MASSACHUSETTS

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Medical Policy

Implantable Bone-Conduction and Bone-Anchored Hearing Aids

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Policy Number: 479

BCBSA Reference Number: 7.01.03 (For Plan internal use only)
NCD/LCD: N/A

Related Policies

- Cochlear Implant, #478
- Semi-Implantable and Fully Implantable Middle Ear Hearing Aid #480

Policy

Commercial Members: Managed Care (HMO and POS), PPO, and Indemnity Medicare HMO Blue[SM] and Medicare PPO Blue[SM] Members

Unilateral or bilateral fully or partially implantable bone-conduction (bone-anchored) hearing aid(s) may be **MEDICALLY NECESSARY** as an alternative to an air-conduction hearing aid in individuals 5 years of age and older with conductive or mixed hearing loss who also meets at least one of the following medical criteria:

- Congenital or surgically induced malformations (e.g., atresia) of the external ear canal or middle ear
- Chronic external otitis or otitis media
- Tumors of the external canal and/or tympanic cavity, or
- Dermatitis of the external canal.

AND meets the following audiologic criteria:

- A pure tone average bone-conduction threshold measured at 0.5, 1, 2, and 3 kHz of better than or equal to 45 dB (Baha 5, Ponto 4), 55 Db (Baha 6 Max, Baha 5 Power, Osia2, Ponto 3 Power) or 65 dB (Baha 5 SuperPower, Ponto 3 Superpower).

For bilateral implantation, individuals should meet the above audiologic criteria and have symmetrically conductive or mixed hearing loss as defined by a difference between left- and right-side bone-conduction threshold of less than 10 dB on average measured at 0.5, 1, 2, and 3 kHz (4 kHz for Baha and Ponto Pro), or less than 15 dB at individual frequencies.

An implantable bone-conduction (bone-anchored) hearing aid may be **MEDICALLY NECESSARY** as an alternative to an air-conduction contralateral routing of signal hearing aid in individuals 5 years of age and older with single-sided sensorineural deafness and normal hearing in the other ear. The pure tone average air-conduction threshold of the normal ear should be better than 20 dB measured at 0.5, 1, 2, and 3 kHz.

Other uses of bone-conduction (bone-anchored) hearing aids, including use in individuals with bilateral sensorineural hearing loss, are **INVESTIGATIONAL**.

Prior Authorization Information

Inpatient

- For services described in this policy, precertification/preauthorization **IS REQUIRED** for all products if the procedure is performed **inpatient**.

Outpatient

- For services described in this policy, see below for products where prior authorization **might be required** if the procedure is performed **outpatient**.

	Outpatient
Commercial Managed Care (HMO and POS)	Prior authorization is **not required**.
Commercial PPO and Indemnity	Prior authorization is **not required**.
Medicare HMO Blue^{SM}	Prior authorization is **not required**.
Medicare PPO Blue^{SM}	Prior authorization is **not required**.

CPT Codes / HCPCS Codes / ICD Codes

Inclusion or exclusion of a code does not constitute or imply member coverage or provider reimbursement. Please refer to the member's contract benefits in effect at the time of service to determine coverage or non-coverage as it applies to an individual member.

Providers should report all services using the most up-to-date industry-standard procedure, revenue, and diagnosis codes, including modifiers where applicable.

The following codes are included below for informational purposes only; this is not an all-inclusive list.

The above medical necessity criteria MUST be met for the following codes to be covered for Commercial Members: Managed Care (HMO and POS), PPO, Indemnity, Medicare HMO Blue and Medicare PPO Blue:

CPT Codes

CPT codes:	Code Description
69710	Implantation or replacement of electromagnetic bone conduction hearing device in temporal bone
69714	Implantation, osseointegrated implant, temporal bone, with percutaneous attachment to external speech processor/cochlear stimulator; without mastoidectomy
69716	Implantation, osseointegrated implant, skull; with magnetic transcutaneous attachment to external speech processor, within the mastoid and/or resulting in removal of less than 100 sq mm surface area of bone deep to the outer cranial cortex
69719	Osseointegrated implant revision or replacement with magnetic transcutaneous attachment to a speech processor
69726	Removal, entire osseointegrated implant, skull; with percutaneous attachment to external speech processor
69727	Removal, entire osseointegrated implant, skull; with magnetic transcutaneous attachment to external speech processor, within the mastoid and/or involving a bony defect less than 100 sq mm surface area of bone deep to the outer cranial cortex
69728	Removal, entire osseointegrated implant, skull; with magnetic transcutaneous attachment to external speech processor, outside the mastoid and involving a bony defect greater than or equal to 100 sq mm surface area of bone deep to the outer cranial cortex

