

Selection criteria and preoperative evaluation in cochlear implants. General principles.

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The shaking air rattled Lord Edward's membrana tympani, the interlocked malleus incus and stirrup bones were set in motion so to agitate the membrane of the oval window and raise an infinitesimal storm in the fluids of his labyrinth. The hairy endings of the auditory nerve shuddered like weeds in a rough sea; a vast number of obscure miracles were performed in the brain and Lord Edward ecstatically whispered, *!Bach!*

Aldous Huxley 1928.

Purpose of the sense organs and the sense of hearing...

- ❖ The sense organs connect us with the environment and allow us to establish a functional relationship with it.
- ❖ Beyond the hearing itself, the sense of hearing allows us to communicate and to become integrated.
- ❖ Hearing losses compromise our possibilities of communication and integration.

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Conductive aspect. Failure= CONDUCTIVE hearing loss.

The hairy endings of the auditory nerve shuddered like weeds in a rough sea;

Sensory aspect. Failure= SENSORY hearing loss.

a vast number of obscure miracles were performed in the brain and Lord Edward ecstatically whispered, *!Bach!*

Neural Aspect. Failure= NEURAL hearing loss.

HEARING LOSSES: Conductive, Sensorineural, Mixed, Functional.

Sensorineural hearing losses.

- ❖ **Timing: Congenitals or after birth.**
- ❖ **After birth: Before or after language development.**
- ❖ **As a child, adolescent or adult.**
- ❖ **Unilateral or bilateral.**
- ❖ **Stable or progressive.**
- ❖ **Of different degrees.**
- ❖ **Duration (period of time) of hearing loss.**

Degrees of Hearing Loss...

- ❖ **-5 - 20 dB Normal hearing.**
- ❖ **20 – 40 dB Mild hearing loss.**
- ❖ **40 – 70 dB Moderate hearing loss.**
- ❖ **70 – 90 dB Severe hearing loss.**
- ❖ **90 dB and + Profound hearing loss.**

Beyond the hearing itself...

- ❖ **Functional use of sound.**
- ❖ **Speech perception and language production.**
- ❖ **Potential for language development and communication...**
- ❖ **Environment, family group.**
- ❖ **Compromise with the rehabilitation process.**

Sensorineural hearing loss. Treatment alternatives.

- ❖ 1. To stimulate better those fibers that remain.
Eg. Hearing Aids.
- ❖ 2. To do a “by pass” skipping the ciliated cells and stimulating directly the ganglion cells. **Eg. Cochlear implants.**
- ❖ 3. To promote regeneration of those which are damaged.
- ❖ 4. To re establish function of dysfunctional cells.

"EVERYTHING IN ITS PROPER PROPORTION..."

By the year 2009, 200 000 persons had received a cochlear implant.

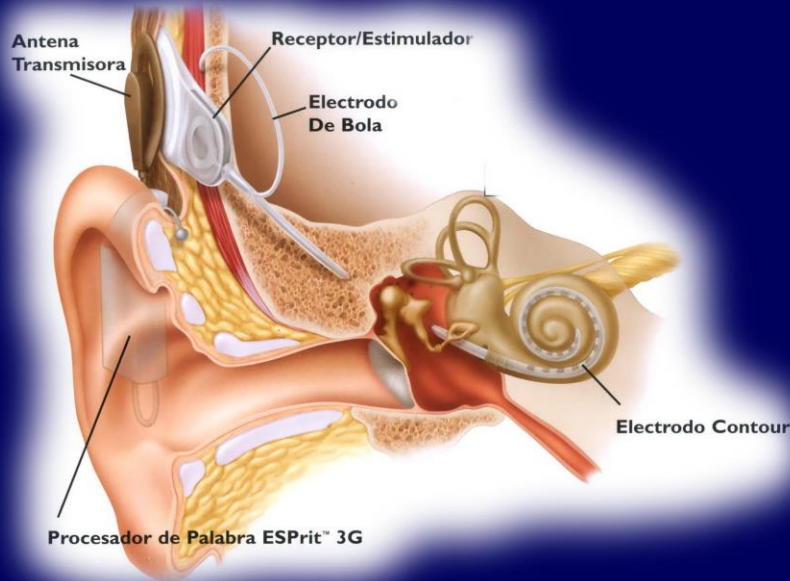
During the year 2009, 9 000 000 persons received hearing aids.

During the year 2009, 41 000 000 iphones were sold.

Purposes of the approach...

- ❖ To allow us to hear in order to be able to communicate and integrate.
- ❖ If possible, our hearing should be:
normal, bilateral and symmetric.
- ❖ And this must be achieved early considering the concept of neural plasticity. “Duration (Time) of hearing deprivation.”
- ❖ * **The hearing of the implanted patient is NOT normal.**

What do cochlear implants do?



