ear device called "Rastronics." It had a black screen and I recall all the tracings were green. Fitting Methods had not changed, and hearing aids were almost all still linear, but Insertion Gain became the new order of the day. It was faster than Functional Gain, and yielded objective, non-behavioural results.

You'd simply enter the client's audiogram into the Real Ear system, choose a fitting method, and the aided "target" gain would then instantly appear on the screen. As with Functional Gain, this target could be based on the ½ gain rule, or any of the above-mentioned fitting methods (Berger, POGO, NAL-R, etc).

The important thing to note is that although the actual Insertion Gain values did not differ from Functional Gain values, the *display* of Insertion Gain was completely new. Instead of decibels (dB) in HL increasing as you looked down the audiogram, dB were displayed in terms of SPL and they increased as you went upwards on the new graph. The difference between unaided ear canal dB SPL versus aided ear canal dB SPL was Insertion gain. The whole idea was to compare the Real Ear Unaided Response (REUR) to the Real Ear Aided Response (REAR),

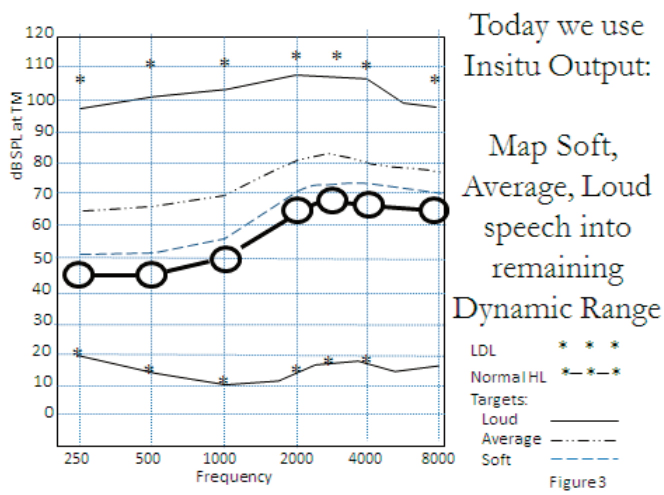


Figure 3. The SPL-o-Gram shows the audiogram, and also the targets in terms of In Situ Output. Note the three targets and how each is generally placed within the client's dynamic range. All fitting methods essentially seek to accomplish these same basic objectives.

with the difference being Real Ear Insertion Gain (REIG). Since the hearing aids were Linear, you could simply say like they do at the carnival, "Pick an input…any input…" In order to make the input audible above ambient room noise, an input of 55 dB SPL was almost always selected. At any rate, the bottom line was, if your REIG matched the target of the particular fitting method you were using, you were good to go (Figure 2)!

But now just try *counseling* a client from the perspective illustrated on Figure 2: "Well, you see, this line is what we're supposed to hit and this little lighter line is right near it, so your hearing aid is doing what it's supposed to do." The main problem here was that the audiogram was not visually part of the picture, so aided speech outputs simply had to be imagined. In this way, Insertion Gain was actually worse than Functional Gain.

Interesting too, was that REUR wasn't incorporated at all in the unaided testing under headphones, but oh well. Non-behavioral Real Ear measures were certainly a whole lot faster than testing someone's thresholds twice! Another good thing about Insertion Gain was that if someone came in saying the new hearing aid just didn't sound like the old one, you could do a quick Real Ear measure on the old one, and then make the new hearing aid do the same thing. Of course you could also do this with ANSI measures…Still, however, some objective data is much better than completely relying on the old saw, "How does that sound?"

IN SITU OUTPUT CHANGES REAL EAR

Richard Seewald really is the father of newer Real-Ear measures. His Desired Sensation Level (DSL) fitting method arose in the early 1980s, and with it, came the SPL-o-Gram. Insertion Gain and REUR were unceremoniously tossed onto the garbage heap of audiologic history, and Real Ear measures took on a whole new look.

Now the whole focus was on in situ output, also known as REAR. Trouble was, only Seewald and his followers used the SPL-o-Gram and DSL. Most clinicians in North America, including myself, plodded on with Insertion Gain Real-Ear measures. I remember returning back to Canada in 1995 from Alabama where I taught audiology at Auburn University for a couple of years. I was a new employee at Unitron Hearing in Kitchener. Here in this pink Commonwealth country of Canada, DSL loomed large as *the* recommended fitting method. I attended a DSL workshop held at Western, where Seewald, Cornelisse, and Moodie diligently presented on DSL. I have to admit that I still didn't really get it. I'd echo the columnist Allan Fotheringham who used to say, "Elucidate the nebulosity of your phantasmagorical perceptions." Insertion Gain just seemed so easy, lots less busy, fewer lines and like an old friend, just so familiar.

