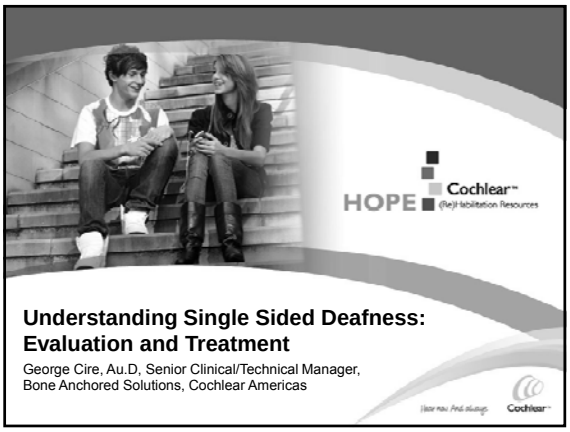

Understanding Single Sided Deafness: Evaluation and Treatment

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Cochlear Americas Commitment to Educational Outreach

HOPE Cochlear™ (Re)-habilitation Resources

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- Fellow, American Academy of Audiology
- Member and CCC/A, American Speech Language and Hearing Association
- Award for Continuing Education ASHA
- Thirty years serving as an Audiologist in both private practice and industry

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Definition of Single Sided Deafness

For the purposes of today's discussion:

Single-sided-deafness is defined as the hearing condition where an individual has a non-functional hearing that will receive no clinical benefit from traditional amplification in that ear with the contralateral ear possessing normal audiometric function as defined as hearing threshold levels no greater that 20dB HL for a pure tone average of .5, 1. 2. and 3Khz

NOTE: The non functional ear can be but is not limited to a profound hearing loss. The key factor is that the poor or "bad" ear has not or will not receive benefit when traditional acoustic amplification is applied.

The only hearing or "good ear" has a pure tone average that does not exceed a 20dB HL fence.

K021837

Indications for Use:

The use of "BAHA hearing aid " for SSD is intended to improve speech recognition.

The single-sided deafness (SSD) indication for "BAHA hearing aid" is intended for patients who suffer from unilateral sensorineural deafness on one ear while the other ear has normal hearing. Normal hearing is defined as PTA AC threshold equal to or better that 20dB measured at 0.5, 1, 2, and 3 Khz.

BAHA for SSD is also indicated for patients who are indicated for an AC CROS but who for some reason cannot or will not use an AC CROS.

SSD: The problem

- Loss of Spatial Hearing (Localization in the Horizontal plane)
- Head Shadow Effect (Difficulty when speech is present at the poor ear)
- Difficulty with speech intelligibility in the presence of background noise

Spatial Hearing

Spatial Hearing

- Interaural Time Difference (ΔIT) Below 800Hz
- Interaural Level Difference (ΔIL) Above 1600Hz
- Spectral Difference (ΔS)

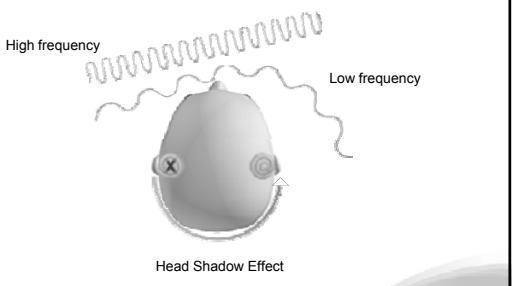
Spatial Hearing

- This loss of Spatial Hearing Ability is usually the motivating factor that moves patients to look for a treatment of the SSD. It is not the only factor but perhaps the first one noticed. Many early SSD patients will report "loss of auditory balance" or the loss of "stereo hearing".
- This loss of spatial hearing presents not only communication concerns but also safety concerns on behalf of SSD patients.
- We usually do not routinely evaluate the spatial hearing domain with current clinical test.
- Finally, Spatial hearing is NOT equal to Localization. However, localization is a component of spatial hearing.

Head Shadow Effect

- With the loss of auditory function in a unilateral configuration, sounds originating from the same side as the impaired ear will be present in the "shadow" of the Head.
- Long wavelength (low frequency sounds) readily "bend" around the head and are largely unaffected by the baffle of the head.
- Short wavelength (high frequency sounds) are "reflected" of "baffled" but the head and are then attenuated by this process, creating difficulty.
- When one considers that consonant sounds contain much of the meaning of speech, the Head Shadow Effect is the primary or root cause of the communication problem.