69729	Implantation, osseointegrated implant, skull; with magnetic transcutaneous attachment to external speech processor, outside of the mastoid and resulting in removal of greater than or equal to 100 sq mm surface area of bone deep to the outer cranial cortex
69730	Replacement (including removal of existing device), osseointegrated implant, skull; with magnetic transcutaneous attachment to external speech processor, outside the mastoid and involving a bony defect greater than or equal to 100 sq mm surface area of bone deep to the outer cranial cortex

HCPCS Codes

HCPCS codes:	**Code Description**
L8690	Auditory osseointegrated device, includes all internal and external components

The following ICD Diagnosis Codes are considered medically necessary when submitted with the CPT/HCPCS codes above if medical necessity criteria are met:

ICD-10 Diagnosis Codes

ICD-10-CM Diagnosis codes:	**Code Description**
C30.1	Malignant neoplasm of middle ear
C44.201	Unspecified malignant neoplasm of skin of unspecified ear and external auricular canal
C44.202	Unspecified malignant neoplasm of skin of right ear and external auricular canal
C44.209	Unspecified malignant neoplasm of skin of left ear and external auricular canal
H60.399	Other infective otitis externa, unspecified ear
H60.60	Unspecified chronic otitis externa, unspecified ear
H60.61	Unspecified chronic otitis externa, right ear
H60.62	Unspecified chronic otitis externa, left ear
H60.63	Unspecified chronic otitis externa, bilateral
H60.8x1	Other otitis externa, right ear
H60.8x2	Other otitis externa, left ear
H60.8x3	Other otitis externa, bilateral
H60.8x9	Other otitis externa, unspecified ear
H60.90	Unspecified otitis externa, unspecified ear
H60.91	Unspecified otitis externa, right ear
H60.92	Unspecified otitis externa, left ear
H60.93	Unspecified otitis externa, bilateral
H61.391	Other acquired stenosis of right external ear canal
H61.392	Other acquired stenosis of left external ear canal
H61.393	Other acquired stenosis of external ear canal, bilateral
H61.399	Other acquired stenosis of external ear canal, unspecified ear
H62.8x1	Other disorders of right external ear in diseases classified elsewhere
H62.8x2	Other disorders of left external ear in diseases classified elsewhere
H62.8x3	Other disorders of external ear in diseases classified elsewhere, bilateral
H62.8x9	Other disorders of external ear in diseases classified elsewhere, unspecified ear
H65.20	Chronic serous otitis media, unspecified ear
H65.21	Chronic serous otitis media, right ear
H65.22	Chronic serous otitis media, left ear
H65.23	Chronic serous otitis media, bilateral
H65.30	Chronic mucoid otitis media, unspecified ear
H65.31	Chronic mucoid otitis media, right ear

H65.32	Chronic mucoid otitis media, left ear
H65.33	Chronic mucoid otitis media, bilateral
H65.411	Chronic allergic otitis media, right ear
H65.412	Chronic allergic otitis media, left ear
H65.413	Chronic allergic otitis media, bilateral
H65.419	Chronic allergic otitis media, unspecified ear
H65.491	Other chronic nonsuppurative otitis media, right ear
H65.492	Other chronic nonsuppurative otitis media, left ear
H65.493	Other chronic nonsuppurative otitis media, bilateral
H65.499	Other chronic nonsuppurative otitis media, unspecified ear
H66.10	Chronic tubotympanic suppurative otitis media, unspecified
H66.11	Chronic tubotympanic suppurative otitis media, right ear
H66.12	Chronic tubotympanic suppurative otitis media, left ear
H66.13	Chronic tubotympanic suppurative otitis media, bilateral
H66.20	Chronic atticoantral suppurative otitis media, unspecified ear
H66.21	Chronic atticoantral suppurative otitis media, right ear
H66.22	Chronic atticoantral suppurative otitis media, left ear
H66.23	Chronic atticoantral suppurative otitis media, bilateral
H66.3X1	Other chronic suppurative otitis media, right ear
H66.3X2	Other chronic suppurative otitis media, left ear
H66.3X3	Other chronic suppurative otitis media, bilateral
H66.3X9	Other chronic suppurative otitis media, unspecified ear
H90.0	Conductive hearing loss, bilateral
H90.11	Conductive hearing loss, unilateral, right ear, with unrestricted hearing on the contralateral side
H90.12	Conductive hearing loss, unilateral, left ear, with unrestricted hearing on the contralateral side
H90.2	Conductive hearing loss, unspecified
H90.41	Sensorineural hearing loss, unilateral, right ear, with unrestricted hearing on the contralateral side
H90.42	Sensorineural hearing loss, unilateral, left ear, with unrestricted hearing on the contralateral side
H90.6	Mixed conductive and sensorineural hearing loss, bilateral
H90.71	Mixed conductive and sensorineural hearing loss, unilateral, right ear, with unrestricted hearing on the contralateral side
H90.72	Mixed conductive and sensorineural hearing loss, unilateral, left ear, with unrestricted hearing on the contralateral side
H90.8	Mixed conductive and sensorineural hearing loss, unspecified
H90.A11	Conductive hearing loss, unilateral, right ear with restricted hearing on the contralateral side
H90.A12	Conductive hearing loss, unilateral, left ear with restricted hearing on the contralateral side
H90.A21	Sensorineural hearing loss, unilateral, right ear, with restricted hearing on the contralateral side
H90.A22	Sensorineural hearing loss, unilateral, left ear, with restricted hearing on the contralateral side
H90.A31	Mixed conductive and sensorineural hearing loss, unilateral, right ear with restricted hearing on the contralateral side
H90.A32	Mixed conductive and sensorineural hearing, unilateral, left ear with restricted hearing on the contralateral side
Q16.1	Congenital absence, atresia and stricture of auditory canal (external)
Q16.4	Other congenital malformations of middle ear