It then came to me suddenly, upon a midnight clear. I remember "the hour I first believed." It may seem blasphemous to the Cardinals of DSL, but the "trick" to my own understanding DSL was in looking at the missing piece, the unsung goal of Functional gain; recall Figure 1, and its *display of where aided speech would lie within one's dynamic range.* DSL used Real Ear to display the SPL-o-Gram of each client. With its SPL-o-Gram, DSL pioneered a way to instantly display what Functional gain measures intended, but did not tend to show. With Real Ear measures, we now actually had the technology to display the audiogram, along with aided speech outputs, all on one graph, all in dB SPL, and all this right-side up!

Let's look at the SPL-o-Gram (Figure 3). Everything including normal hearing and the client's own thresholds is plotted according to output, and in terms of dB SPL. Now hearing loss and

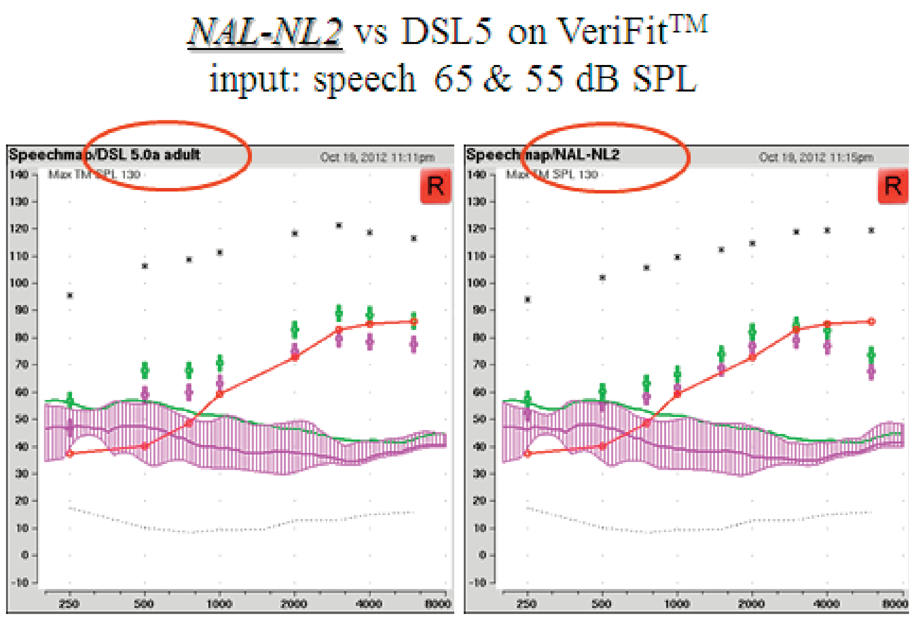


Figure 4.The SPL-o-Gram for a typically encountered sloping mild-moderate hearing loss is shown for DSL 5 (left) and for NAL-NL2 (right). The pink shaded area on both panels is simply the unaided 55 dB SPL input speech spectrum. The in situ output targets are shown for average (65 dB SPL speech inputs (top green crosses) and for soft 55 dB SPL speech inputs lower pink crosses). Note the similarity between the targets for both fitting methods.

hearing aids are speaking the same language. "More" on the graph now goes up, like every other graph in the world (except the Oddiogram). Normal hearing thresholds are placed on the bottom and Loudness Discomfort Levels (LDLs) are placed on the top. The patient's hearing loss is placed part way up on the graph, thus showing a reduced dynamic range (the "floor" is elevated but the LDL "ceiling" is the same). One can show and compare unaided to aided speech. Clients can readily see what parts of speech were inaudible without hearing aids, and what parts have now become audible when aided.

Since compression hearing aids give different gains and output for different input levels, three targets are shown for: soft, medium, and loud inputs. The idea is to aid the listener so that soft speech input sounds soft, average speech input sounds average, and loud speech input sounds loud. Now *there's* an improvement for counseling! As we say in Canada, "Neat, eh?"

The trouble with Functional Gain was its lack of displaying its goal; namely, putting aided outputs nicely with the client's dynamic range. How could it be blamed for this; the technology of Real Ear had yet to make the scene. The trouble with Insertion gain was that the goal seemed to be all about hitting those targets. I recall feeling quite good about things as I drove home from my day's work, thinking, "I hit the target 4 times today!" Ensuring that aided in situ outputs were positioned properly within the client's dynamic range is just not a natural or logical extension of Real Ear Insertion gain measures. Counselling with it was next to impossible!

In 1997, NAL-NL1 emerged from another large pink commonwealth country (Australia) on the globe, and I remember how it very *gradually* began to follow suit with DSL's SPL-o-Gram. One could initially see NAL-NL1's simultaneous usage of both Insertion gain and in situ output, but this was followed within about a year by their rather quick dumping of Insertion gain. For DSL then, imitation could be considered the finest form of flattery.

