1042

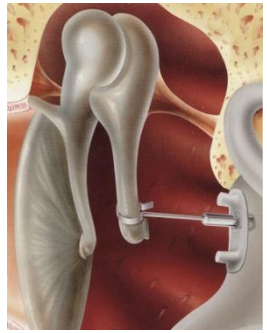
OTOSCLEROSIS : HEARING AND/OR SURGERY ?

- B. FRAYSSE

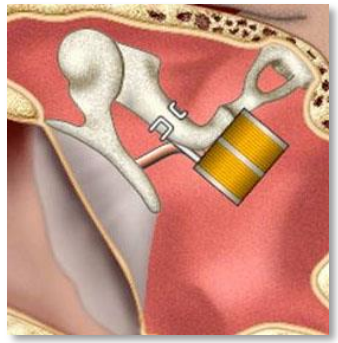
GOAL OF THE PRESENTATION

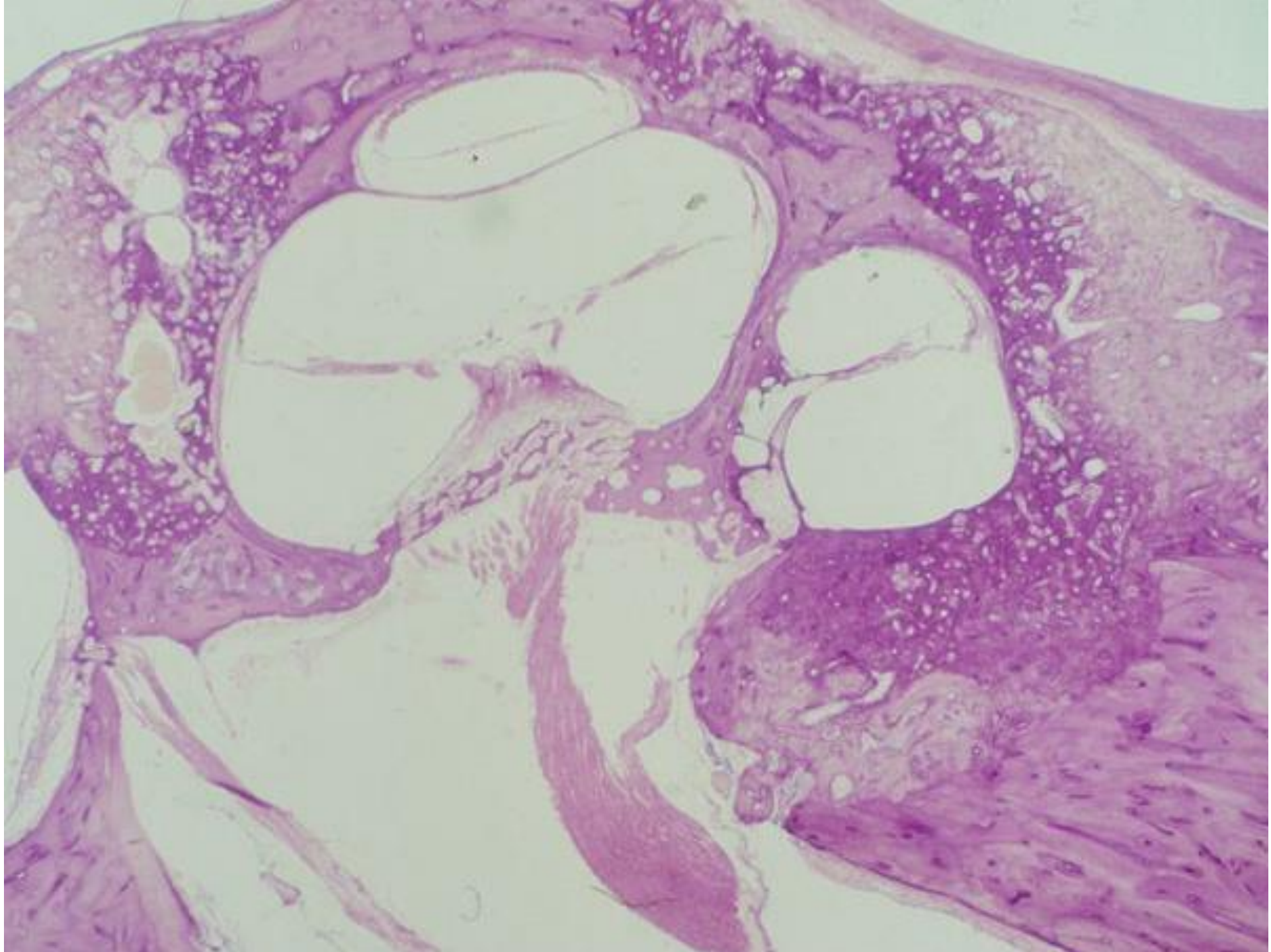
- To discuss the various factors which may influence the decision in councelling patient between :
  - Hearing aid