Description

Hearing Loss

Hearing loss is described as conductive, sensorineural, or mixed, and can be unilateral or bilateral. Normal hearing detects sound at or below 20 decibels (dB). The American Speech Language Hearing Association has defined degree of hearing loss based on pure-tone average detection thresholds as mild (20 to 40 dB), moderate (40 to 60 dB), severe (60 to 80 dB), and profound (≥80 dB). Pure-tone average is calculated by averaging hearing sensitivities (ie, the minimum volume that a patient hears) at multiple frequencies (perceived as pitch), typically within the range of 0.25 to 8 kHz.

Sound amplification using an air-conduction (AC) hearing aid can provide benefit to patients with sensorineural or mixed hearing loss. Contralateral routing of signal (CROS) is a system in which a microphone on the affected side transmits a signal to an AC hearing aid on the normal or less affected side.

Treatment

External bone-conduction hearing devices function by transmitting sound waves through the bone to the ossicles of the middle ear. The external devices must be applied close to the temporal bone, with either a steel spring over the top of the head or a spring-loaded arm on a pair of spectacles. These devices may be associated with pressure headaches or soreness.

A bone-anchored implant system combines a vibrational transducer coupled directly to the skull via a percutaneous abutment that permanently protrudes through the skin from a small titanium implant anchored in the temporal bone. The system is based on osseointegration through which living tissue integrates with titanium in the implant over 3 to 6 months, conducting amplified and processed sound via the skull bone directly to the cochlea. The lack of intervening skin permits the transmission of vibrations at a lower energy level than required for external bone-conduction hearing aids. Implantable bone-conduction hearing systems are primarily indicated for people with conductive or mixed sensorineural or conductive hearing loss. These may also be used with CROS as an alternative to an AC hearing aid for individuals with unilateral sensorineural hearing loss.

Partially implantable magnetic bone-conduction hearing systems also referred to as transcutaneous bone-anchored systems, are an alternative to bone-conduction hearing systems that connect to bone percutaneously via an abutment. With this technique, acoustic transmission occurs transcutaneously via magnetic coupling of the external sound processor and the internally implanted device components. The bone-conduction hearing processor contains magnets that adhere externally to magnets implanted in shallow bone beds with the bone-conduction hearing implant. Because the processor adheres magnetically to the implant, there is no need for a percutaneous abutment to physically connect the external and internal components. To facilitate greater transmission of acoustics between magnets, skin thickness may be reduced to 4 to 5 mm over the implant when it is surgically placed.

Summary

Sensorineural, conductive, and mixed hearing loss may be treated with various devices, including conventional air-conduction or bone-conduction external hearing aids. Air-conduction hearing aids may not be suitable for patients with chronic middle ear and ear canal infections, atresia of the external canal, or an ear canal that cannot accommodate an ear mold. Bone-conduction hearing aids may be useful for individuals with conductive hearing loss, or (if used with contralateral routing of signal), for unilateral sensorineural hearing loss. Implantable, bone-anchored hearing aids (BAHAs) that use a percutaneous or transcutaneous connection to a sound processor have been investigated as alternatives to conventional bone-conduction hearing aids for patients with conductive or mixed hearing loss or for patients with unilateral single-sided sensorineural hearing loss.