The "rub" is that even though fitting methods all differ in various ways they are all actually trying to accomplish what the SPL-o-Gram shows! Placing aided outputs properly into a client's dynamic range is what it's all about. *It's just that in the past, we didn't have the equipment to show this*. Up until DSL, gain was always the order of the day. Functional gain compared aided to unaided thresholds, and Insertion gain compared REAR to REUR. The SPL-o-Gram changed everything by focusing on output instead of gain. Output is king; gain is just a means to an end. Output is the groceries delivered to the doorstep of one's eardrum; gain is like asking how did you get to the store, by driving or cycling. The SPL-o-Gram allowed us to visualize (1) normal hearing, the client's audiogram and the reduced dynamic range, and (2) unaided and aided speech outputs all on one graph. While this may have seemed like a "small step" for a print job, it really was a "giant leap" for audiology. Neil Armstrong taught us that we all need to look at the moon from time to time … Richard Seewald I understand enjoys photography … but I digress.

There's another twist, however, to this story. The main two kids on the block, the DSL and NAL fitting methods have each evolved over the past few years. DSL 4 became DSL 5, and NAL-NL1 became NAL-NL2. They have evolved, however, to become more similar than different. In fact their adult versions are so similar that if you don't compare them carefully, you may not even notice the differences. Check out the target comparisons for yourselves (Figure 4).

ISLANDS IN THE SETTING SUN?

The use of today's Real Ear measures, along with the similarity of the two major fitting method heavyweights can lead us to paint with broad strokes, at least for the adult population. Clinicians know all too well that the hearing aid manufacturers all have the major fitting methods in their fitting software, along with their own proprietary fitting methods. We also know that we don't always slavishly adhere to the targets of a particular fitting method. Rather, we tweak the hearing aid settings according to the adult client's perceptions and drift to some sort of general compromise.

Although there are minor differences between the adult version of DSL 5 and NAL-NL2, one can easily see the general trends as to how soft, average and loud inputs are literally mapped or placed into the adult client's dynamic range. If you place soft input speech so that when aided, the output speech surrounds the thresholds, you'll find that the patient can barely hear it. That's normal; neither can you or I. Average speech inputs should be aided so its outputs sit in the dynamic range about 1/3 above the thresholds. Loud speech inputs should be aided so they sound loud, but remain below LDLs. Isn't that what all fitting methods are basically trying to do in the first place? Isn't that what Lybarger would have wanted to see?

For adults (not the pediatric population, of course) it looks as if fitting methods can actually recede away from a frontal focus. To borrow a phrase from the songwriter Paul Simon, they are becoming "islands in the setting sun." Ensuring that aided speech outputs are placed within one's dynamic range is a relatively easy objective to achieve without the use of any Fitting Method targets. To continue with Paul Simon's lyric, mapping of speech is rapidly becoming the "bottom line for everyone."

Canadian Hearing Report 2014;9(4):10-14.

Vestibular Diagnostics: For All of Us

By Mark Caffery, MA

About the Author

Mark Caffrey, AuD, Doctor of Audiology. Owner/founder of Caffrey & Associates Audiology with offices in Gloversville and Amsterdam, NY. Dr. Caffrey specializes in vestibular diagnostics and vestibular rehabilitation. Additionally, being hearing impaired himself, he also specializes in diagnostic audiologic evaluations and in hearing aid dispensing. He is a fellow of the American Academy of Audiology, the Academy of Doctors of Audiology, and the New York State Speech-Language-Hearing Association.

I was chatting recently with a patient during a videonystagmography (VNG) evaluation. I was informed, by this surprisingly technology savvy 80-plus-year-old woman, that in her web search for "dizziness specialists," audiologists did not get even an honorable mention! She was actually shocked, she continued, when her physician referred her to me, her "hearing aid doctor," for testing and possible diagnosis of her dizziness complaints. This particular patient has been a hearing aid patient of mine for more than 8 years. I admit that I too was both shocked and even a little hurt by her disclosure.

Later I retired to my laptop and began my own internet search ... like a patient. I avoided the professional websites that we so easily utilize as audiologists and instead began my search like a patient would; I turned to Google, Yahoo, and Bing. My search topics included: Dizziness, Dizziness Specialists, Who Tests for Dizziness, Who Treats Dizziness, and the same searches using "BPPV" instead of the word "Dizziness". Each of these searches resulted in essentially the same results.

Unfortunately, my search results were no different than my patient's findings. With just a single exception, audiologists are not mentioned at all. Since, by definition, audiologists are "trained to diagnose, manage and/or treat hearing or balance problems"[1] this was disheartening to say the least. Most search results (YahooAnswers.com, Healthboards.com, MedLine.com, WebMD.com, UIHealthcare.org, Medicine.net, MedScape.com, and HealthCommunities.com) did not mention the audiologist in any capacity. The suggested sources for the diagnosis of dizziness were overwhelmingly in favor of the primary care physician, which we could concede is a logical place for patients to start, but then the search results directed prospective patients to the neurologist next, then the ear, nose and throat physician, and lastly to physical therapists; even neurotologists managed to obtain only one mention. One of the sites, MedLinePlus, the website of the National Institute of Health/National Library of Medicine, stated that the primary physician might order hearing testing and ENG testing but failed to mention what specialist would provide those specific services.[2] Regarding the treatment of dizziness and/or BPPV, the various sources listed the primary care physician, the ENT, the Physical Therapist, and even the Occupational Therapist. Again, the audiologist was omitted.

