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Original Research Paper

ENT

A MODALITY FOR CONDUCTIVE HEARING LOSS- ACTIVE BONE BRIDGE CONDUCTION HEARING AID.

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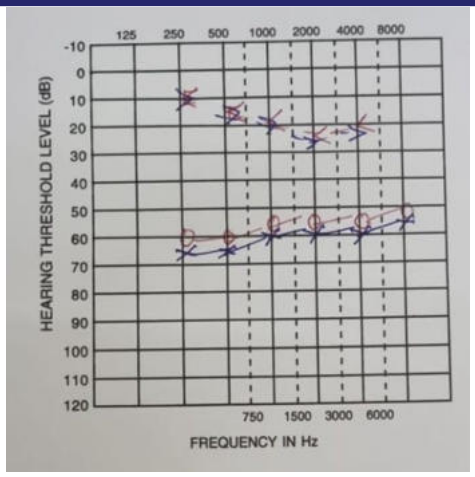
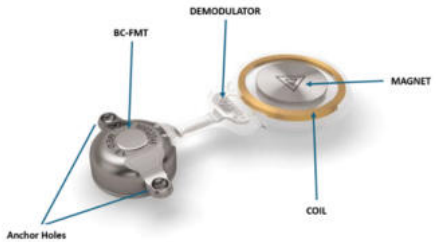
KEYWORDS :

INTRODUCTION:

Worldwide approx. 360 million persons (about 5%) of the population suffer from hearing loss & nearly 32 million are of children age group [1].Hearing is important for speech and language development. Depending on the site of the lesion 3 major types of hearing loss- Conductive hearing loss, due to lesion in outer or /& middle ear; Sensorineural hearing loss, due to lesion in inner ear or auditory pathway; Mixed hearing loss, combination of these two. There are various medical & surgical modalities of treatment available for these hearing losses.Congenital malformation of external &/or middle ear are common in population & average incidence approx. 1:10000 to 1:20000, these patients facing hearing disability (conductive type), these malformations may be unilateral or bilateral [2]. There are 2 types of hearing aid options are bone conduction hearing aids (BCHA) & Bone conduction hearing implant (BCI), BCHA has some limitations like constant pressure on skull poor sound quality inconvenience unwanted visibility for older children and adolescents that's why BCI has advantage over the BCHA [3,4].BCI are better option in recurrent otitis externa, aural atresia, unilateral hearing loss [5].Audiological criteria for bone bridge are conductive or mixed hearing loss with bone conduction threshold up to 45dB, as well as those with single sided deafness (contralateral threshold up to 0 to 20dB) [6].In 2019, Med-EL introduced updated active bone conduction implant, the bone bridge BCI-602 (older BCI- bone bridge BCI-601 in 2012, there 3 approaches for the BCI implantation: the mastoid approach, retro-sigmoid approach, middle fossa approach [6,7,8].



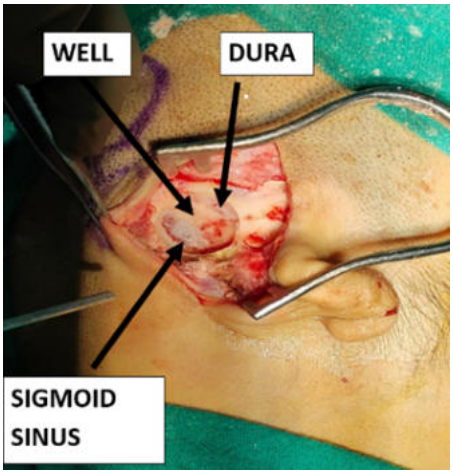
Pic-1



Pic-2

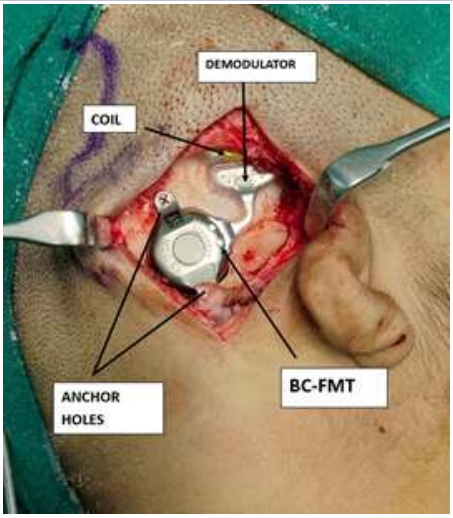
Case:

A 14-year-old female patient visited to our ENT OPD with bilateral hearing loss & bilateral grade-3 microtia with severe atresia, on audiological assessment examination she has moderate hearing loss with bone conduction at 20dB on right side & 20dB at left side & air conduction at 58dB on right side & 60dB on left side. Radiological scan shows bilateral pinna microtia, bilateral external auditory canal completely atretic, absent bilateral tympanic part of temporal bone bony segment of external auditory canal & styloid process with normal bilateral normal inner ear & internal acoustic meatus. After routine investigation & proper consent, patient is planned for the active bonebridge conduction implant-602. Intraoperative, mastoid approach was used through post aural route with appropriate marking, on drilling bone was thin, low-lying dura, sigmoid sinus placed anteriorly & inferiorly. Bonebridge implantation done successfully.