For individuals who have conductive or mixed hearing loss who receive an implantable BAHA with a percutaneous abutment or a partially implantable BAHA with transcutaneous coupling to the sound processor, the evidence includes observational studies that have reported pre-post differences in hearing parameters after treatment with BAHAs. Relevant outcomes are functional outcomes, quality of life, and treatment-related morbidity. No prospective trials were identified. Observational studies reporting on

within-subjects changes in hearing have generally reported hearing improvements with the devices. Given the objectively measured outcomes and the largely invariable natural history of hearing loss in individuals who would be eligible for an implantable bone-conduction device, the demonstrated improvements in hearing after device placement can be attributed to the device. Studies of partially implantable BAHAs have similarly demonstrated within-subject's improvements in hearing. The single-arm studies have shown improvements in hearing in the device-aided state. No direct comparisons other than within-individual comparisons with external hearing aids were identified, but, for individuals unable to wear an external hearing aid, there may be few alternative treatments. The evidence is sufficient to determine that the technology results in an improvement in the net health outcome.

For individuals who have unilateral sensorineural hearing loss who receive a fully or partially implantable BAHA with the contralateral routing of signal, the evidence includes an RCT, multiple prospective and retrospective case series, and a systematic review. Relevant outcomes are functional outcomes, quality of life, and treatment-related morbidity. Single-arm case series, with sample sizes ranging from 9 to 180 patients, have generally reported improvements in patient-reported speech quality, speech perception in noise, and satisfaction with bone-conduction devices with contralateral routing of the signal. However, a well-conducted systematic review of studies comparing bone-anchored devices with hearing aids using contralateral routing of signal found no evidence of improvement in speech recognition or hearing localization. The single RCT included in the systematic review was a pilot study enrolling only 10 patients and, therefore, does not provide definitive evidence. Quality RCTs on BAHA for unilateral sensorineural hearing loss are lacking. The evidence is insufficient to determine that the technology results in an improvement in the net health outcome.

For patients with single-sided sensorineural deafness, a binaural hearing benefit may be provided by way of contralateral routing of signals to the hearing ear. There is evidence that bilateral hearing assistance devices improve hearing to a greater degree than unilateral devices. BAHAs may be considered an alternative to external devices in patients who are not candidates for external devices. By extension, the use of an implantable bone-conduction device with contralateral routing of the signal may be considered medically necessary in patients with unilateral sensorineural deafness.

Policy History

Date	Action
4/2024	Annual policy review. References updated. Policy statements unchanged.
4/2023	Annual policy review. Minor editorial refinements to policy statements; intent unchanged.
1/2023	Clarified coding information.
3/2022	Annual policy review. Policy statements unchanged.
1/2022	Clarified coding information.
7/2021	Clarification made to policy statement for FDA approved devices.
4/2021	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
4/2020	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
4/2019	Annual policy review. Description, summary, and references updated. Policy statements unchanged.
3/2017	Annual policy review. New references added.
12/2016	Annual policy review. Policy statements changed to remove investigational statement for partially implantable devices. References added. Clarified coding information Effective 12/1/2016.
8/2016	New medically necessary indications described for partially implantable bone conduction hearing systems using magnetic coupling for acoustic transmission. Effective 8/1/2016.
4/2016	Annual policy review. New references added.
2/2016	Clarified coding information.
3/2015	Annual policy review. New references added.
7/2014	Updated Coding section with ICD10 procedure and diagnosis codes, effective 10/2015.

3/2014	Annual policy review. Investigational statement clarified. Effective 3/1/2014.
11/2013	Coding information clarified.
5/2013	Annual policy review. New references added.
2/2013	Annual policy review. New references added.
2007-2012	Reviewed - Medical Policy Group - Allergy and ENT/Otolaryngology. No changes to policy statements.

Information Pertaining to All Blue Cross Blue Shield Medical Policies

Click on any of the following terms to access the relevant information:
Medical Policy Terms of Use
Managed Care Guidelines
Indemnity/PPO Guidelines
Clinical Exception Process
Medical Technology Assessment Guidelines