  - Stapes surgery

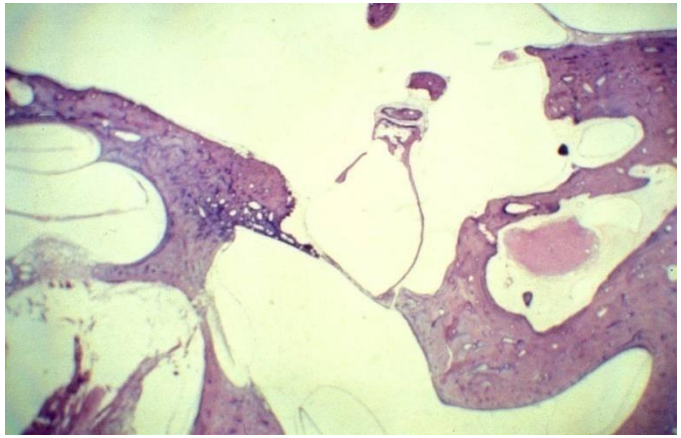


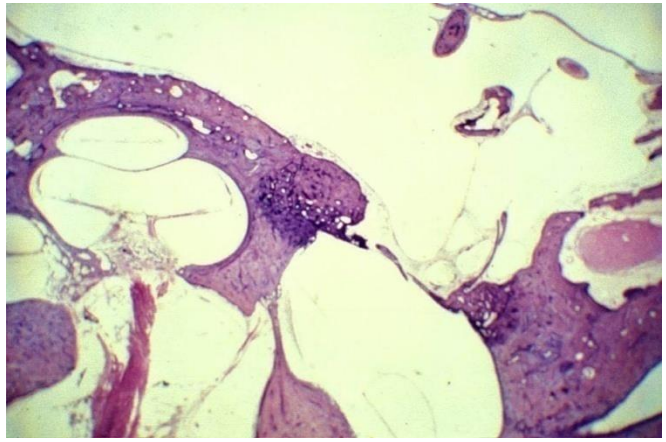
  - Auditory implant

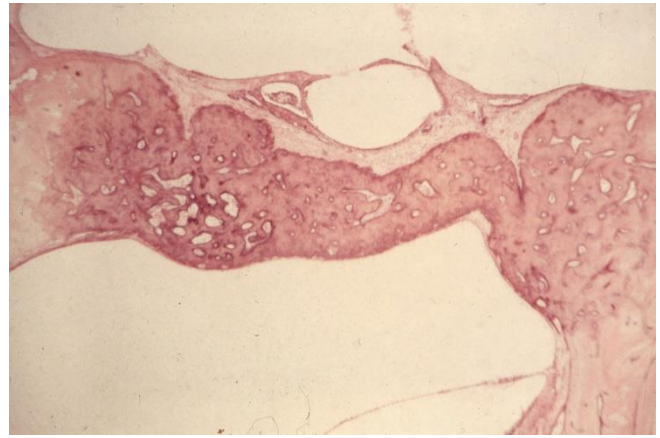


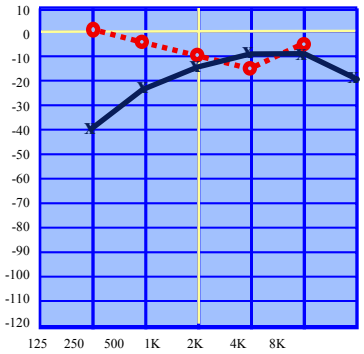


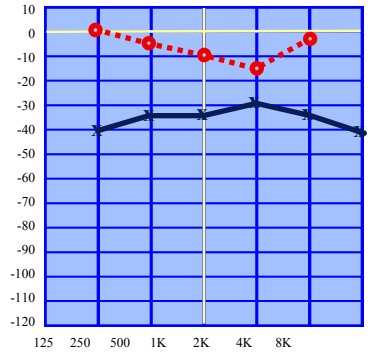
CONDUCTIVE HEARING LOSS
DEGREE OF STAPES FIXATION

