



## ABT Bone Conduction System Provider Reference Document

The Listening Program® (TLP) method of Music-Based Auditory Stimulation™ is enhanced with the addition of bone conduction technology with the ABT Bone Conduction System (ABT BCS). This exciting technology takes TLP to a whole new level of effectiveness. It combines the experience of listening to music through modified headphones adding subtle, synchronized acoustic vibration of the skin and skeletal system, engaging the whole body and brain in the listening process. This multi-sensory approach accelerates and expands the benefits of The Listening Program.

### **ABT Bone Conduction System**

The ABT BCS is comprised of a small, custom made, pocket sized, battery operated headphone amplifier and specialized, open-air headphones that have been modified to include a bone conduction transducer in the headband. It can be used with any ABT iListen® system.

This portable bone conduction technology offers the convenience and flexibility of listening in the home, school, clinic, and even when the listener is on the move. ABT BCS is very affordable and allows your clients to own their own equipment. It also reduces and in many cases eliminates the need for lengthy in-clinic auditory stimulation programs.

### **Bone Conduction Background**

Although bone conduction was first referenced in 1827, the first known application of bone conduction in the field of auditory stimulation was by Dr. Tomatis in the 1960s. Up to that point in time, the application of bone conduction was a hearing aid device to improve the perception of sound in those with hearing loss or deafness. By picking up the sounds of human voice from the environment and amplifying it, those with hearing loss could be helped to hear. These hearing aids were worn behind the ear on the mastoid bone (the hard bone directly behind the ear). They vibrated the sounds being received and transmitted them into the bone which then carried the sounds to the inner ear. For this reason, bone conductors were often referred to as vibrators or transducers. A transducer is a device that changes the energy from one system into another form of energy, e.g. your loud speakers convert electrical energy into sound. This technology is still used today and has been greatly improved through the use of a system called the Baha Implant, which is surgically implanted to the skull bone and provides direct bone conduction.

Dr. Tomatis initially strapped the bone conductors to the head, either behind the ear as in a traditional hearing aid or on top of the head, separate from the air conduction headphone. He even experimented with placement on the wrist and ankles. This was in the mid 1960's in Ottawa, Canada where he was introducing his Tomatis Method into the Northern Hemisphere. As will be explained later, these early trials led Dr. Tomatis to use bone conduction to enhance listening skills and to address other problems of listening as his awareness of the importance and role of air and bone conduction grew.

As the father of auditory stimulation Dr. Tomatis found that his Tomatis Method had a profound effect in helping children with learning disabilities, attention problems, and singers who needed enrichment of their voice and enhancement of their vocal technique. However, as their pitch discrimination improved, some children experienced a heightened degree of sensitivity that expressed itself in irritability, crying spells or even aggressive behavior. These "melt downs", as they were called, were troublesome and confusing since they often occurred in the face of other positive changes such as improved speech, language or vocabulary. In addition, these children often seemed more anxious. The use of bone conduction began after many attempts on Dr. Tomatis' part to alleviate these untoward effects.

To better understand how Dr. Tomatis decided to introduce bone conduction into his method, it would be helpful to briefly review his theory of listening. For Dr. Tomatis, all listening is first and foremost through bone conduction. Air conduction is a human adaptation along evolutionary lines as we moved out of the fluid filled world of our ancestors and a necessary accommodation as we emerge from the fluid filled womb of our mothers. For Dr.

Tomatis, we listen and attend to others via air conduction and listen to ourselves through bone conduction. This role of bone conduction and self-listening informed many of his psychological theories of listening.

After much research into the perceptions of sound and the role of the muscles of the middle ear, Dr. Tomatis no longer subscribed to the traditional theory of sound traveling through the ossicular chain. Rather he believed the vibrations of the eardrum, firmly cradled by the annular ring of the temporal bone, were carried to the cochlea via the bony chamber called the osseous labyrinth. All listening is ultimately, therefore, through bone. **Dr. Tomatis thus proclaimed that good listening is accomplished with the whole body.** It was an easy leap to consider applying a bone conductor to the skull to stimulate the cochlea directly, by-passing the middle ear to enhance one's inner awareness of sound and one's own voice. As he soon discovered, this extra vibration also resulted in stimulation of the vestibular system as well, which promoted a calming and grounding effect along with improved motor control.