References

1. Heath E, Dawoud MM, Stavrakas M, et al. The outcomes of bilateral bone conduction hearing devices (BCHD) implantation in the treatment of hearing loss: A systematic review. Cochlear Implants Int. Mar 2022; 23(2): 95-108. PMID 34852723
2. Janssen RM, Hong P, Chadha NK. Bilateral bone-anchored hearing aids for bilateral permanent conductive hearing loss: a systematic review. Otolaryngol Head Neck Surg. Sep 2012; 147(3): 412-22. PMID 22714424
3. Bosman AJ, Snik AF, van der Pouw CT, et al. Audiometric evaluation of bilaterally fitted bone-anchored hearing aids. Audiology. 2001; 40(3): 158-67. PMID 11465298
4. Priwin C, Stenfelt S, Granström G, et al. Bilateral bone-anchored hearing aids (BAHAs): an audiometric evaluation. Laryngoscope. Jan 2004; 114(1): 77-84. PMID 14709999
5. Snik AF, Mylanus EA, Proops DW, et al. Consensus statements on the BAHA system: where do we stand at present?. Ann Otol Rhinol Laryngol Suppl. Dec 2005; 195: 2-12. PMID 16619473
6. Dun CA, de Wolf MJ, Mylanus EA, et al. Bilateral bone-anchored hearing aid application in children: the Nijmegen experience from 1996 to 2008. Otol Neurotol. Jun 2010; 31(4): 615-23. PMID 20393374
7. Ho EC, Monksfield P, Egan E, et al. Bilateral Bone-anchored Hearing Aid: impact on quality of life measured with the Glasgow Benefit Inventory. Otol Neurotol. Oct 2009; 30(7): 891-6. PMID 19692937
8. Briggs R, Van Hasselt A, Luntz M, et al. Clinical performance of a new magnetic bone conduction hearing implant system: results from a prospective, multicenter, clinical investigation. Otol Neurotol. Jun 2015; 36(5): 834-41. PMID 25634465
9. Denoyelle F, Coudert C, Thierry B, et al. Hearing rehabilitation with the closed skin bone-anchored implant Sophono Alpha1: results of a prospective study in 15 children with ear atresia. Int J Pediatr Otorhinolaryngol. Mar 2015; 79(3): 382-7. PMID 25617189
10. Gawęcki W, Gibasiewicz R, Marszał J, et al. The evaluation of a surgery and the short-term benefits of a new active bone conduction hearing implant - the Osia®. Braz J Otorhinolaryngol. 2022; 88(3): 289-295. PMID 32713797
11. Hol MK, Nelissen RC, Agterberg MJ, et al. Comparison between a new implantable transcutaneous bone conductor and percutaneous bone-conduction hearing implant. Otol Neurotol. Aug 2013; 34(6): 1071-5. PMID 23598702
12. Nelissen RC, Agterberg MJ, Hol MK, et al. Three-year experience with the Sophono in children with congenital conductive unilateral hearing loss: tolerability, audiometry, and sound localization compared to a bone-anchored hearing aid. Eur Arch Otorhinolaryngol. Oct 2016; 273(10): 3149-56. PMID 26924741
13. Iseri M, Orhan KS, Tuncer U, et al. Transcutaneous Bone-anchored Hearing Aids Versus Percutaneous Ones: Multicenter Comparative Clinical Study. Otol Neurotol. Jun 2015; 36(5): 849-53. PMID 25730451
14. Gerdes T, Salcher RB, Schwab B, et al. Comparison of Audiological Results Between a Transcutaneous and a Percutaneous Bone Conduction Instrument in Conductive Hearing Loss. Otol Neurotol. Jul 2016; 37(6): 685-91. PMID 27093021

