The Bonebridge system – Our clinical experience /Case report/

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Abstract:
Introduction: Bone conduction implants are a standard treatment option for patients with conductive or mixed, hearing loss. The Bonebridge system was introduced by MED-EL in 2012, and two years after its debut, it was used in more than 200 centers worldwide (6). For the first time the Bonebridge system was implanted in Bulgaria in 2015 by associated professor P. Rouev. The main audiological criteria for placement is conductive hearing loss, which is caused by atresia of the auditory canal or diseases of the middle ear with preserved bone conduction (below 45 dB), as well as unilateral hearing loss above 70 dB (contralateral hearing loss not more than 20 dB). The system does not penetrate the skin and consists of an internal part - an implant, which is placed completely under the skin, and an external part - a processor. The acoustic signal from the environment is transformed into mechanical vibrations that are transmitted to the mastoid bone. The expected results are an improved hearing threshold and better hearing in noisy environments.
Methods: Our clinical experience with the Bonebridge system is based on three operated patients aged between 56 and 73 years. All three patients had evidence of bilateral conductive hearing loss. Here we present one of these cases.
Results: Test results showed significant improvement in hearing sensitivity especially in frequencies round 1000 Hz.
Conclusions: Bone conduction implants such as the Bonebridge system are an excellent treatment option for patients with bilateral conductive deafness. Bonebridge has good hearing results, relative simplicity, and low rate of complications. Experience has shown that the Bonebridge system is easy to use and highly reliable. The use of Bonebridge conduction implant system leads to a significant improvement in the quality of life.
Keywords: Bonebridge, bone conduction, conductive hearing loss, implant, audiometry

Introduction

Bone conduction is the transmission of sound waves to the inner ear by means of vibrations of the bones of the skull. The cochlea is stimulated in three ways:

1. Compression vibration - vibrational energy turns into volumetric deformation of the labyrinth and displacement of fluids.
2. Inertia oscillation (below 800Hz) - the skull oscillates as a unit and the labyrinth moves relative to the stapes plate and oscillates the labyrinthine capsule.
3. Osteo-tympanic pathway - vibrations of the skull are transmitted to the walls of the eardrum and from there to the eardrum.

When a patient has a conductive or mixed hearing loss the conduction of the sound waves from the environment is restricted or lost. In some cases, hearing loss could be improved by healing an existing inflammatory process or repairing damage somewhere along the auditory circuit. When normal audibility cannot be restored through established methods the use of active middle ear implants is appropriate (1). According to Faris F. Brkic et al. bone conduction implants are recommended for patients with conductive, unilateral or mixed hearing loss, who are contraindicated for surgery or who do not want to use hearing aids (2). Pathologies that can lead to conductive or sensorineural hearing loss, in which Bonebridge implantation is indicated are congenital causes (atresia, microtia), acquired causes (e.g. chronic otitis), trauma that led to hearing loss, inability to use hearing aids (cavity after radical surgery, extremely narrow ear canal, resection

of the temporal bone or skull base surgery). As noted by Lassaletta et al. the active middle ear implants are surgically implanted prosthesis, which intend to stimulate the ossicular chain or the inner ear fluids through the oval or round windows (3).

In 2012 MED-EL introduced the first Bonebridge implant in Innsbruck, Austria - BCI 601 (now in use is BSI 602). This is a semi-implantable, active, transcutaneous bone conduction hearing device. The implantable part of the Bonebridge consists of the foating mass transducer (FMT), the demodulator, and a coil for receiving data from the sound processor, which is held outside on the skin surface by a magnet in the receiver coil. One of the major advantages of the device is that no skin penetration is necessary for sound transmission. Hobson et al. reported that skin penetration has been associated with higher risks of wound infections and complications (4). Bonebridge generates vibration stimulation that acts directly on the bone. It is indicated for conductive hearing loss that is caused by atresia of the auditory canal or diseases of the middle ear with preserved bone conduction (below 45 dB) and for unilateral hearing loss greater than 70 dB (contralateral hearing loss no more than 20 dB) Fig№1. The designated site for implantation of the FMT is the mastoid (sinodural angle or retrosigmoidal). Placement in the squamous portion of the temporal bone also has been described (5). The implant is fixed in the temporal bone with two screws. Careful preoperative planning is essential, and it is based on computed tomography scan data of the temporal bone. The implantability must be evaluated to avoid damage to important brain structures such as the dura mater and sigmoid sinus.