In the Tomatis Method, as the program progresses, it is customary to filter out low frequencies via high-pass filters during the process of listening training. In some children, the highly filtered music was over stimulating and could not be integrated, sometimes leading to the aforementioned irritability and moodiness. Once the use of the bone conductor was initiated, there was a remarkable decrease in the number of adverse responses to the auditory stimulation. In The Listening Program we also observe more grounding as the music becomes more highly filtered.

### **Theory on the Physiology of Bone Conduction**

How was the addition of listening through bone conduction simultaneously with air conduction able to have the calming effects observed? How was it that children tolerated the listening intervention so much more easily than before? Again, we return to anatomy. The inner ear resides within the petrous portion of the temporal bone which angles forward at about a 45-degree angle ending near the foramen magnum near the midline. This means the left and right inner ears are quite close to one another. Housed within this bony chamber is the membranous labyrinth that contains the cochlea and the vestibule. The vestibular system includes the three semicircular canals that provide information on rotation and dynamic movement of the head and the saccule and utricle that give the brain information on the effects of gravity and acceleration and deceleration.

Vibration of the bone is transmitted into the fluid medium of the vestibular system causing the hair cells to move in response to agitation of the calcium deposits in the macula of the utricle and saccule. The movement of the hair cells causes an electrical discharge to occur which is carried to the cerebellum, the basal ganglia and to the cortex of the brain. Through rich connections between the ear's vestibular system, cerebellar pathways and the body's muscles and joints, awareness of our body at a conscious and deep subconscious level is enhanced. This is the infrastructure of our 'psyche' or body awareness, the organizations of which is the foundation for higher learning and integration. The input from the vestibular system to the brain also charges the brain with energy at sub-cortical and cortical levels, leading to a deeper somatic awareness of ourselves as well as improved focus and attention due to this added energy input. In essence, the bone conduction through the vestibular system is grounding, meaning that we feel connected mind to body and to gravity. There is improved ability to execute the motor activities required for success in the world; be it in sports, dance, handwriting or riding a bicycle. Once the conscious attention can be freed up by making the regulation of our body movements automatic, attention can now be directed to taking on the challenges of learning, regulating our emotions, and developing the executive functions of organization, planning and impulse control.

Much of what has been described above is attributable to both air conduction and bone conduction. However, bone conduction is an added form of stimulation to the vestibular system that is stronger than air conduction alone and is particularly helpful in dealing with issues related to balance, fine and gross motor development and speech and language control. The increased input to the cortex of the brain may accelerate the maturation of the brain as well. Therefore, along with the improvements observed in balance and motor control are improvements in emotional control with reduced anxiety, fewer melt downs, less anger, crying spells and a better adjustment to the listening process.

The vagus nerve, the 10<sup>th</sup> cranial nerve, sends branches to the external surface of the eardrum and external acoustic meatus. Thus we reach out to our environment to get a "gut sense" so to speak, and to test the reliability of what we hear against our inner awareness. Stimulation of the vagus nerve also stimulates the parasympathetic

nervous system, the homeostatic branch of the autonomic nervous system. This stimulation provides another level of calming influence to that provided by the bone conduction.

We listen to ourselves through bone conduction and to others through the air. If you have ever listened to a recording of your own voice you have experienced this phenomenon. Bone conduction tends to amplify low frequencies, so most people hear their own voice as being of a lower pitch than it actually is.

As we speak our entire body resonates due in part to the speed in which sound travels through bone. Our self perception through speech is primarily through the influence of the bone conduction pathway. This is quite different from how we listen to others, whose voices are transmitted through the air.

