Bone Conduction: How Your Skull Shapes Your Reality

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A consumer stereo bone conduction headset. The two transducers fit slightly in front of the ears.

Bone conduction is the conduction of sound to the inner ear through the bones of the skull. Bone conduction transmission can be used with individuals with normal or impaired hearing.

Overview

Bone conduction is one reason why a person's voice sounds different to them when it is recorded and played back. Because the skull conducts lower frequencies better than air, people perceive their own voices to be lower and fuller than others do, and a recording of one's own voice frequently sounds higher than one expects it to sound.

Musicians may use bone conduction while tuning stringed instruments to a tuning fork. After the fork starts vibrating, placing it in the mouth with the stem between the back teeth ensures that one continues to hear the note via bone conduction, and both hands are free to do the tuning.

Hearing aids

Some hearing aids employ bone conduction, achieving an effect equivalent to hearing directly by means of the ears. A headset is ergonomically positioned on the temple and cheek and the electromechanical transducer, which converts electric signals into mechanical vibrations, sends sound to the internal ear through the cranial bones. Likewise, a microphone can be used to record spoken sounds via bone conduction. The first description, in 1923, of a bone conduction hearing aid was Hugo Gernsback's "Osophone", which he later elaborated on with his "Phonosone".

After the discovery of Osseointegration around 1950 and its application to dentistry around 1965, it was noticed that implanted teeth conducted vibrations to the ear. As a result, bone anchored hearing aids were developed and implanted from 1977 on.

Products

Bone conduction products are usually categorized into three groups:

Ordinary products, such as hands-free headsets or headphones
Bone-anchored hearing aids and assistive listening devices
Specialized communication products (e.g. for underwater or high-noise environments)

One example of a specialized communication product is a bone conduction speaker that is used by scuba divers. The device is a rubber over-moulded, piezoelectric flexing disc that is approximately 40 millimetres (1.6 in) across and 6 millimetres (0.24 in) thick. A connecting cable is moulded into the disc, resulting in a tough, waterproof assembly. In use, the speaker is strapped against one of the dome-shaped bone protrusions behind the ear and the sound, which can be surprisingly clear and crisp, seems to come from inside the user's head.

Use in the 21st century

The Google Glass device employs bone conduction technology for the relay of information to the user through a transducer that sits beside the user's ear. The use of bone conduction means that any vocal content that is received by the Glass user is nearly inaudible to outsiders.

German broadcaster Sky Deutschland and advertising agency BBDO Germany collaborated on an advertising campaign that uses bone conduction that was premiered in Cannes, France at the International Festival of Creativity in June 2013. The "Talking Window" advertising concept uses bone conduction to transmit advertising to public transport passengers who lean their heads against glass train windows. Academics from Australia's Macquarie University suggested that, apart from not touching the window, passengers would need to use a dampening device that is made of material that would not transmit the vibration from the window.