Methods

For a period of less than one year at our university hospital three patients were implanted with the Bonebridge bone-conductive hearing device. Here we present you one of them.

Patient – 56-year-old male D.T. with medical history of progressive hearing loss in both ears, periodic purulent discharge with an odor from both ears, medical history for performed conservative radical trepanation of the right ear and extended mastoidectomy of the left ear. Otoscopic findings - condition after conservative radical trepanation on the right, Cloudy left tympanic membrane with limited mobility, without perforation, operative cicatrices behind both auricles. CT data for surgical interventions - radical conservative trepanation of the right ear (Fig. №2A), and mastoidectomy with one-stage type-I tympanoplasty of the left ear (Fig. №2B).

Audiometry showed conductive hearing loss for both ears, with predominance of the sensorineural hearing loss for the high frequencies of the right ear (Fig. №3).

The implant was positioned in the retrosigmoid area (Fig. №4).

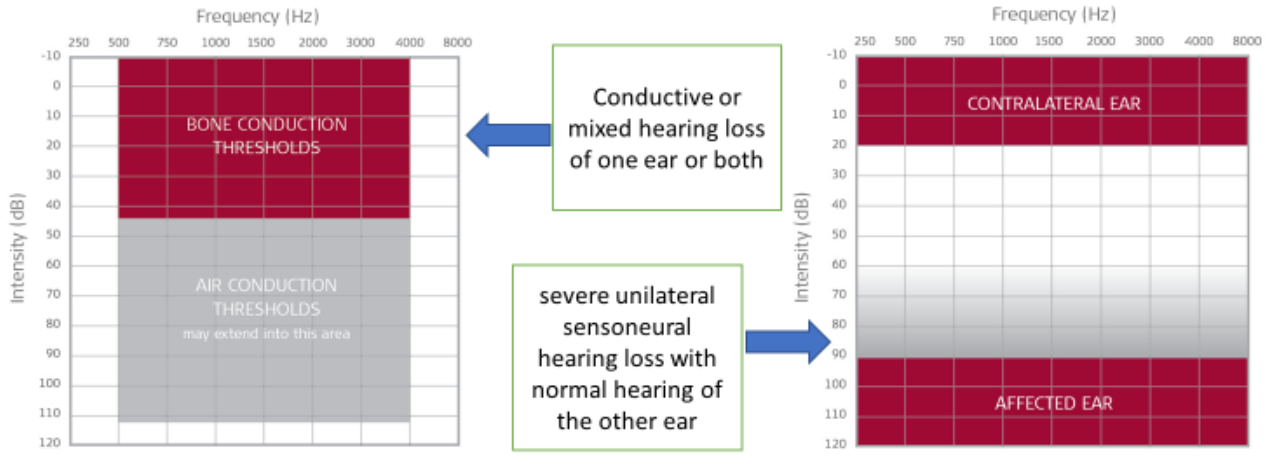

Fig №1 indications for Bonebridge implantation

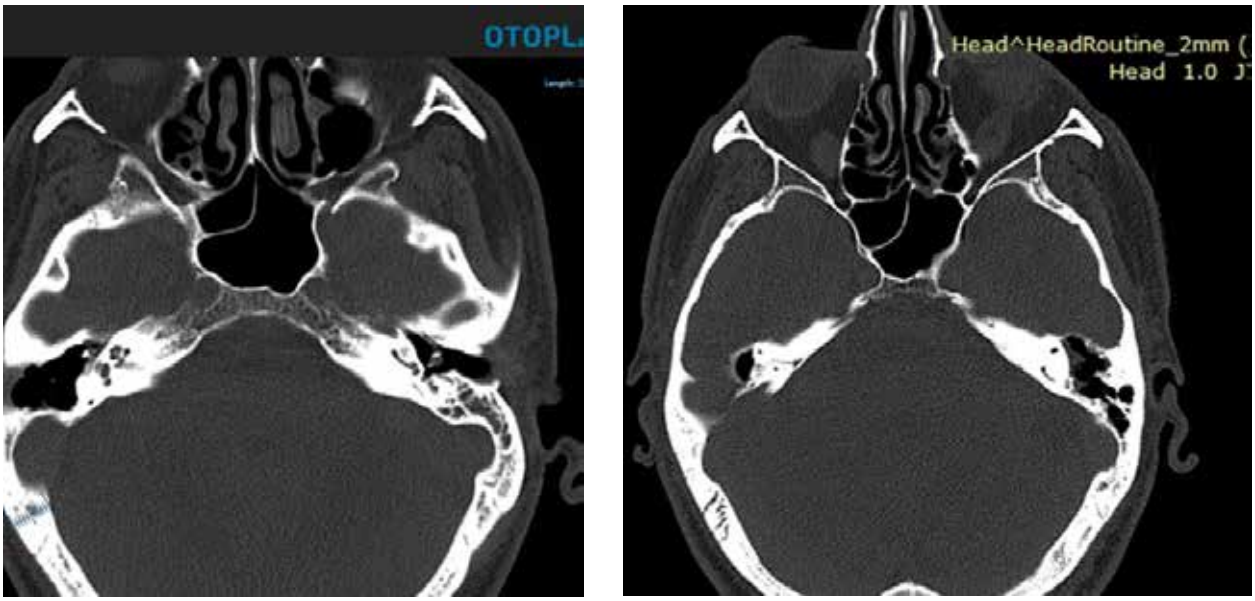

Fig. №2A and Fig. №2B. CT scan of the patient D.T. before implantation

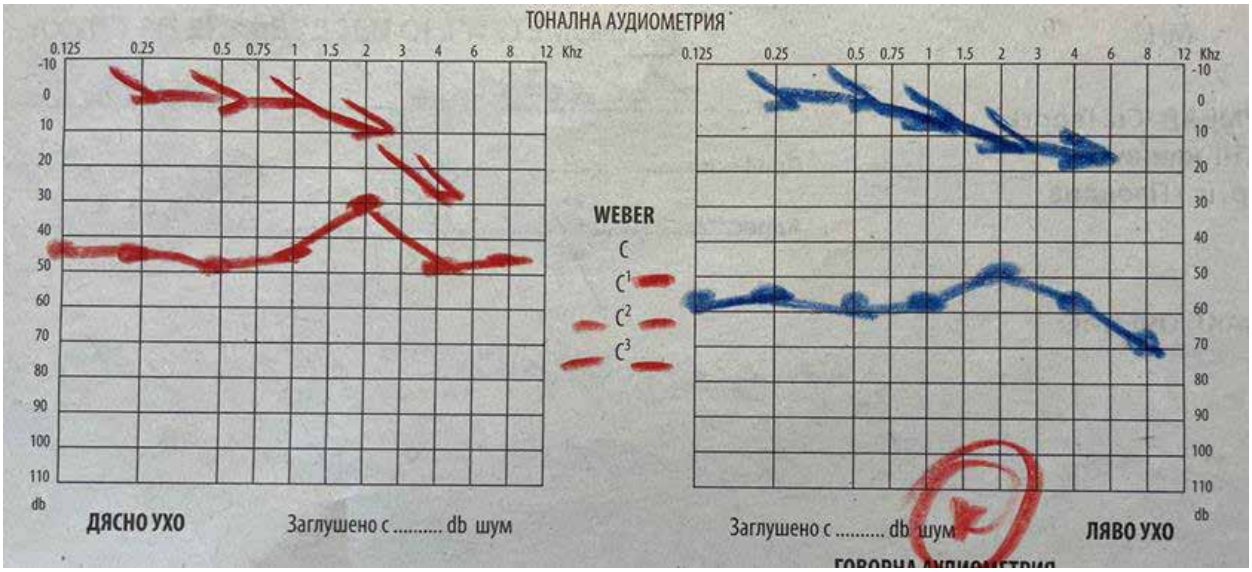

Fig. №3 Preoperative pure tone audiometry of the patient D.T.

