Light-driven contact hearing aid: a removable direct-drive hearing device option for mild to severe sensorineural hearing impairment

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T41a: LIGHT-DRIVEN CONTACT HEARING AID: A REMOVABLE DIRECT-DRIVE HEARING DEVICE OPTION FOR MILD TO SEVERE SENSORINEURAL HEARING IMPAIRMENT

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The most common treatment for mild to severe sensorineural hearing impairment is acoustic hearing aids, however middle ear implants also target a portion of the sensorineural hearing loss market. Acoustic hearing aids have been limited in their ability to provide amplification for frequencies above 5 kHz due to the inability to deliver output and gain at sufficient levels to provide audibility of speech signals at high frequencies, for which the speech energy is relatively low and the hearing loss is typically rather large (Moore et al., 2008). Signal processing strategies to increase gain by methods such as cancelling the feedback are known to degrade sound quality and are still insufficient to greatly extend the upper limit of amplification (Chasin and Russo, 2004). Additionally, in acoustic hearing aids the earmold must be fully occluded in order to provide sufficient output at low frequencies, and fully plugging the ear canal can have negative effects on the user’s perception of their own voice (the occlusion effect). Middle ear implants (MEIs) offer several potential advantages to address these challenges, and the use of implantable hearing aids that function by delivering amplification via direct vibration of the middle ear have been studied in a variety of implementations (Backous and Duke, 2006; Rameh et al., 2010; Puria, 2012). Typically, a magnet or other transducer is surgically implanted and attached to an ossicle in the middle ear, which is then actuated to produce the perception of sound (Silverstein et al., 2005). The potential advantages of such a system over a conventional air conduction hearing aid include a broad frequency range with low-frequency output (while still being able to leave the ear canal open) and large amounts of functional gain (Kraus et al., 2011). A light-driven contact hearing aid option is available for mild to severe sensorineural hearing loss which offers the advantages of directly driving the ossicles while being non-surgical. The mechanism of action of the contact hearing device as well as how the devices is able to be maintained to dwell long-term in the ear non-surgically will be explained. The differences between the contact hearing aid, middle ear implants, and air conduction hearing aids will be reviewed. The contact hearing aid system performance including maximum output, maximum gain, and functional gain will be compared to both MEIs and air conduction hearing aids. Results from several clinical studies with the contact hearing aid will be presented which include objective and subjective outcome measures. Advantages and disadvantages of the device as well as areas of future investigation will be explored.