One solitary site during my search specifically listed audiologists as a source for the diagnosis and/or treatment of dizziness. This site is ShareCare.com. In fact, at this source, ShareCare.com, the Honor Society of Nursing lists the audiologist as the preferred source, followed by ENTs and neurologists only if the dizziness is linked to brain anomalies.[3]

These mostly unflattering search results reminded me of a NYSSLHA conference a couple of years ago when one of the presenters asked the audience how many audiologists in attendance were treating BPPV in the office; sadly, I was the only one to raise my hand. All this brings me

Reprinted with kind permission from Caffery M, Vestibular diagnostics: For All of Us The Communicator 2014;44(2):19=20.

to the ultimate purpose of this article. The American Academy of Audiology, in its bylaws, has challenged audiologists to advance "the science and practice of audiology, and [achieve] public recognition of audiologists as experts in hearing and balance."[4] Audiologists need to do a more effective job representing themselves as more than hearing experts; we need to step up to the plate and fulfill our mission completely. We have clearly not achieved public recognition as experts in balance disorders.

Many audiologists simply may not wish to get involved with VNG assessment or may not have the funds necessary to invest $35,000–75,000 in a vestibular diagnostics lab, let alone have the physical space required to provide complete vestibular/balance rehabilitation services. However, for a very modest investment of about $300, any audiologist could begin to provide diagnosis and remediation for the most common form of dizziness. Benign paroxysmal positional vertigo (BPPV) accounts for half of all the dizziness complaints of our elderly patients.[5] A simple Dix-Hallpike maneuver, performed on a very basic flat therapy table, costing about $300, will allow you to determine if BPPV is present. The positive Dix-Hallpike will yield a torsional (rotary) nystagmus that has latency, short duration (paroxysmal), and fatigues; this will be accompanied by vertigo and sometimes nausea. This torsional nystagmus will beat toward the affected ear.[5] While use of Frenzel lenses or VNG recording assures that even the most subtle variations of BPPV are identified, nearly all BPPV can be visualized with the naked eye.

Once identified, the same inexpensive therapy table can then be used to perform any of the canalith repositioning procedures to treat BPPV. The Epley maneuver is the most widely used method in the United States, but I personally prefer the Semont maneuver, which is more commonly utilized in Europe. The Epley maneuver is gentler on the back and is easier to perform on larger patients and patients unable to move rapidly, but it does require a head-hanging position which can be difficult for some elderly patients with limited neck mobility.[5] It also requires a bit more time. The Semont maneuver entails moving the patient very rapidly, which can be difficult with arthritic or frail patients or patients with bad backs, but does not require a head-hanging position. The Semont maneuver requires less time and it has a success rate of approximately 90%.[5] Reimbursement for audiologists is often problematic with all canalith repositioning, but having the patient sign an ABN (advanced beneficiary notice) resolves this.

With such a meager investment, audiologists in nearly all practice settings could begin to diagnose and treat at least the most common cause of dizziness for our patients. If the Dix-Hallpike test is negative, a referral to a colleague that offers VNG and possibly vestibular rehabilitation services would be appropriate. We need to utilize each other and should not fear losing this patient to a competitor. Very few of us consistently provide comprehensive central auditory processing evaluations but may perform a screening and/or provide a referral to a colleague; even fewer of us are directly involved with cochlear implants, but we certainly have the capacity to refer potential candidates to the appropriate facility for further evaluation and treatment. We should therefore exercise the same ethical duty to our patient's well being by referring them to other colleagues when necessary for more advanced diagnosis and treatment of vestibular disorders. Our wonderful profession is not only about hearing aid sales. If we do not represent ourselves as THE specialists for the diagnosis and remediation of vestibular and balance disorders, why would the primary care physician, who will most likely make such a referral, do so? The provision of this very minimal diagnostic procedure and subsequent remediation will not only provide very significant benefit to our vertiginous patients, but will also help our profession better meet its mission to establish ourselves as the experts in hearing AND balance disorders.

Additional discussion regarding the specifics of performing the Epley versus. Semont versus Brandt-Daroff maneuvers for the remediation of BPPV, the myriad of other possible diagnoses from more in depth vestibular assessment, as well as other types of vestibular therapy and balance retraining therapy are reserved for possible other, future article(s). The reader is otherwise referred to his/her vestibular text books for immediate clarification.

REFERENCES

1. Wikipedia. Definition of Audiologist. Retrieived January 15, 2014 from http://en.wikipedia.org/wiki/Audiologist
2. MedLinePlus.com. Dizziness. Retreived December 21, 2013 from http://www.nlm.nih.gov/medline plus/ency/article/003093.htm.
3. The Honor Society of Nursing. What Type of Specialist Treats Vertigo & Dizziness? Retreived December 21, 2013 from http://www.sharecare.com/health/vertigo-dizziness-treatment/what-specialists-treat-vertigo-&-dizziness.htm.
4. American Academy of Audiology. Bylaws. Retrieved on January 15, 2014 from http://www.audiology.org/about/leadership/bylaws/Pages/default.aspx.
5. Hain TC. Benign Paroxysmal Postional Vertigo. Dizziness-and-Balance.com, January 8, 2014. Retreived January 15, 2014 from http://www.dizziness-and-balance.com/disorders/bppv/bppv.html.