Head Shadow Effect



Head Shadow Effect

Combination Effect

The combined effect of loss of Spatial Hearing and the Head Shadow Effect create the third problem of: Hearing in the presence of background Noise

Speech recognition in noise is also confounded by the lack of binaural summation due the unilateral deafness. Use of any CROS system will have no effect in this area.

Causes of SSD

- Acoustic Neuroma (or other space occupying lesion of the CPA)
- Sudden idiopathic sensorineural hearing loss (Viral infection)
- Blunt Trauma to the head resulting in a Transverse fracture of the temporal bone
- Unilateral vascular insult to the brain stem resulting in damage to the auditory pathway
- Meniere's Disease
- Congenital (Genetic) loss of hearing in a unilateral presentation

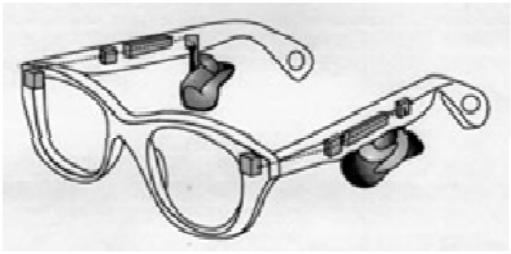
SSD Solutions

- Do nothing?
- CROS hearing system
- Bone Anchored System

Contralateral Routing of Signal

Harford and Barry, (1965) Volume 30, Number (2) pp121-138, J Speech and Hearing Disorders

Eyeglass CROS



Phonak CROS

Off Side

Good Ear Side

(Same case size as Audeo SMART) uses streaming technology to route signal to device in good ear (BTE or ITE configuration)

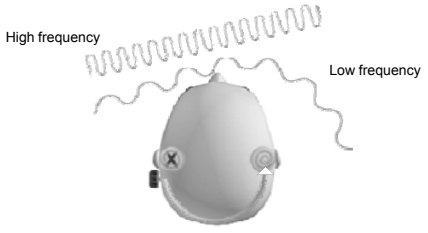
Audifon Via

Transcranial CROS via Power CIC

- First Described in the early 1990s
- Uses a Power completely-in-the-ear (CIC) acoustic hearing aid fitted to the poor or dead ear.
- Sound pressure in the residual volume of this ear is transmitted via an osseotympanic pathway to the contralateral ear that has good hearing
- The “poor or dead” ear must be able to handle the SPL without tolerance or recruitment issues.
- The ear contralateral to the poor ear must have good hearing sensitivity to allow this technique to work.

Transcranial Acoustic CROS

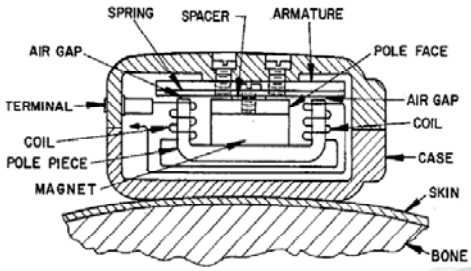
Bone Conduction Solutions



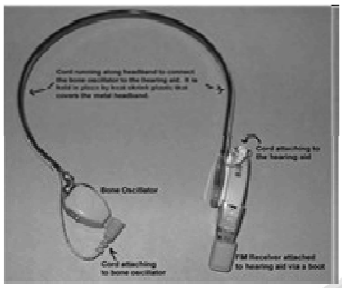
Reduces Head Shadow Effect

Paledino's Fonifero

B-71



BC Hearing Aid



Starkey BC 1

TransEAR

Soundbite by Sonitus Medical

Bone Anchored Solutions

Sophono




Oticon Medical


Components of the Baha® 3 System

Baha® 3 Sound Processor (BP100)

Titanium skin-penetrating abutment

Titanium fixture/ implant 3 or 4 mm

The Baha® System

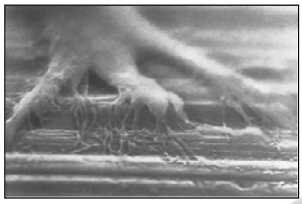
- The Baha System has been a well recognized hearing treatment for conductive and mixed hearing loss since 1977.
- The Baha System is the first implanted hearing treatment that works through direct bone conduction.
- Sound is conducted through the skull bone bypassing the outer and middle ear and stimulating the cochlea.