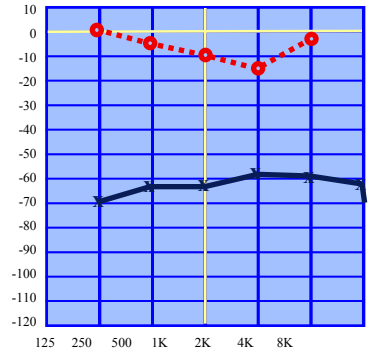




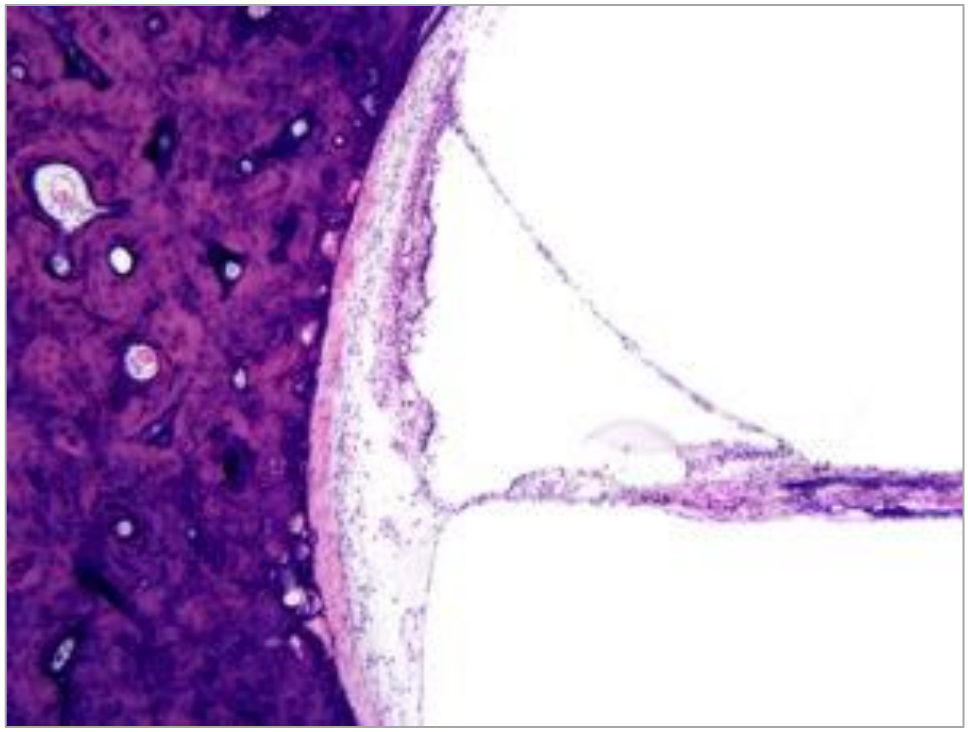


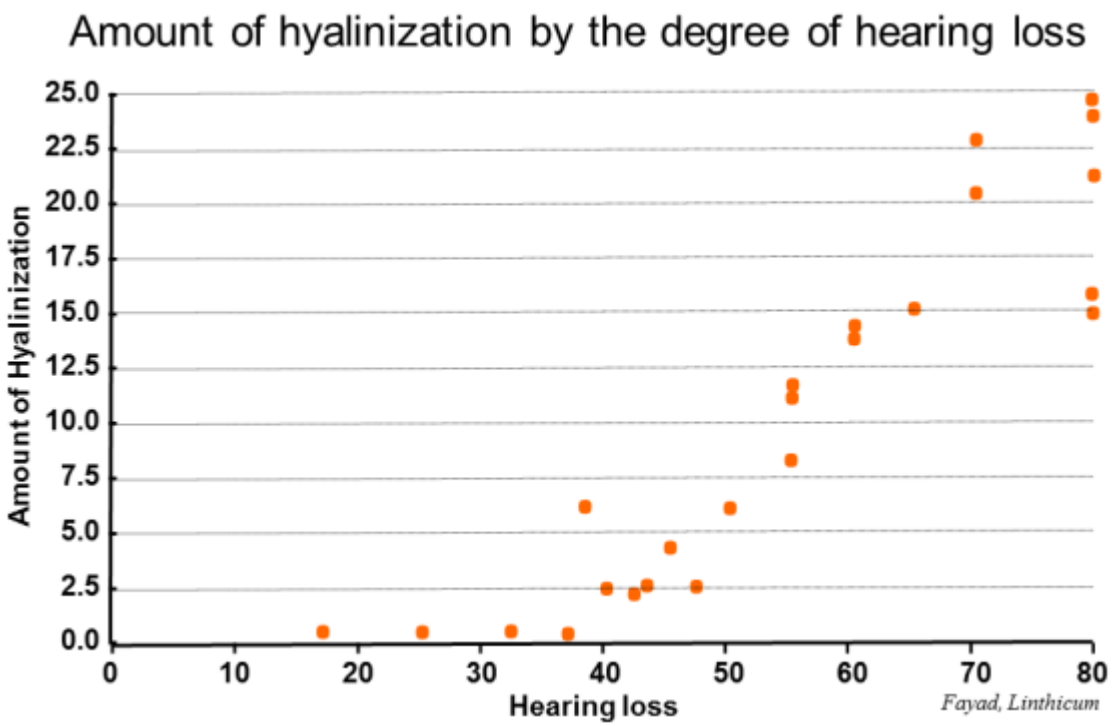






SENSORINEURAL HEARING LOSS
DEGREE OF HYALINIZATION





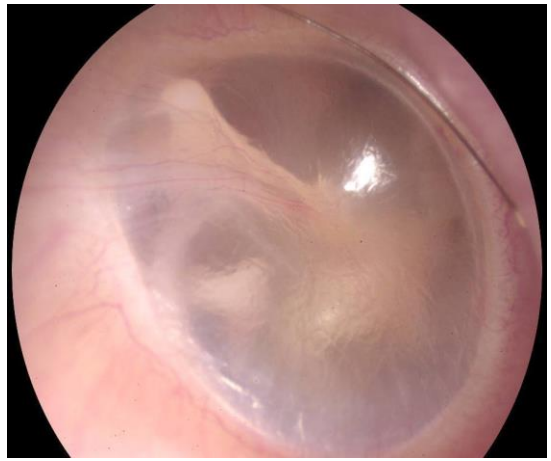
Pure cochlear otosclerosis

1%

No stapes fixation, pure cochlear otosclerosis

DIAGNOSIS

- Progessive hearing loss
- Family history of otosclerosis
- Good understanding in noise
- Speaks softly
- Normal otoscopy