When the body and brain are stimulated with simultaneous acoustic and somatosensory stimulation, the limbic system is engaged. With the numerous cortical and subcortical brain structures that are part of the limbic system it becomes easy to understand what a profound influence bone conduction technology can have when used with The Listening Program. The whole body becomes engaged with listening, connecting mind and body with profound influence.

### **Bone Conduction Applications**

Most listeners of all ages will achieve faster results with The Listening Program® with the addition of bone conduction technology. Bone conduction reduces the need for and duration of preparatory listening and is particularly beneficial for people with concerns or goals related to functions in Tomatis Zone One.

Following is a list of circumstances that would indicate the use of TLP with bone conduction technology:

- History of ear infections
- History of middle ear fluid
- Hearing loss
- Autism spectrum disorders
- Sensory processing problems
- Over or under arousal
- Poor self regulation
- Anxiety
- Hyperacousis or sound sensitivities
- Difficulty filtering out background sound
- Poor body awareness
- Gravitational insecurity
- Poor posture
- Balance problems
- Low muscle tone
- Poor coordination
- Poor spatial awareness
- Expressive speech and language issues
- Poor vocal production or control
- Accelerated program benefits for all listeners.

### **Bone Conduction Contraindications**

The following circumstances constitute contraindications for the use of TLP with bone conduction technology;

- Seizure disorder
- Meniere's disease

While we have no reported problems with listeners with a seizure disorder or Meniere's disease from using TLP with bone conduction technology, we list these as contraindications due to the instability of the central nervous system associated with these conditions.

When considering the use of TLP with or without bone conduction for an individual with a psychiatric diagnosis please consult with the person's psychiatrist before using The Listening Program®.

### **Protocols**

Bone conduction technology does not require special listening schedules. You will develop listening schedules as normal. However, with the addition on bone conduction, preparatory listening times can generally be reduced, and in many cases eliminated.

If you do any facility based treatments you may consider incorporating TLP with bone conduction technology into your treatment sessions and may explore a combination of clinic based and home listening. Initial clinic based listening is recommended for clients you feel need close monitoring, or if you are concerned with a family's ability to comply with a home based listening schedule.

Generally, iListen with bone conduction technology will be used throughout a client's Level One program. However, you can use the system in conjunction with any TLP albums of your choosing. If you have not been using the Level One Kits or are not comfortable in your understanding of them, we recommend that you re-attend a Provider Training Course and/or access the Level One Self-Study Kit on the Provider Resource Center Online.

When people listen with specialized bone conduction headphones for the first time, they may expect their head to really vibrate or even shake. They are often surprised to find that the bone conduction vibration is gentle and subtle. We do not perceive sound the same way with bone conduction as we do through the air. When listening through bone conduction only the music will sound muted, and give the impression to be coming from inside the listeners head at a very low volume. People may want to turn the bone conduction volume higher in order to hear it better. It is not necessary or recommended. The listener will hear the music very well through the air conduction, while the bone conduction provides gentle internal stimulation.

### **Equipment Warranty**

In order to receive service or warranty support, the ABT Bone Conduction System must be registered within 30 days of purchase. Your clients will register by going to [www.thelisteningprogram.com](http://www.thelisteningprogram.com) and clicking on the "TLP Listener Resources" button located on the home page. Then they will select "ABT Bone Conduction System Registration" and complete the form.

Advanced Brain Technologies warrants the bone conduction amplifier and bone conduction headphones (Product) to be free from defects in material and workmanship for a period of one year from purchase. If a Product proves to be defective in material or workmanship during the warranty period, ABT will at its sole option, repair or replace the Product with a similar Product. Replacement Product or parts may include remanufactured or refurbished parts or components. The replacement unit will be covered by the balance of the time remaining on the customer's original warranty.

### **References**

The following references on bone conduction have been compiled by ABT Faculty Member, Sheila Allen, MA, OTR, BCP. ABT would like to recognize Sheila and thank her for her extensive efforts in compiling this information, in our search to better understand the underlying mechanisms of bone conduction and their potential impact on improving human function.

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