History

- Work first done by Swedish Professor Per Ingvar Branemark who was looking at regenerative qualities of bone
- He discovered that titanium, if left undisturbed in bone, forms an initial bond which strengthens over time
- Professor Branemark coined the term “osseointegration,” combining os meaning “bone” and integro meaning “renew”
- Technology first developed for oral implant retention, then for craniofacial prosthetic anchoring systems
- In the late 1970s, Branemark and Anders Tjellstrom (University of Goteborg) worked together with engineers at Chalmers University to develop the Baha® System

Osseointegration

- The process by which living bone tissue bonds with titanium
- Makes direct bone conduction possible
- The basis of long-term predictability and success of the bone anchored system



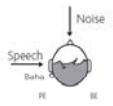
Direct Bone Conduction

- Works independently of ear canal and middle ear
- Direct transmission gives clear and natural sound
- Preoperative testing possible
- High wearing comfort
- Safe and straight forward surgery
- Predictable outcome

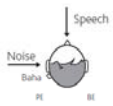
FDA Clearance

- **1995** - The Baha® System was cleared to treat mixed and conductive hearing loss.
- **1999** - The Baha® System was cleared for pediatric use in children age five and older.
- **2001** - The Baha® System was cleared for bilateral fittings.
- **2002** - The Baha® System was cleared for use in patients with unilateral sensorineural hearing loss also known as Single Sided Deafness (SSD). Also, the Baha Softband was introduced for children under the age of five.
- **2004** – Clearance for the Divino sound processor
- **2008** – Clearance for the Intenso sound processor with expanded fitting range
- **2009** – Clearance for the Baha® BP100, the world's first programmable sound processor for bone conduction.
- **2010** – Clearance for the Baha® BI300 implant system.

Win/Lose Scenario for Baha and SSD

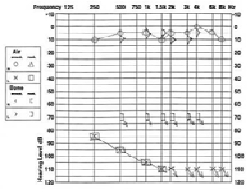


Performs better with Baha



Performs worse with Baha

The Baha® System Single Sided Deafness



Single Sided Deafness

Diagnosis example: acoustic neuroma removal, left ear.

FDA Indication Criteria for implantation

Single Sided Deafness

- ≥ 5 years of age*
- Normal hearing in contralateral ear
  - Normal hearing is defined as PTA AC threshold equal to or better than 20 dB at .5, 1, 2 and 3kHz.

Functions by transcranial routing of the signal

* Children under 5 may use the Baha on a softband until reaching the appropriate age for implantation.

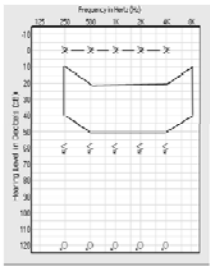
Single Sided Deafness (SSD)

- Purpose
  - To provide sufficient amplification force to overcome the head transfer function
- Additional force **may be** required to;
  - Overcome large head transfer function
  - Compensate for sensorineural hearing loss (if loss develops due to aging or some other natural process later in life)
- Common difficulties adults with SSD experience
  - Hearing in background noise
  - Localization
  - Understanding a person situated on the deaf side
- Common Experiences of children with unilateral hearing loss[1]
  - Speech and language delay
  - Difficulty paying attention in school
  - Difficulty hearing in noisy environments
  - Difficulty localizing sounds

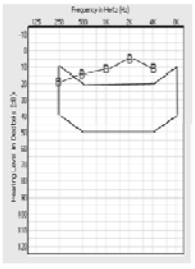
1. Bess FH, Tharpe, AM: Case history data on unilaterally hearing impaired children. Ear Hear 1986;7(1):14-19