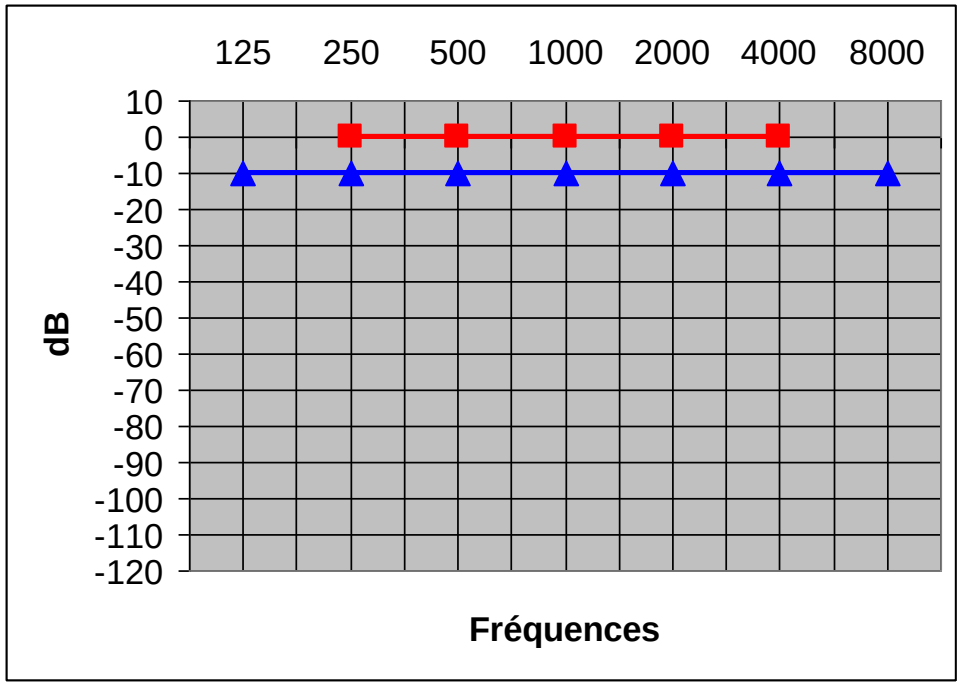
Signe de Schwarts

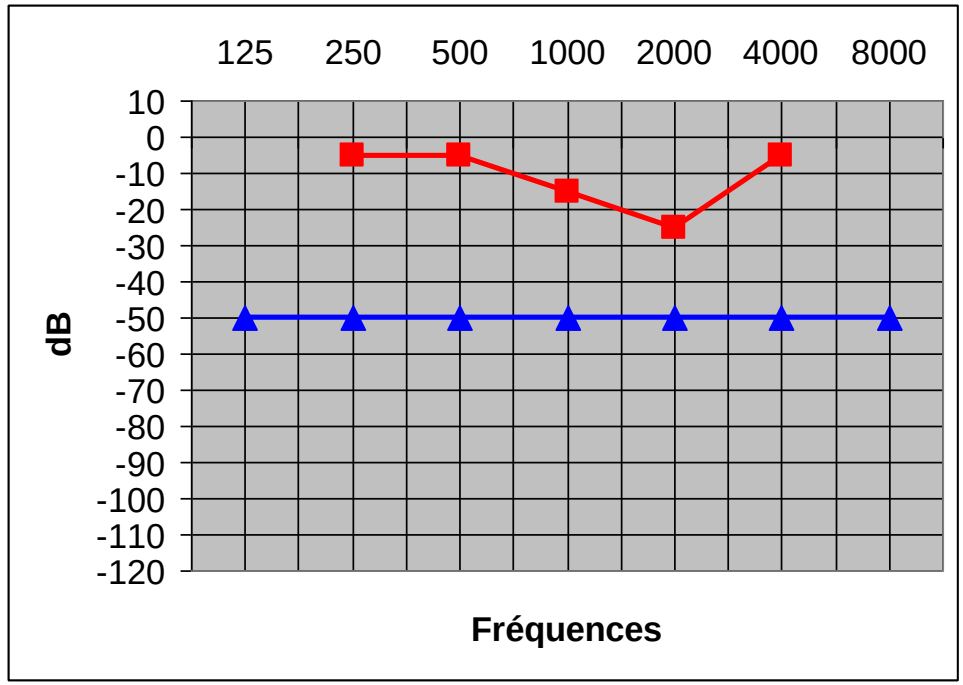
TUNING FORK TEST

- Weber : 256, 512, 1024, 2048 Hz compare the findings of the tuning fork with those found on pure tone

