

It's time we listened to our teeth: The SoundBite hearing system

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The SoundBite hearing system (Sonitus Medical, San Mateo, Calif) allows people with single-sided deafness to wear an intraoral device and a small microphone in the deaf ear to regain lost hearing. A piezoelectric activator in a small removable unilateral oral appliance conducts sound through the bone via the teeth to the good ear. The goal of this article is to introduce the SoundBite, a new bone-conduction hearing device, to dentists and orthodontists. (*Am J Orthod Dentofacial Orthop* 2010;138:666-9)

Perhaps you remember old stories about people hearing sounds in their teeth when they got new fillings or braces. In 1942, Lucille Ball discussed hearing radio broadcasts through her teeth with her friends Ethel Merman and Buster Keaton at MGM Studios. That story ended up in a Cole Porter musical and various sitcoms over the years. It is no longer just a Hollywood legend.

Sound can travel along 2 pathways—air conduction and bone conduction. Dentists know that moving the jaw and clenching the teeth can play a part in the way we perceive sound. Place a forefinger into each ear; then open and close your mouth. As you open, you can clearly feel the condyle of the mandible moving and changing the size of the external ear canal. You can hear your own teeth tap together. We hear that tapping through bone conduction to the ear. The oral structures are close to the auditory structures.

A brief review of the ear is in order. The ear consists of an outer ear, a middle ear, and an inner ear. Hearing occurs when sound vibrations strike the eardrum, the thin membrane between the outer and middle parts of the ear. The auditory ossicles vibrate, and the footplate of the stapes moves at the oval window. Movement of the oval window causes the fluid inside the scala vestibuli and the scala typani to move. Fluid movement against the cochlear duct sets off nerve impulses, which are carried to the brain via the cochlear nerve.

Although dentists are not involved in the health of the ears, as health care professionals, we use our ears

every day to help diagnose our patients and manage our staff and our businesses. Many of us have treated patients with hearing loss, and more than likely we will eventually have some level of hearing loss. Dentists in general are prone to hearing loss in the sound frequencies associated with the air turbine hand pieces that we use daily.¹

It is estimated that single-sided deafness (SSD) afflicts almost 9 million people in the United States alone.² SSD is the complete or significant loss of hearing in 1 ear. SSD can be associated with tinnitus and affects the way sound is perceived. SSD affects sufferers in different ways and can be debilitating. The inability to determine the direction or point of origin of a sound can make even the simplest day-to-day tasks such as crossing the road, cycling, and jogging both difficult and dangerous. But by far the biggest obstacle for SSD sufferers is socializing in large groups or noisy environments. In these circumstances, many sufferers feel excluded because they miss out on conversations, whereas others worry that they will appear ignorant or rude if they do not hear a question. There is a constant need to turn the good ear toward the sound; this requires unusual movements of the head, and some SSD sufferers find it embarrassing.

SOUNDBITE TECHNOLOGY

Sonitus Medical has developed an intraoral device called the SoundBite hearing system. SoundBite is different from conventional hearing aids, which use air conduction to simply turn up the volume of sound traveling into the ear. Conventional hearing aids require a functional ear. As a bone-conduction device, the SoundBite hearing system does not require a functional middle or outer ear to deliver sound. The SoundBite hearing system is designed to allow sound to travel via the teeth, through the bones, to both cochleae, bypassing the middle and outer ears entirely. By using

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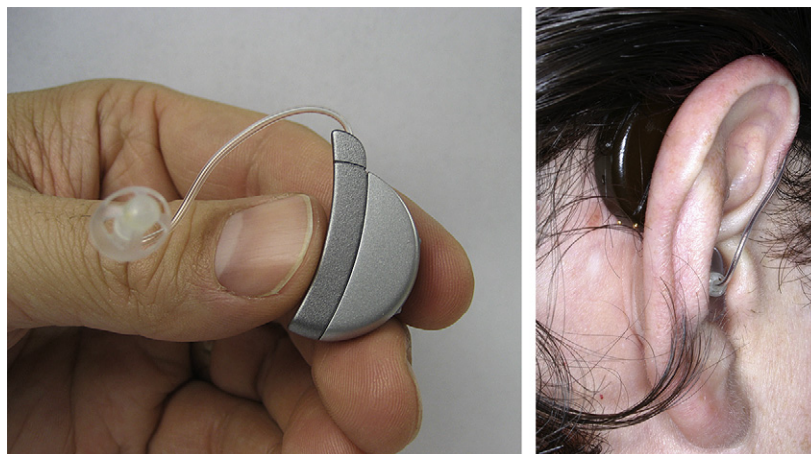


Fig 1. BTE microphone unit houses the receiver, wireless transmitter, and attached microphone.

bone conduction via the teeth, the SoundBite is intended to restore normal hearing to patients with SSD, conductive, or mixed hearing loss, all without surgery. The most prevalent devices that use bone conduction require surgery and are more expensive, such as bone-anchored hearing aids.

According to a traditional audiologic test called HINT (hearing in noise test), a 1-decibel increase is associated with a 10% increase in perceived sound for the patient. Preliminary data from ongoing trials with the SoundBite hearing system show that patients on average have an improvement of 2.6 decibels—a 26% increase in perceived hearing.³

HOW SOUNDBITE WORKS

Merging the well-known principles of bone conduction with advanced wireless and sound processing technology, the SoundBite is a nonsurgical, removable bone-conduction hearing system designed to transmit sound via the teeth. The SoundBite hearing system consists of a behind-the-ear (BTE) microphone unit (Fig 1), housing the receiver, wireless transmitter, and attached microphone, and a discreet, removable in-the-mouth (ITM) device (Fig 2). The tiny microphone sits in an open-fit dome in the ear canal of the impaired ear, where it detects sounds. Placing the microphone in the ear canal is intended to allow the SoundBite hearing system to capitalize on the natural acoustic benefit provided by the patient's own pinna, or outer ear, to capture and direct sound. Once sound is captured by the microphone, it is processed by the BTE digital audio device and transmitted wirelessly to the removable ITM hearing device. The ITM device uses advanced technology to produce imperceptible sound vibrations that are conducted via the teeth, through bone, to

both cochleae. In this way, the SoundBite hearing system is intended to provide clear, high-fidelity sound and thus restore hearing to patients who are essentially deaf in 1 ear; no surgery or modifications to the teeth are required.

The SoundBite hearing system is intended for patients who have SSD, conductive hearing loss, or mixed hearing loss and who seek a nonsurgical, noninvasive hearing device that delivers high-fidelity sound.

Sonus Medical is conducting trials of the SoundBite system; orthodontists and dentists could start seeing the devices in their patients' mouths in the not too distant future.

SoundBite is currently dispensed by a physician, such as an ear, nose, and throat specialist, who works closely with an audiologist. The physician will usually diagnose and treat any disease process of the ear. The audiologist performs a number of tests to determine the exact level of hearing loss and at what frequencies. If a decision is made that the SoundBite is the right form of treatment, then a dentist will take an impression of the maxillary arch and help with any appliance adjustments of the oral part of the device. Because this device spans several health care professions, it is an opportunity to reevaluate current referral patterns or create new ones.

The patients who might benefit from SoundBite vary in age. In our trial, a number of patients lost hearing due to acoustic neuromas—slow-growing benign tumors that can damage the acoustic nerve and are generally removed surgically. Other causes include other types of tumors, infections, and trauma. One patient had a motorcycle accident, and another caught a really bad cold that left 1 ear deaf. In the end, something damages some part of 1 ear, creating SSD.

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