SSD 'Aided' Outcomes

Unaided Audiogram



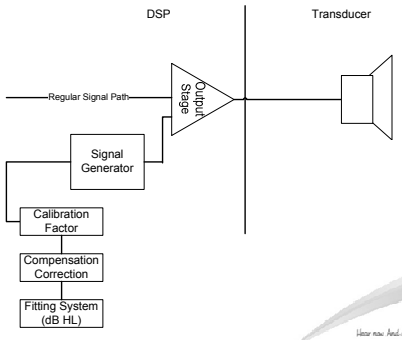
Aided Audiogram



Transcranial attenuation

- Attenuation of the signal as it is sent through the skull to the hearing cochlea.
- Attenuation varies greatly between different patients and frequencies.
- Can be measured pre-operatively with bone conduction audiometry**.**

BC Direct



Transcranial Attenuation (TCA)

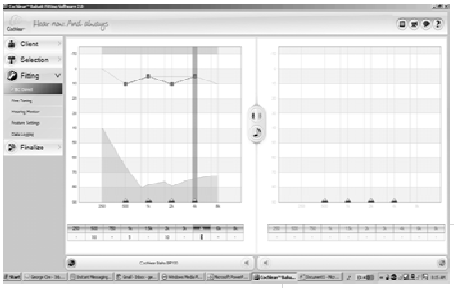
TABLE II

TRANSCRANIAL ATTENUATION (TCA) AS A FUNCTION OF FREQUENCY FOR GROUP A (n = 15) (db.)

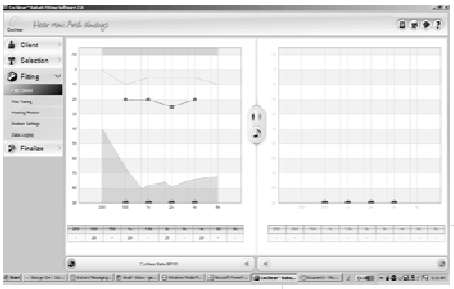
Subject	Frequency (kHz.)							
	0·25	0·50	0·75	1	1·5	2	3	4
A	10	15	10	10	15	15	10	10
B	5	0	5	5	15	20	15	10
C	5	15	0	10	0	5	10	10
D	10	0	15	15	5	5	5	30
E	0	0	10	15	10	5	10	25
F	25	0	10	10	10	5	15	10
G	10	5	5	15	25	0	5	0
H	5	10	15	15	20	30	15	25
I	15	20	20	20	0	30	25	10
J	15	5	10	0	5	25	5	5
K	5	5	0	5	5	10	5	25
L	5	25	15	10	15	5	10	25
M	10	15	0	0	0	10	5	5
N	0	20	15	25	5	15	10	25
O	5	10	10	15	25	15	10	25
Mean TCA	8·33	9·33	10·33	10·66	10·33	13·0	10·33	16·0
SD	6·45	8·20	5·81	7·03	8·54	9·59	5·49	9·85
Range	0–25	0–25	0–25	0–20	0–25	0–30	5–25	0–30

Nolan M, Lyon DJ. Transcranial attenuation in bone conduction audiometry. J Laryngol Otol 1981;95:597-608.

BC Direct with little Transcranial Loss



BC Direct w/significant Transcranial Loss



Upcoming HOPE Events

HOPE Cochlear™ (Re)habilitation Resources

Upcoming Online Sessions

HOPE Cochlear™ (Re)habilitation Resources

Next Up:

Wednesday, December 7, 3:00 pm ET

Sound Foundation for Babies and Toddler: A Habilitation Resource

Nancy Caleffe-Schenck, M.Ed., CCC-A, LSLS Cert. AVT
Oakland Children's Hospital

Tuesday, January 10, 2:00 pm ET

Auditory Comprehension

Ashley Garber, M.S., CCC-SLP, LSLS Cert. AVT
Listening and Language Connections

Children with Cochlear Implants: The Words and the Music

HOPE Cochlear™ (Re)habilitation Resources

- One day introductory level workshops on reading, vocabulary and music
- Two remaining sites: San Diego (CA) on January 25 and Washington (DC) on March 13
- For more information, go to www.regonline.com/hopeworkshops
- Or call Sarah Gard at 303.524.6848, sgard@cochlear.com

Contact Cochlear

- For questions about this seminar, please contact: gcire@cochlear.com
- For inquiries and comments regarding HOPE programming, please contact: dsorkin@cochlear.com
- For a Certificate of Participation, please send your completed Feedback Form to: hopefeedback@cochlear.com

Questions and Discussion