Canadian Hearing Report 2014;9(4):15-16.

New Text with 9-1-1 Service Increases Safety for Deaf, Hard of Hearing and Speech Impaired Canadians

By Ashlee Smith

About the Author
Ashlee Smith is the manager of communications with the Canadian Wireless Telecommunications Association (CWTA). The Ottawa-based group is the authority wireless issues, trends and developments in Canada. Ms. Smith can be reached at asmith@cwta.ca.

Very few people could have predicted a decade ago how dramatically the power of wireless would totally transform the lives of Canadians – not only in how we communicate with each other – but in almost every aspect of our day-to-day lives in the home, in the workplace and anywhere and anytime in between.

The speed at which wireless technology has evolved is truly incredible. Every day, it seems there are new advances that are reshaping our world for the better. The days of the cell phone that just simply made phone calls are long gone. In addition to sending text messages and e-mails and browsing the Internet at lightning fast speeds, we can do things like monitor our homes and provide critical medical information to our doctors directly from our smartphones.

Canada now has well over 28 million wireless subscribers. This number is staggering considering just 10 years ago there were only 13 million users. And, Canada has some of the fastest, most advanced wireless networks on the planet, and we are among the fastest adopters of the latest and greatest smartphones in the world.

But beyond calling, texting and watching videos, wireless is also quickly becoming a game changer for those in vulnerable communities. A new text-messaging based wireless service is connecting those in the deaf, deafened, hard of hearing or speech impaired (DHHSI) communities to emergency services in Canada.

Text with 9-1-1, or commonly referred to as T9-1-1, provides 9-1-1 call centres with the ability to converse with a DHHSI person during an emergency, using text messaging. When a DHHSI person requires 9-1-1 services, they dial 9-1-1 on their cell phone. There is no need for a caller to speak or hear, as the 9-1-1 call taker will normally receive an indicator from registered users that tells them to communicate with the caller via text messaging. The 9-1-1 call taker then initiates a text message conversation with the caller to address the emergency.

This unique Canadian solution was developed by the CRTC Interconnection Steering Committee (CISC) Emergency Services Working Group (ESWG), comprised of members from emergency services, telecommunications service providers, vendors and other stakeholders. After examining the ways in which emergency services could be more readily access by those in the DHHSI community, T9-1-1 was put to the test in 2012 in Vancouver, Toronto, the Peel Region, and Montreal. The results of these trials showed that while limitations exist with the service, it would be a dramatic improvement to the current system.

Since that time, wireless carriers across the country have completed all of the required network upgrades to implement T9-1-1. However, before the T9-1-1 service can be made available to DHHSI cell phone users, 9-1-1 call centres must also complete technology upgrades as well.

All members of the DHHSI community across Canada can start to register for the service, even though the service is not yet available nation-wide. National registration allows those who need it to utilize the service only when they are within a specific region that has deployed T9-1-1.

At this time, the T9-1-1 service is only available in Metro Vancouver, the City of Calgary, and the Peel Region. The service will be implemented by 9-1-1 call centres in different municipalities or regions at different time periods over the next several years. DHHSI citizens should check the new www.Textwith911.ca Web site frequently to see which new areas or regions have rolled out the service.

Those who wish to register for the service must do so through their wireless service provider. Without taking this crucial step, important information may not be relayed to the user such as checking to make sure that the user's device is compatible with the service. Some devices are not able to make a voice call and send and received text messages simultaneously, so it is critical to double check this when registering for the service. Links to the wireless service provider's Web sites are also available at www.Textwith911.ca.

This service is an exciting step in the right direction in ensuring that all Canadians will have access to life-saving emergency services. However, as with any new technology, limitations do exist. For example, no text messaging service can guarantee that a message will be sent or received in a timely manner. Additionally, mobile devices are, well, mobile, and staying within the footprint of a service area may also present challenges for those who utilize the service.

Also, voice calling remains the only way to communicate with 9-1-1 services for a person that is not deaf, deafened, hard of hearing, or have speech impairment. Text messages sent directly to the digits "9-1-1" do not reach emergency services. Text with 9-1-1 for the public at large is expected to be deployed at a later date.

We must keep in mind that when 9-1-1 first became available for Canadians last century, the concept of a cellular phone, let alone text messaging, was something out of science-fiction. 9-1-1 was not created in such a way that combining this type of sophisticated technology with emergency services would be easy nor that it would be seamless. The goal for Text with 9-1-1 for now is to do a better job at connecting vulnerable Canadians than ever before.

How Near is the End of the Occlusion Effect?