- **Hearing Aids:**

SonElectronic devices designed to detect sounds and amplify them selectively.

- **Cochlear Implants:**

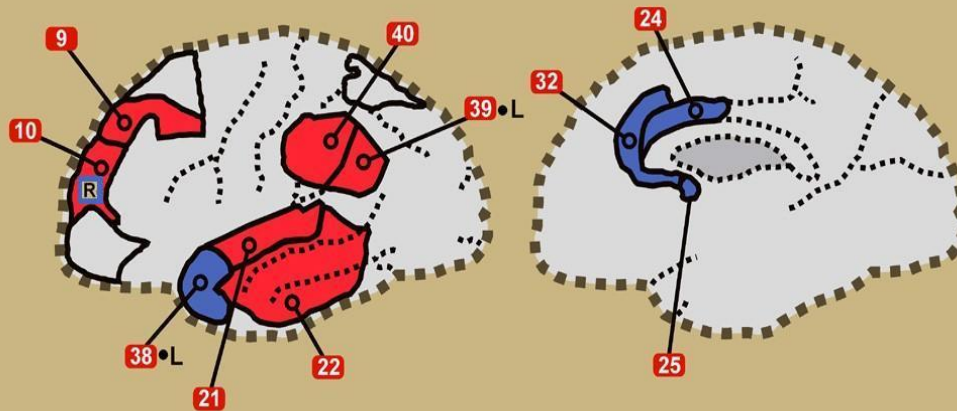
Electronic devices designed to detect sounds and transform them into electrical impulses that are transmitted to the auditory nerve and are interpreted by the brain as sounds.

Neuronal Circuits.

Source, distance, emotions, meaning, etc.

AUDITORY ACTIVATION NORMALS: ANATOMO-FUNCTIONAL CORRELATIONS

Means of Maximum and Minimal St. Dev. N=10




 Executive Area
 Anterior Frontal Reg.
 (Brodmann 9-10)
 > 3 S.D.
 (Brodmann 10)
 < 3 S.D.


 Internal Frontal
 Region
 (Brodmann 24-32)
 < 3 S.D.