15. Kim Y, Choe G, Oh H, et al. A comparative study of audiological outcomes and compliance between the Osia system and other bone conduction hearing implants. Eur Arch Otorhinolaryngol. May 2023; 280(5): 2217-2224. PMID 36318324
16. Dimitriadis PA, Farr MR, Allam A, et al. Three year experience with the cochlear BAHA attract implant: a systematic review of the literature. BMC Ear Nose Throat Disord. 2016; 16: 12. PMID 27733813
17. Reddy-Kolanu R, Gan R, Marshall AH. A case series of a magnetic bone conduction hearing implant. Ann R Coll Surg Engl. Nov 2016; 98(8): 552-553. PMID 27490984
18. Siegert R. Partially implantable bone conduction hearing aids without a percutaneous abutment (Otomag): technique and preliminary clinical results. Adv Otorhinolaryngol. 2011; 71: 41-46. PMID 21389703
19. Powell HR, Rolfe AM, Birman CS. A Comparative Study of Audiologic Outcomes for Two Transcutaneous Bone-Anchored Hearing Devices. Otol Neurotol. Sep 2015; 36(9): 1525-31. PMID 26375976
20. O'Niel MB, Runge CL, Friedland DR, et al. Patient Outcomes in Magnet-Based Implantable Auditory Assist Devices. JAMA Otolaryngol Head Neck Surg. Jun 2014; 140(6): 513-20. PMID 24763485
21. Centric A, Chennupati SK. Abutment-free bone-anchored hearing devices in children: initial results and experience. Int J Pediatr Otorhinolaryngol. May 2014; 78(5): 875-8. PMID 24612554
22. Baker S, Centric A, Chennupati SK. Innovation in abutment-free bone-anchored hearing devices in children: Updated results and experience. Int J Pediatr Otorhinolaryngol. Oct 2015; 79(10): 1667-72. PMID 26279245
23. Marsella P, Scorpecci A, Vallarino MV, et al. Sophono in Pediatric Patients: The Experience of an Italian Tertiary Care Center. Otolaryngol Head Neck Surg. Aug 2014; 151(2): 328-32. PMID 24714216
24. Magliulo G, Turchetta R, Iannella G, et al. Sophono Alpha System and subtotal petrosectomy with external auditory canal blind sac closure. Eur Arch Otorhinolaryngol. Sep 2015; 272(9): 2183-90. PMID 24908070
25. Carnevale C, Morales-Olavarría C, Til-Pérez G, et al. Bonebridge ® bone conduction implant. Hearing outcomes and quality of life in patients with conductive/mixed hearing loss. Eur Arch Otorhinolaryngol. Apr 2023; 280(4): 1611-1619. PMID 36063211
26. Cywka KB, Skarzynski PH, Krol B, et al. Evaluation of the Bonebridge BCI 602 active bone conductive implant in adults: efficacy and stability of audiological, surgical, and functional outcomes. Eur Arch Otorhinolaryngol. Jul 2022; 279(7): 3525-3534. PMID 35182185
27. Huber AM, Strauchmann B, Caversaccio MD, et al. Multicenter Results With an Active Transcutaneous Bone Conduction Implant in Patients With Single-sided Deafness. Otol Neurotol. Feb 01 2022; 43(2): 227-235. PMID 34816809
28. Hundertpfund J, Meyer JE, Ovari A. Long-term audiological benefit with an active transcutaneous bone-conduction device: a retrospective cohort analysis. Eur Arch Otorhinolaryngol. Jul 2022; 279(7): 3309-3326. PMID 34424382
29. Seiwerth I, Fröhlich L, Schilde S, et al. Clinical and functional results after implantation of the bonebridge, a semi-implantable, active transcutaneous bone conduction device, in children and adults. Eur Arch Otorhinolaryngol. Jan 2022; 279(1): 101-113. PMID 33674927
30. Šikolová S, Urík M, Hošnová D, et al. Two Bonebridge bone conduction hearing implant generations: audiological benefit and quality of hearing in children. Eur Arch Otorhinolaryngol. Jul 2022; 279(7): 3387-3398. PMID 34495351
31. Bravo-Torres S, Der-Mussa C, Fuentes-López E. Active transcutaneous bone conduction implant: audiological results in paediatric patients with bilateral microtia associated with external auditory canal atresia. Int J Audiol. Jan 2018; 57(1): 53-60. PMID 28857620
32. Schmerber S, Deguine O, Marx M, et al. Safety and effectiveness of the Bonebridge transcutaneous active direct-drive bone-conduction hearing implant at 1-year device use. Eur Arch Otorhinolaryngol. Apr 2017; 274(4): 1835-1851. PMID 27475796
33. Rahne T, Seiwerth I, Götze G, et al. Functional results after Bonebridge implantation in adults and children with conductive and mixed hearing loss. Eur Arch Otorhinolaryngol. Nov 2015; 272(11): 3263-9. PMID 25425039
34. Laske RD, Röösli C, Pfiffner F, et al. Functional Results and Subjective Benefit of a Transcutaneous Bone Conduction Device in Patients With Single-Sided Deafness. Otol Neurotol. Aug 2015; 36(7): 1151-6. PMID 26111077