- Rinne Test negative indicates an air bone gap of at least 30 to 45 dB

PURE TONE AUDIOMETRY





Arch. Otollaryngol. 1950; 51 (6): 798-808

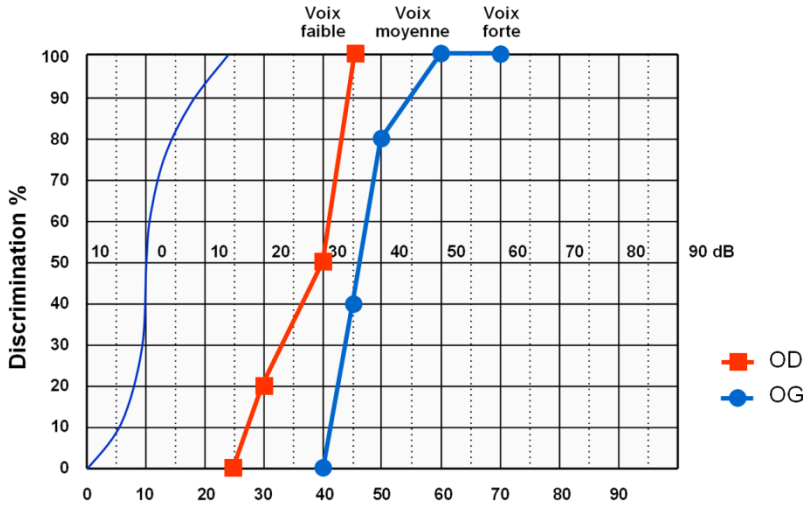
The clinical application of bone conduction audiometry

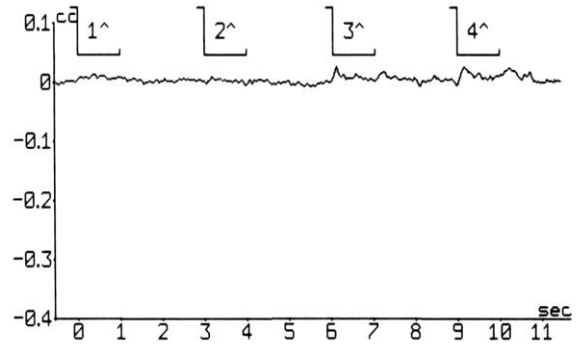
Raymond CARHART, Ph. D.

Frequency	250	500	1 000	2 000	3 000	4 000
Correction	0	5	10	13	10	6

SPEECH DISCRIMINATION

- Speech discrimination in quiet and in noise
- Normal tympanometry
- Stapedial reflex absent or ON/OFF





DO WE NEED A CT-SCAN IN THE DIAGNOSIS OF OTOSCLEROSIS ?

Otology & Neurotology
34:e55–e60 © 2013, Otology & Neurotology, Inc.

The Role of Imaging in the Diagnosis and Management of Otosclerosis

*Jagdeep Singh Virk, *Arvind Singh, and †Ravi Kumar Lingam

**ENT Department, and †Radiology Department, Northwick Park Hospital, North West London NHS Trust, Harrow, U.K.*

Otology & Neurotology
37:9–15 © 2015, Otology & Neurotology, Inc.