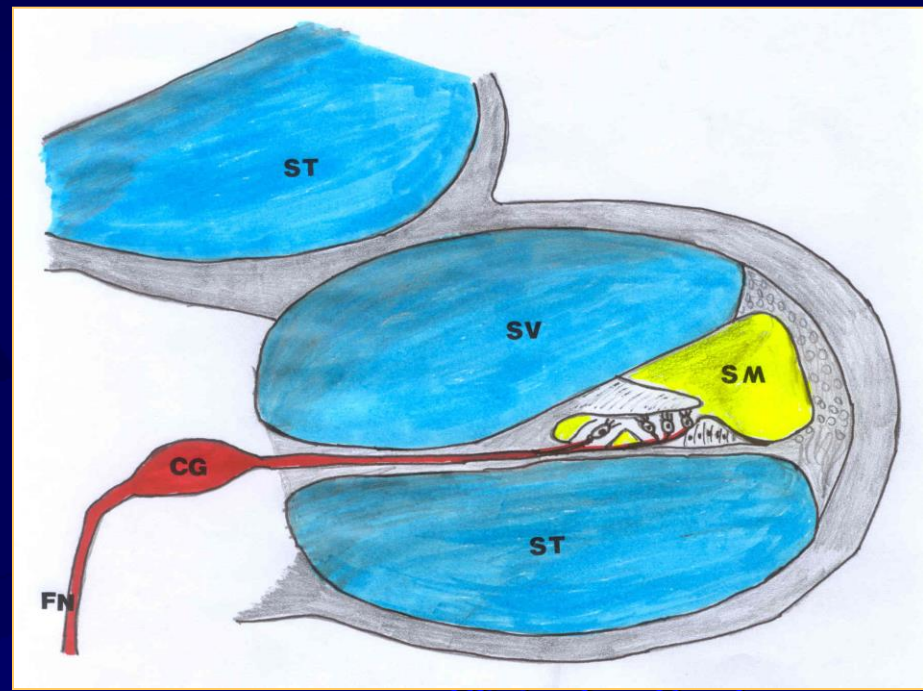
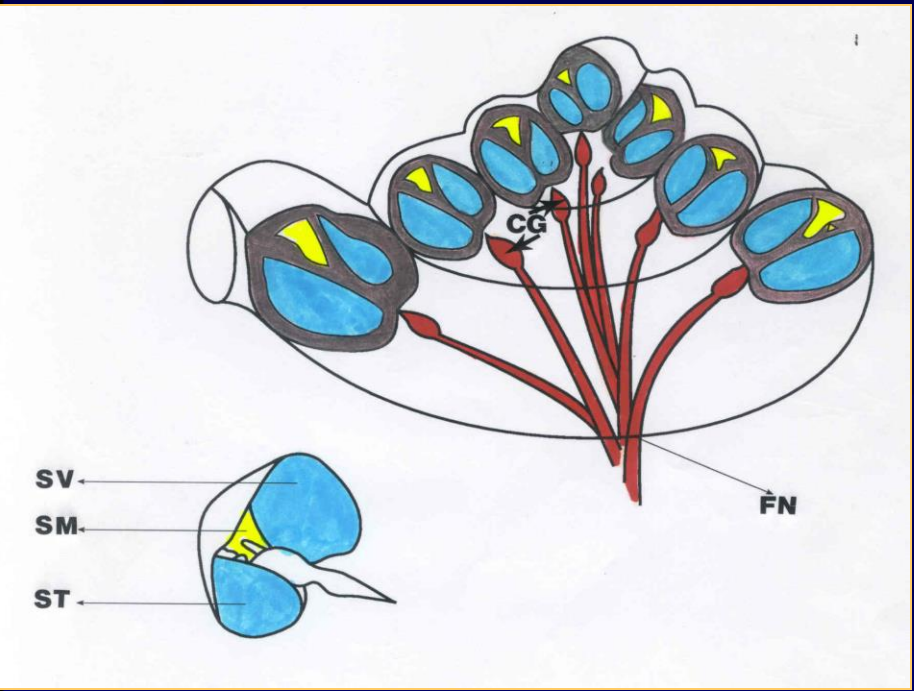
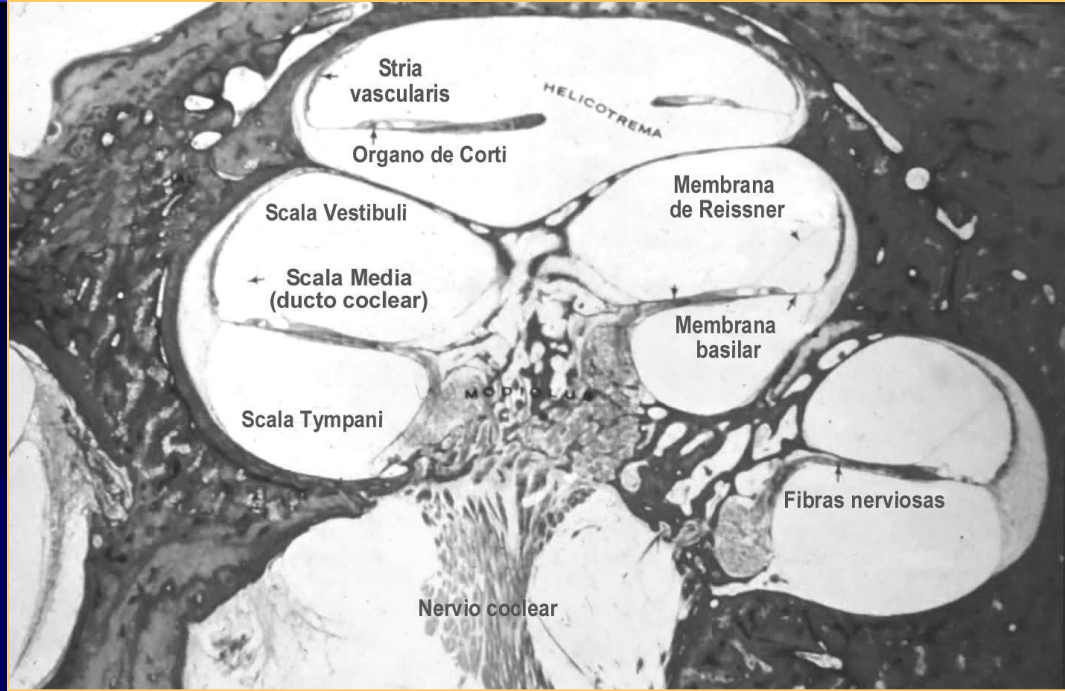

 Affective Area
 Orbito-Frontal Reg.
 (Brodmann 25)
 < 3 S.D.


 Temporal
 Region
 (Brodmann 21-22)
 > 3 S.D.
 (Brodmann 38)
 < 3 S.D.


 Auditory
 Center
 (Brodmann 39-40)
 > 3 S.D.

Cochlear implant alternatives.

- ❖ **Unilateral.**
- ❖ **Unilateral with a contralateral hearing aid (bimodal).**
- ❖ **Bilateral.**



When are we going to need cochlear implants?