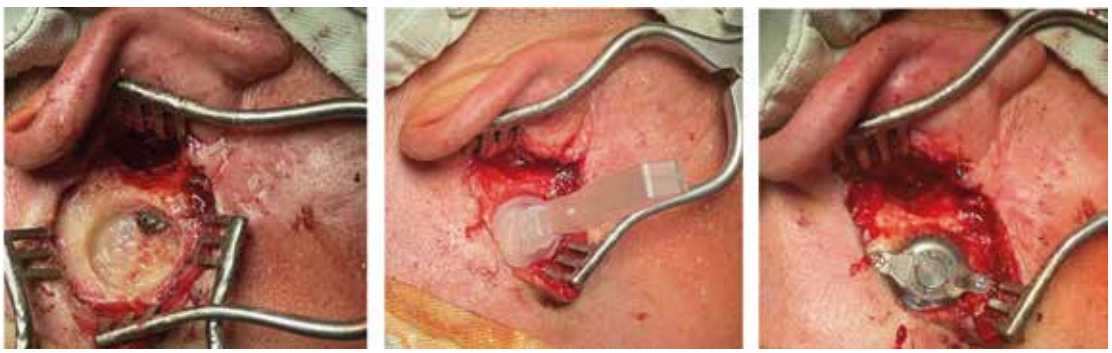

Fig. №4. patient D.T. - surgical intervention

The audio processor was programmed with a special software to fit the individuals hearing requirements and was switched on, on the thirtieth day after surgery

Results

Pure tone audiometry tests were performed before implanation and free sound field audiometry tests were used after it to evaluate the outcome of the implant placement. Test results showed significant improvement in hearing sensitivity (Fig № 5)

The highest value of functional gain was for 1000 Hz. The lowest value of functional gain was for 8000 Hz.

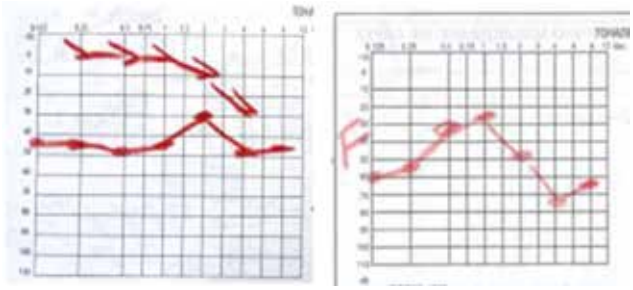

Fig №5.- Comparison of patient's hearing before and after implantation

Discussion and conclusions

The Bonebridge is an active bone conduction implant that can benefit patients with conductive or mixed hearing loss of one ear or both ears as well as patients with severe unilateral sensoneural hearing loss with normal hearing of the other ear. Especially suitable are those people who cannot tolerate hearing aids or have specific contraindications for operative interventions.

The system is applicable to both children and adults and shows good results in all age categories. Correct preoperative patient selection is extremely important. An imaging study - computed tomography - is mandatory to assess the anatomy of the temporal bone. This is done in order to avoid intraoperative complications because its close proximity to important anatomical structures such as the sigmoid sinus and the dura mater.

Performing hearing tests is extremely important to evaluate the results of the implant placement. No skin penetration is needed for the sound transmission, so the risks of complications and inflammation of the surgical wound are minimized. (7)

The operative intervention is relatively easy for the experienced surgeon, and the operative time is about an hour and a half. It is performed under general anesthesia. The postoperative period is going well. Complications are rarely observed.

Experience has shown that the Bonebridge system is easy to use and highly reliable. The rapid activation of the implant after surgery allows the recipient to "take advantage" of the results in the shortest time possible.

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