A Systematic Review of the Diagnostic Value of CT Imaging in Diagnosing Otosclerosis

*†Inge Wegner, *Anne M. A. van Waes, *†Arnold J. Bittermann, *Sophie H. Buitinck, *Caroline F. Dekker, *Sophie A. Kurk, *Matea Rados, and *†Wilko Grolman

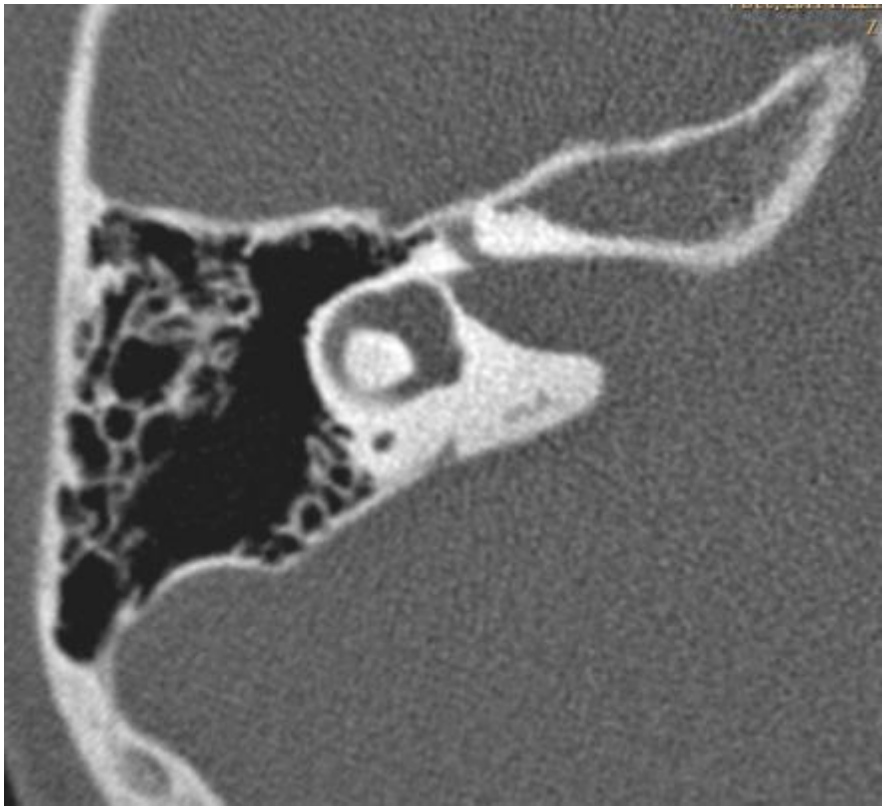
**Department of Otorhinolaryngology–Head and Neck Surgery; and †Brain Center Rudolf Magnus, University Medical Center Utrecht, Utrecht, The Netherlands*

GUIDELINES OF THE FRENCH SOCIETIES

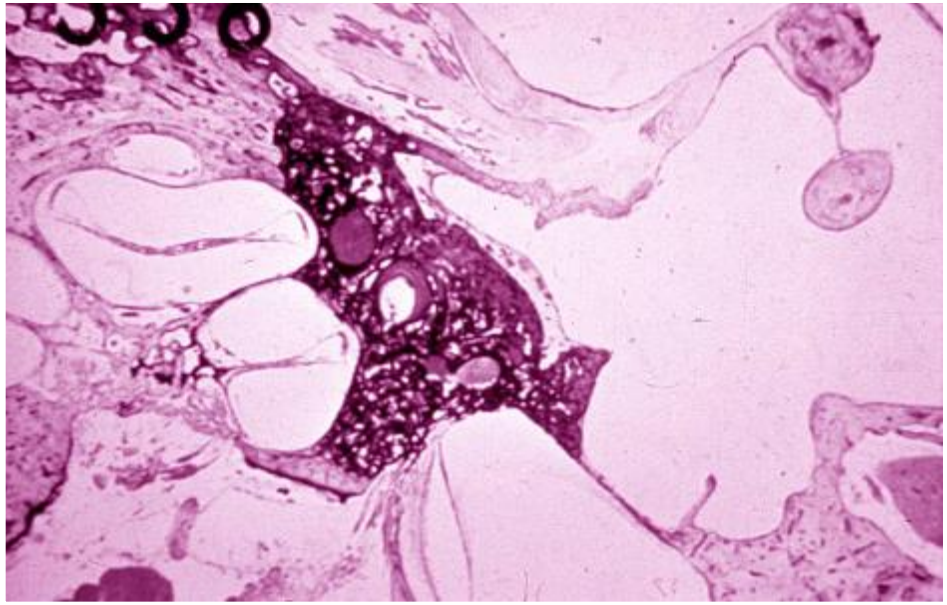
« Recommandations pour la pratique de l'imagerie de l'oreille et du rocher »