Pictures

Pic-3



Pic-4

Pic-1: Showing pure tone audiometry, BC- 20dB HL on both sides and AC 58dB HL at right side, 60dB HL at left side.
Pic-2: Showing bonebridge, bone conduction implant- 602 with parts.
Pic-3: Intra-operative finding showing well, dura & sigmoid sinus.
Pic-4: Intra-operative finding showing implant in situ.

Bonebridge is a semi-implantable device that is indicated for permanent conductive or mixed type of hearing loss either unilateral or bilateral [9,10].Audiological criteria conductive hearing loss with bone conduction <45dB, sigle sided deafness [11,12].

This Device Is Suitable Due To:

- Bio-compatible with human tissue.
- Fixation with bio-compatible screws.
- Low biofilm formation.

The materials in the Bonebridge were selected to be inert with respect to body tissue. For the implanted parts, commonly used long term implant materials were used. The materials in direct tissue contact are:

- Medical grade silicone elastomeres (types MED-4750 and MED2-4213)
- Ti 6Al 4V according to ASTM F136
- Ti 6Al 7Nb according to ASTM F1295 for the cortical screws.

Bonebridge implants are MRI compatible under 1.5tesla or less with spatial gradient field of 118 T / m or less for 15min of continues MR scanning. External part of bonebridge is presented by a sound processor, low profile SAMBA audio processor. It detects sound and sends the signal to implant coil through radio frequency transmission. The coil receives transcutaneously electronic signals from the audio processor and converts them into mechanical sound vibrations of the BC-FMT. These vibrations are directly conducted through the bone to the cochlea, where they are processed like normal sound and have the effect of a natural sound quality [13-16].

Radiological Planning:

Imagining tools are useful for the pre-operative assessment of canal, tympanic cavity, Inner ear & temporal bone. It can be done 3D slicer & BB fastview program. For correct placement of BC-FMT CT imaging in DICOM with axial, coronal, sagittal & 3D reconstruction [17].

DISCUSSION:

In 2019, Med-EL introduced updated active bone conduction implant, the bone bridge BCI-602 (older BCI- bone bridge BCI-601 in 2012). There 3 approaches for the BCI implantation: the mastoid approach, retro-sigmoid approach, middle fossa approach [6,7,8]. Effect of implant location, flap thickness and screw type on Bonebridge bone conduction implant has no significant difference in outcome [18]. Bonebridge implant surgery is safer for the pediatric population who has various anatomical limitations with lower complications [19-22].In our patient the mean word recognition score (WRS) changes from 15.3% before implantation to 82.5% at activation, this result is comparable to past studies [23-26].Bravo-Torres et al. [27] reported an improvement in speech recognition from 29.4% before surgery to 96.4% after wards, and Zernotti et al.[28] reported an improvement in speech understanding from 29.4 to 97% 1 month after activation. Regarding congenital aural atresia, Siegert, et. al[29]. Proposed three surgical steps, including treatment of microtia with plastic reconstruction. In this publication, the author reports that 76% of patients present hearing with thresholds near 30 dB. Digoy et al [30], only 50% of patients reach thresholds near 30 dB. Yellon et al.[31] published results in atresioplasty surgery with pure tone average thresholds and air-bone gaps (ABG) of 37.5 and 29.4 dB, respectively. Hobson et al.[32], in a series of over 600 implants, reported a complication rate of 23.9%, while presenting a surgical revision rate of 12.1%. Badran et al. [33] concluded that, postoperative complications that included severe skin infections in 8% of patients, while 18% of the cases presented problems with osseointegration, and an additional 8% of patients presented skin growing over the external connector. Tsang et al. [34] state "unlike traditional percutaneous bone anchored hearing aid, the use of the Bonebridge system eliminates postoperative pin tract infections, which greatly enhances the patient's quality of life as it obviates the need for daily implant wound care." Barbara et al. [35] state: "regards the comparison with the other transcutaneous devices whose efficacy is directly related to the magnetic attraction between the magnet of the external unit and the metallic implanted plaque that, in some cases, may cause problems as regards the interposed skin. In the [Bonebridge], the magnet only acts as a coupling tool for the external unit with the implanted BC-FMT and its strength does not affect the efficacy of the system, making it unlikely that any skin problems will arise." Complications that may arise are flap necrosis or infection, problem of the magnet on skin, injury to meninges or sigmoid sinus, BC-FMT may touch or press meninges and may cause damage to it but these complications are negligible in Bonebridge-602.

CONCLUSION:

Limited therapeutic options are available for the patients of conductive or mixed type of hearing loss with external and middle ear deformity. Active Bonebridge BCI-602 is suitable option for those patients with negligible complications and cosmetically better. Surgery is safe and effective among children, adolescent and adults. Proper pre-operative radiological scanning with 3D reconstruction is needed is recommended for selection of the approach of the surgery and implantation of prosthesis with or without anchors for ear prosthesis.

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