By Chester Pirzanski, BSc

By Catherine V. Palmer PhD

About the Author
Chester Pirzanski is ITE process engineer in R&D at Unitron Corp, Kitchener, ON, Canada.
Correspondence can be addressed to Chester Pirzanski, Unitron, 20 Beasley Dr, Kitchener, ON N2E 1Y6, email: Chester.Pirzanski@unitron.com

The occlusion effect and acoustic feedback are the oldest and most common problems associated with hearing aid fittings. Both are considered a major deterrent for wearing hearing aids; both are linked to each other in a fine relationship: a sound leak from the ear canal diminishes the occlusion effect but increases the risk of acoustic feedback. A total earmold seal prevents feedback but elevates the sensation of occlusion.

It was 1979 when Huntington[1] asked *How near is the end of feedback?* and believed that the answer was in the newly introduced vinyl earmold. This soft material was supposed to seal the ear canal effectively enough to make hearing instruments feedback free. This did not happen at that time. We needed a couple of decades more before effective feedback cancelation algorithms were developed. Interestingly, it was the advancement in electronics, not material technology, that brought the end to acoustic feedback.

A study done in 1985 and later research, reported that 30% of hearing instrument users had problems with their own voice.[2] They perceived it hollow or booming, or echoing. Two factors contributing to this complaint were established: a shell origin and an amplifier origin.[3]

A review of what we know about the occlusion effect and the most recent technological advancements will help us to conclude if modern hearing instruments are able to manage the occlusion effect effectively.

THE OCCLUSION AND AMPCLUSION EFFECT

There are two principle paths by which one hears one's own voice when speaking. The first is a direct path via the bone and cartilaginous structures of the head, and the second is an indirect path via air conduction.

Echo-like sounds are caused by bone-conducted sound vibrations reverberating off the object filling the ear canal. When talking or chewing, these vibrations normally escape through an open ear canal; most people are unaware of their existence. When the ear canal is blocked, the vibrations are reflected back toward the eardrum. Compared to an open ear canal, this can boost low frequency sound pressure in the ear canal by 20 dB or more. This is called the occlusion effect.[4]

A person with normal hearing can experience this by sticking their finger into their ear and talking. Otherwise, this effect is often experienced by hearing aid users who only have a mild to moderate high-frequency hearing loss and use hearing aids which block the ear canal.

The introduction of amplification impacts the overall voice perception because the intensity of the wearer's own voice at the hearing aid microphone is considerably greater than the sounds coming from the environment. This effect, combined with occlusion is termed ampclusion,[5] and is most noticeable for individuals with a good low frequency hearing. With increasing hearing loss, the wearer relies less on bone conduction and leakage through the vent, and more on amplification through the hearing aid, and the ampclusion effect is less noticeable.

TOTAL ACOUSTIC SEAL

Zwislocki found that extending the medial end of the earmold into the bony portion of the ear canal significantly reduced the occlusion effect. Killion[6] established that a deeply sealed earmold was able to diminish the occlusion effect to the level of sound pressure measured with the open ear canal. Bryant[7] followed this with a comparison of several

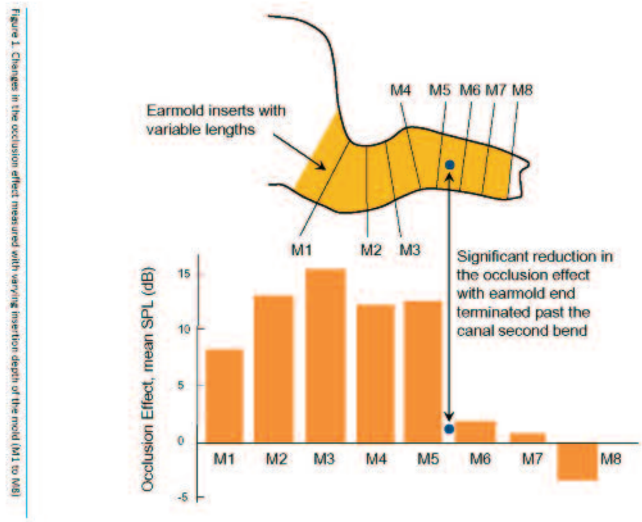


Figure 1. Changes in the occlusion effect measured with varying insertion depth of the mold (M1 to M8).

traditionally built full shell ITEs and ITEs made with a minimum contact technology (MCT). The MCT instruments had shells with long canals sealed at the bony portion. The rest of the shell in the canal area was reduced to help with the aid insertion and comfort. Real ear measurements established that the MCT aids were able to reduce the occlusion effect by 10 dB at 200 Hz compared to the standard ITE. Pirzanski[8] investigated the relationship between the mold insertion depth and the magnitude of the occlusion effect with a set of soft unvented earmolds with varying canal lengths. It was found that the increase in canal length past the canal aperture elevated the occlusion effect, as provided in Figure 1. Then, as the canal length increased, a progressive reduction was noted. The greatest reduction occurred with the change from mold M5 to M6. Mold 7 eliminated the occlusion effect. These findings correspond with the well-known Berger's[9] chart showing that the occlusion effect is minimized with deeply inserted plugs, increases in magnitude as the plug is withdrawn, peaks when the canal is capped by a semi-aural device, and continues to diminish with an earmuff.