- ❖ When the use of implants exceeds the ability to help of the other alternatives (Eg. Hearing aids) or complement them satisfactorily.
- ❖ **"Patients with bilateral severe to profound sensorineural hearing loss who do not benefit from the use of hearing aids."**

Factors to consider.

- ❖ **The selection process is multidisciplinary.**
- ❖ **The implant itself is only a device. The surgical procedure is a stage.**
- ❖ **“Cochlear implantation” implies a process that involves a professional team, a patient, a family context and a social environment.**
- ❖ **Therefore...there are multiple factors and criteria to consider beyond the numbers...**

Factors to consider...

Already mentioned...

- ❖ Age, relation to language, stability or progression, etc.**
- ❖ Technological developments.**
- ❖ Audiological factors.**
- ❖ Anatomical factors.**
- ❖ Uni or bilateral criteria.**
- ❖ Associated symptoms and problems.**

Technological developments and changes in indications over time.

Criteria for candidacy, USA (FDA)

	1985	1990	1998	2001
Edad de Implantacion	Adultos (18 años)	Adultos y niños (2 años)	Adultos y niños (18 mes)	Adultos y niños (12 meses)
Inicio de la perdida auditiva	Postlinguistico	Postlinguistico Adultos Pre y Postlinguistico niños	Adultos y niños Pre y Postlinguistico	Adultos y niños Pre y Postlinguistico
Grado de perdida Auditiva	Profundo	Profundo	Severa-Profunda Adultos Profunda niños	Severa-Profunda + 2 años Profunda niños - 2 años
Adultos porcentaje (open-set)	0%	0%	40% o menos (CID)	≤ 50% (HINT) en el oido implantar y con ≤ 60% en el contralateral
Niños porcentaje (open set)	No candidatos	0% open-set	Menos que 20%	No progreso en adquisiciones linguisticas (MAIS, ≤ 30% (MLNT/LNT) (depende de la edad)

Appearance age: Children.

- ❖ **Bilateral severe to profound sensorineural hearing loss from 5 years onwards and profound in less than age 5.**
- ❖ **The earlier the better.**
- ❖ **How early?**
- ❖ **Over 1 year.**
- ❖ **Under 1 year: improvements in diagnosis and now less surgical risks.**
- ❖ **Residual hearing.**

Children.

- ❖ **Pre and post development of language.**
- ❖ **Concept of plateau.**
- ❖ **Urgency in cases of meningitis.**
- ❖ **Congenital anomalies (an increase).**
- ❖ **Other disabilities (Eg. Cerebral disf.).**
- ❖ **Structural factors for the placement of electrodes. Presence of nerve.**

Adults.

- ❖ **Bilateral severe to profound sensorineural hearing loss.**
- ❖ **50% or less discrimination with hearing aids.**
- ❖ **Post lingual losses.**
- ❖ **Importance of ossification (Eg. Meningitis).**
- ❖ **Structural importance for electrode placement.**
- ❖ **Age limit (We have a 98 11/12 months patient that was successfully implanted).**

Preoperative Considerations...

- ❖ **Comprehensive otologic evaluation.**
- ❖ **General health.**
- ❖ **Imaging. CT MRI in order to evaluate the structures where the electrodes will be placed. Evaluation of the auditory nerve.**

Preoperative Considerations.

- ❖ **Absence of nerve?**
- ❖ **Central damage that prevents auditory processing. Alzheimers case.**
- ❖ **Medical risks.**
- ❖ **Psychological contraindications.**

Criteria of uni or bilaterality.

- ❖ **Bilateral is significantly better.**
- ❖ **La binauralidad provides us with:**
- ❖ **Orientation.**
- ❖ **Discrimination in sound.**
- ❖ **Noise reduction.**
- ❖ **Bilaterality-Symmetry and integration.**

Bilateral Implants.

- ❖ **Bilaterally implanted children discriminate better in silence and in noise.**
- ❖ **With early bilateral implants (2 years) they can acquire binaurality.**
- ❖ **They communicate better and they get tired less.**
- ❖ **They acquire auditory symmetry and bilaterality.**
- ❖ **They develop better language.**
- ❖ **(Ramos 2013, Gordon & Papsin 2015).**

Timing.

- ❖ **Simultaneous or sequential. Before age 2.**
- ❖ **With Simultaneous we aim for binaurality, bilaterality, symmetry and stimulation of the full neuronal circuits from the beginning.**
- ❖ **If sequential... before 12 months.**

Extending cochlear implant indications...

- ❖ **Among them: Residual hearing, bilateral implants, unilateral hearing loss, tinnitus, auditory neuropathy, etc.**
- ❖ **To be discussed by Leopoldo Cordero.**
- ❖ **Global review of the subject in spanish: Guía para la indicación de implantes cocleares. M. Manrique et al.**