35. Riss D, Arnoldner C, Baumgartner WD, et al. Indication criteria and outcomes with the Bonebridge transcutaneous bone-conduction implant. Laryngoscope. Dec 2014; 124(12): 2802-6. PMID 25142577
36. Manrique M, Sanhueza I, Manrique R, et al. A new bone conduction implant: surgical technique and results. Otol Neurotol. Feb 2014; 35(2): 216-20. PMID 24448280
37. Ihler F, Volbers L, Blum J, et al. Preliminary functional results and quality of life after implantation of a new bone conduction hearing device in patients with conductive and mixed hearing loss. Otol Neurotol. Feb 2014; 35(2): 211-5. PMID 24448279
38. Desmet J, Wouters K, De Bodt M, et al. Long-term subjective benefit with a bone conduction implant sound processor in 44 patients with single-sided deafness. Otol Neurotol. Jul 2014; 35(6): 1017-25. PMID 24751733
39. Işeri M, Orhan KS, Kara A, et al. A new transcutaneous bone anchored hearing device - the Baha® Attract System: the first experience in Turkey. Kulak Burun Bogaz Ihtis Derg. 2014; 24(2): 59-64. PMID 24835899
40. Peters JP, Smit AL, Stegeman I, et al. Review: Bone conduction devices and contralateral routing of sound systems in single-sided deafness. Laryngoscope. Jan 2015; 125(1): 218-26. PMID 25124297
41. Baguley DM, Bird J, Humphriss RL, et al. The evidence base for the application of contralateral bone anchored hearing aids in acquired unilateral sensorineural hearing loss in adults. Clin Otolaryngol. Feb 2006; 31(1): 6-14. PMID 16441794
42. den Besten CA, Monksfield P, Bosman A, et al. Audiological and clinical outcomes of a transcutaneous bone conduction hearing implant: Six-month results from a multicentre study. Clin Otolaryngol. Mar 2019; 44(2): 144-157. PMID 30358920
43. Leterme G, Bernardeschi D, Bensemman A, et al. Contralateral routing of signal hearing aid versus transcutaneous bone conduction in single-sided deafness. Audiol Neurootol. 2015; 20(4): 251-60. PMID 26021779
44. Snapp HA, Holt FD, Liu X, et al. Comparison of Speech-in-Noise and Localization Benefits in Unilateral Hearing Loss Subjects Using Contralateral Routing of Signal Hearing Aids or Bone-Anchored Implants. Otol Neurotol. Jan 2017; 38(1): 11-18. PMID 27846038
45. Zeitler DM, Snapp HA, Telischi FF, et al. Bone-anchored implantation for single-sided deafness in patients with less than profound hearing loss. Otolaryngol Head Neck Surg. Jul 2012; 147(1): 105-11. PMID 22368043
46. Pai I, Kelleher C, Nunn T, et al. Outcome of bone-anchored hearing aids for single-sided deafness: a prospective study. Acta Otolaryngol. Jul 2012; 132(7): 751-5. PMID 22497318
47. Saroul N, Akkari M, Pavier Y, et al. Long-term benefit and sound localization in patients with single-sided deafness rehabilitated with an osseointegrated bone-conduction device. Otol Neurotol. Jan 2013; 34(1): 111-4. PMID 23202156
48. Lin LM, Bowditch S, Anderson MJ, et al. Amplification in the rehabilitation of unilateral deafness: speech in noise and directional hearing effects with bone-anchored hearing and contralateral routing of signal amplification. Otol Neurotol. Feb 2006; 27(2): 172-82. PMID 16436986
49. Kunst SJ, Leijendeckers JM, Mylanus EA, et al. Bone-anchored hearing aid system application for unilateral congenital conductive hearing impairment: audiometric results. Otol Neurotol. Jan 2008; 29(1): 2-7. PMID 18199951
50. Kunst SJ, Hol MK, Mylanus EA, et al. Subjective benefit after BAHA system application in patients with congenital unilateral conductive hearing impairment. Otol Neurotol. Apr 2008; 29(3): 353-58. PMID 18494142
51. Gluth MB, Eager KM, Eikelboom RH, et al. Long-term benefit perception, complications, and device malfunction rate of bone-anchored hearing aid implantation for profound unilateral sensorineural hearing loss. Otol Neurotol. Dec 2010; 31(9): 1427-34. PMID 20729779
52. Faber HT, Nelissen RC, Kramer SE, et al. Bone-anchored hearing implants in single-sided deafness patients: Long-term use and satisfaction by gender. Laryngoscope. Dec 2015; 125(12): 2790-5. PMID 26152833
53. Monini S, Musy I, Filippi C, et al. Bone conductive implants in single-sided deafness. Acta Otolaryngol. Apr 2015; 135(4): 381-8. PMID 25720582
54. AlFarraj A, AlIbrahim M, AlHajjaj H, et al. Transcutaneous Bone Conduction Implants in Patients With Single-Sided Deafness: Objective and Subjective Evaluation. Ear Nose Throat J. May 02 2022: 1455613221099996. PMID 35499947