Despite these encouraging research results the concept of building deeply sealed ear pieces was not implemented in manufacturing hearing aids and earmolds because it was commonly noted that deeply fitted molds caused discomfort to the wearer. The author estimates that approximately 80% of users may have difficulty accepting the instrument if the mold makes contact with the bony portion of the ear canal.

VENTING

Since the occlusion effect comes from occluding the ear with an earpiece, researchers tried to establish how much ventilation though the earmold is needed to bring the occlusion to an acceptable level, or to eliminate it.

Revit[10] found that a 2 mm vent was able to reduce the occlusion effect by 8.5 dB at 200 Hz. However, at 500 Hz the venting had no effect. A small 0.6 mm vent reduced the effect only by 2 dB. These results of venting are common and have been reported by numerous researchers. Dillion[11] considers a 2 mm vent a starting point and advises to use a 3 mm vent, if possible.

Fulton[12] investigated the effectiveness of a 2 mm vent on 29 ears. She found that the average occlusion effect was 19.5 dB for a fully occluded ear, and varied from 9 dB to 32 dB, depending on the individual. When the vent was added, only 7 ears had a reduction in SPL of more than 5 dB, and of these 4 ears had a reduction of more than 10 dB. For the other 22 ears, the average impact of the 2 mm vent was 2.8 dB. This is consistent with May[13] who found that a 2 mm vent reduced the sound pressure level between 4 and 5 dB in 10 subjects.

Kampe[14] found that real-ear measurements were unable to predict how the user would perceive his/her own voice when the vent diameter was changed. In addition, he found that in a number of subjects the vent enlargement increased the occlusion effect for one vowel and reduced for another. This should not be a surprise if we consider that the occlusion effect results from the skull vibrations. Since the skull is composed of different bone plates, having different density and vibration characteristics, the vibratory behaviour is quite complicated. Therefore the vibrating effect may vary from person to person.

A major limitation in manufacturing custom hearing aids with a 2 mm vent at the time of the research was that such a vent could not be accommodated in most CICs and many ITCs assembled with the traditional acrylic shell: the size of the receiver along with the thickness of the shell and vent wall limited the space for a larger vent.

While research established some

Figure 2. Digital modeling and acoustic tuning of the vent in a hearing aid

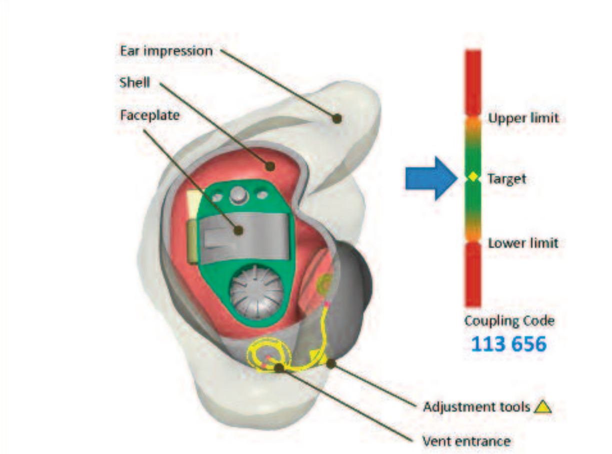


Figure 2. Digital modeling and acoustic tuning of the vent in a hearing aid.

Figure 3. Hearing aid gain adjustments in Occlusion Manager.

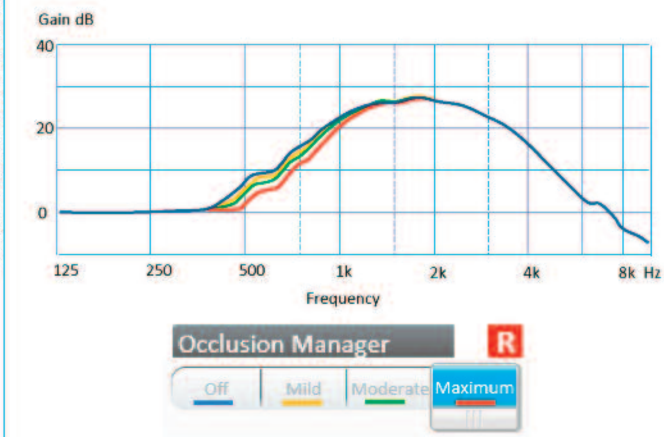


Figure 3. Hearing aid gain adjustments in Occlusion Manager.

consistencies, variability was common. Based on testing 15 ears Sweetow[15] concluded there was virtually no correlation between subjective voice perception and objectively measured ampclusion: only one ear demonstrated a statistically significant correlation between the amount of objectively measured ampclusion and the subjective ratings. In repeated measures, the occlusion effect varied by as much as 10 dB, furthermore, this variability was not consistent over frequency. It was observed that the magnitude of occlusion may be quite different for each ear within a given individual.