55. Amonoo-Kuofi K, Kelly A, Neeff M, et al. Experience of bone-anchored hearing aid implantation in children younger than 5 years of age. Int J Pediatr Otorhinolaryngol. Apr 2015; 79(4): 474-80. PMID 25680294
56. Marsella P, Scorpecci A, Pacifico C, et al. Pediatric BAHA in Italy: the "Bambino Gesù" Children's Hospital's experience. Eur Arch Otorhinolaryngol. Feb 2012; 269(2): 467-74. PMID 21739094
57. Davids T, Gordon KA, Clutton D, et al. Bone-anchored hearing aids in infants and children younger than 5 years. Arch Otolaryngol Head Neck Surg. Jan 2007; 133(1): 51-5. PMID 17224524
58. McDermott AL, Williams J, Kuo MJ, et al. The role of bone anchored hearing aids in children with Down syndrome. Int J Pediatr Otorhinolaryngol. Jun 2008; 72(6): 751-7. PMID 18433885
59. Schwab B, Wimmer W, Severens JL, et al. Adverse events associated with bone-conduction and middle-ear implants: a systematic review. Eur Arch Otorhinolaryngol. Feb 2020; 277(2): 423-438. PMID 31749056
60. Verheij E, Bezdjian A, Grolman W, et al. A Systematic Review on Complications of Tissue Preservation Surgical Techniques in Percutaneous Bone Conduction Hearing Devices. Otol Neurotol. Aug 2016; 37(7): 829-37. PMID 27273402
61. Kiringoda R, Lustig LR. A meta-analysis of the complications associated with osseointegrated hearing aids. Otol Neurotol. Jul 2013; 34(5): 790-4. PMID 23739555
62. Dun CA, Faber HT, de Wolf MJ, et al. Assessment of more than 1,000 implanted percutaneous bone conduction devices: skin reactions and implant survival. Otol Neurotol. Feb 2012; 33(2): 192-8. PMID 22246385
63. Hobson JC, Roper AJ, Andrew R, et al. Complications of bone-anchored hearing aid implantation. J Laryngol Otol. Feb 2010; 124(2): 132-6. PMID 19968889
64. Wallberg E, Granström G, Tjellström A, et al. Implant survival rate in bone-anchored hearing aid users: long-term results. J Laryngol Otol. Nov 2011; 125(11): 1131-5. PMID 21774847
65. Kraai T, Brown C, Neeff M, et al. Complications of bone-anchored hearing aids in pediatric patients. Int J Pediatr Otorhinolaryngol. Jun 2011; 75(6): 749-53. PMID 21470698
66. Allis TJ, Owen BD, Chen B, et al. Longer length Baha™ abutments decrease wound complications and revision surgery. Laryngoscope. Apr 2014; 124(4): 989-92. PMID 24114744
67. Calvo Bodnia N, Foghsgaard S, Nue Møller M, et al. Long-term results of 185 consecutive osseointegrated hearing device implantations: a comparison among children, adults, and elderly. Otol Neurotol. Dec 2014; 35(10): e301-6. PMID 25122598
68. Rebol J. Soft tissue reactions in patients with bone anchored hearing aids. Ir J Med Sci. Jun 2015; 184(2): 487-91. PMID 24913737
69. Larsson A, Tjellström A, Stalfors J. Implant losses for the bone-anchored hearing devices are more frequent in some patients. Otol Neurotol. Feb 2015; 36(2): 336-40. PMID 24809279
70. den Besten CA, Nelissen RC, Peer PG, et al. A Retrospective Cohort Study on the Influence of Comorbidity on Soft Tissue Reactions, Revision Surgery, and Implant Loss in Bone-anchored Hearing Implants. Otol Neurotol. Jun 2015; 36(5): 812-8. PMID 25811351
71. Mohamad S, Khan I, Hey SY, et al. A systematic review on skin complications of bone-anchored hearing aids in relation to surgical techniques. Eur Arch Otorhinolaryngol. Mar 2016; 273(3): 559-65. PMID 25503356
72. Fontaine N, Hemar P, Schultz P, et al. BAHA implant: implantation technique and complications. Eur Ann Otorhinolaryngol Head Neck Dis. Feb 2014; 131(1): 69-74. PMID 23835074
73. Hultcrantz M, Lanis A. A five-year follow-up on the osseointegration of bone-anchored hearing device implantation without tissue reduction. Otol Neurotol. Sep 2014; 35(8): 1480-5. PMID 24770406
74. Nelissen RC, Stalfors J, de Wolf MJ, et al. Long-term stability, survival, and tolerability of a novel osseointegrated implant for bone conduction hearing: 3-year data from a multicenter, randomized, controlled, clinical investigation. Otol Neurotol. Sep 2014; 35(8): 1486-91. PMID 25080037
75. Singam S, Williams R, Saxby C, et al. Percutaneous bone-anchored hearing implant surgery without soft-tissue reduction: up to 42 months of follow-up. Otol Neurotol. Oct 2014; 35(9): 1596-600. PMID 25076228
76. Roplekar R, Lim A, Hussain SS. Has the use of the linear incision reduced skin complications in bone-anchored hearing aid implantation?. J Laryngol Otol. Jun 2016; 130(6): 541-4. PMID 27160014
77. American Academy of Otolaryngology-Head and Neck Surgery. Position Statement: Bone Conduction Hearing Devices. Position Statements 2016; https://www.entnet.org/resource/position-statement-bone-conduction-hearing-devices/. Accessed December 22, 2023.

78. Centers for Medicare & Medicaid Services. Medicare Policy Benefit Manual. Chapter 16 - General Exclusions from Coverage (Rev. 198). 2014; Rev. 189. http://www.cms.gov/manuals/Downloads/bp102c16.pdf. Accessed December 22, 2023.
79. Centers for Medicare & Medicaid Services. Fact sheets: CMS Updates Policies and Payment Rates for End- Stage Renal Disease Facilities for CY 2015 and Implementation of Competitive Bidding-Based Prices for Durable Medical Equipment, Prosthetics, Orthotics, and Supplies. 2014; https://www.cms.gov/newsroom/fact-sheets/cms-updates-policies-and-payment-rates-end-stage-renal-disease-facilities-cy-2015-and-implementation. Accessed December 22, 2023.