Not long ago, telling the patient that they will need to get used to the occlusion effect was still the most common and in many cases the most sound advice they could get.

RIC HEARING AIDS

A breakthrough came around 2005 when receiver-in-canal (RIC) hearing aids were introduced. These hearing aids had the receiver fitted deeply in the ear canal in a small 80% open soft dome. This deep receiver placement made the instrument less susceptible to acoustic feedback and the open dome allowed for enough ventilation to eliminate the feeling of occlusion.

ADVANCED SHELL TECHNOLOGY

Today's digital shell technology allows for making hearing aids with optimized component placement and thinner walls. This allows for larger vents. Most manufactures offer now a 2.5 mm or larger vent as a standard. Group Companies under Sonova, Unitron, and Phonak, offer the Acoustically Optimized Vent (AOV), or the Intellivent. The diameter of the vent is automatically calculated during the shell modeling process based on the patient audiogram and the length of the vent.

Figure 2 shows the process of AOV modelling. The operator optimizes the position of the vent entrance and exit so that the vent is not covered by the ear wall, then ensures that the vent size falls within the green target area. Each vent is modeled individually, often the vent size is different for the right and left ear of the same patient. At the end of the modelling, a six digit coupling code is generated which is later entered into the fitting software when the hearing aid is programmed with the customer settings. This creates an occlusion free fitting for most patients. Minor in-office adjustments in the fitting software may be necessary for some wearers.

ADVANCED AMPLIFICATION

Recent fitting software offers an occlusion manager that can be used to adjust the gain response curve in lower frequencies. In Unitron hearing aids, the clinician can adjust the gain by moving the on-screen slider to mild, moderate, or maximum, see an example in Figure 3. These changes are done when the patient wears the hearing aids, often wirelessly, and in real time. The real time option is particularly important because the wearer can instantly hear the change and select the response that gives him/her the best sound quality.

The ampclusion effect can also be managed with an automatic adaptation manager that will increase the initial fitting gain over time at a fixed rate (commonly 5% every two weeks, from 80 to 100%). This will soften the sensation of occlusion and allow the time for the user to get used to the sound. Digital hearing aids can also adaptively change their low frequency gain according to input levels and reduce the perception of hollowness.

Unitron offers a unique Flex:trial program under which the patient is fitted at no cost, no obligation to purchase, with a set of BTE or RIC hearing aids for a period of four weeks. This gives them the opportunity to determine the technology level they need to manage their listening situations and the style of the coupling, a dome or earmold, that provides the least occlusion and best physical fit in the ear.

Huntington might be happy today. His dream of having feedback free hearing aids has become the reality. In addition, modern digital hearing instrument technologies are bringing the end to the occlusion effect. The two can be put at rest, finally.

REFERENCES

1. Huntington A. How near is the end of feedback? J Brit Assn Teachers of Deaf 1979;3(4):123.
2. Lazenby B, Logan S. Ahlstrom J, Bess F. Self-assessment questionnaire for the elderly: hearing aid dispensary use. Paper presented at the 1985 American Speech and Hearing Association Convention.
3. Kuk F, Ludvigsen C. Occlusion management 101: understanding variables. Hear Rev 2002;9(8):22–32.
4. Tonndorf J. Bone conduction. In: JV Tobias, ed. Foundations of Modern Auditory Theory. New York: Academic Press, 1972:195–273.
5. Painton S. Objective measure of low frequency reduction in canal hearing aids with adaptive circuitry. J Am Acad Audiol 1993;4:152–56.
6. Killion M, Wilber L, Gudmundsen G. Zwislocki was right: A potential solution to the "hollow voice" problem (amplified occlusion effect) with deeply sealed earmolds. Hear Instrum 1988;39(1):14–18.
7. Bryant M, Mueller G, Northern J. Minimal contact long canal ITE hearing instruments. Hear Instrum 1991;42(1):12–15.
8. Pirzanski C. Diminishing the occlusion effect: clinician/manufacturer factors. Hear J 1998; 51(4):66–78.
9. Berger E. EARlog, Tips for fitting hearing protectors. Sound Vibr 1988;22(10):22–25.
10. Revit L. Two techniques for dealing with the occlusion effect, Hear Instrum 1992;43:16–18.
11. Dillion H. Hearing Aids. New York: Thieme; 2001, 132.
12. Fulton B, Martin L. Drilling a vent often fails to give relief from occlusion. Hear J 2006; 59(7):40–45.
13. May A, Dillon H. A comparison of physical measurements of the hearing aid occlusion effect with subjective report. Presented at Audiological Society of Australia Conference, Adelaide, 1992.
14. Kampe S, Wynne M. The influence of venting on the occlusion effect. Hear J 1996;49(4):59–66.
15. Sweetow R, Valla A. Effect of electroacoustic parameters on ampclusion in CIC hearing instruments. Hear Rev 1997;4:8–12.

Canadian Hearing Report 2014;9(4):17-20.

Prepare for a world's first in hearing technology.

Discover the next generation of BestSound Technology.

BestSound™ Technology

Life sounds brilliant.