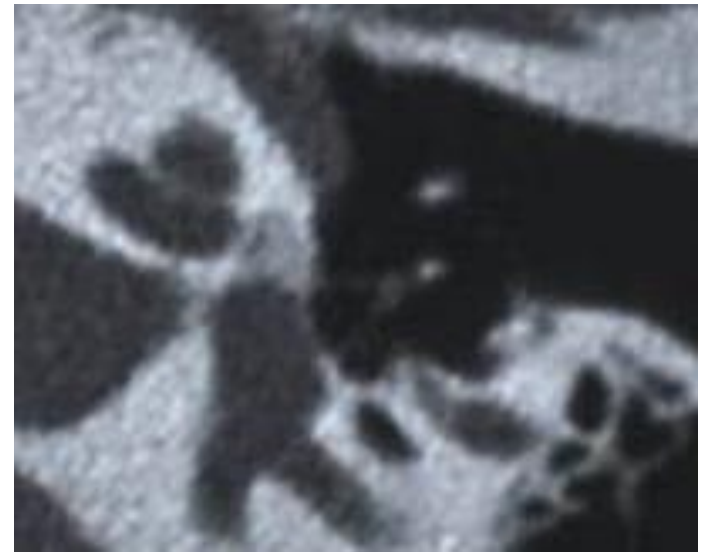
- These guidelines relate
  - The technique of acquisition
  - The normal anatomy
  - The morphological modification
  - The classification of lesions

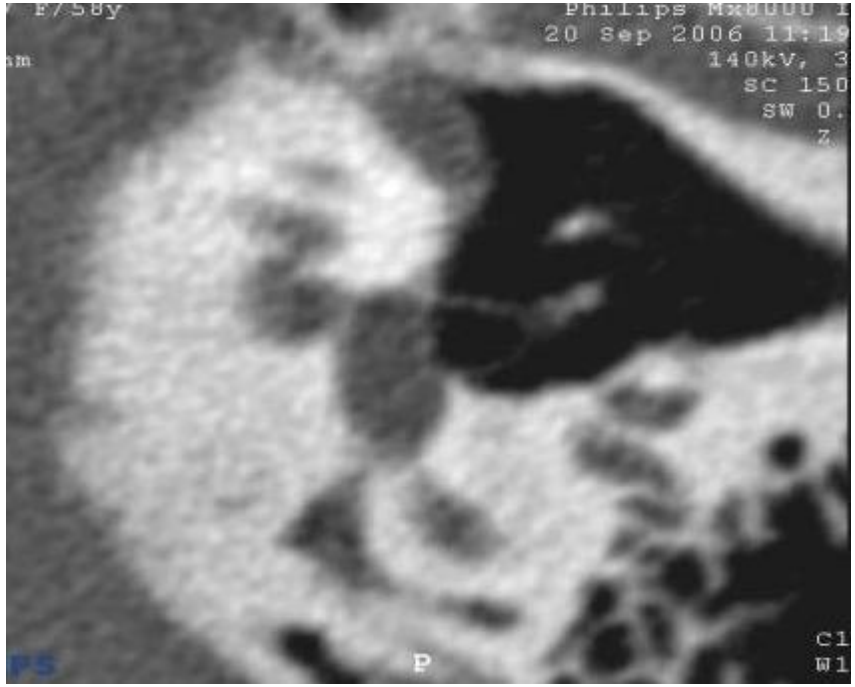
TECHNIQUE OF ACQUISITION

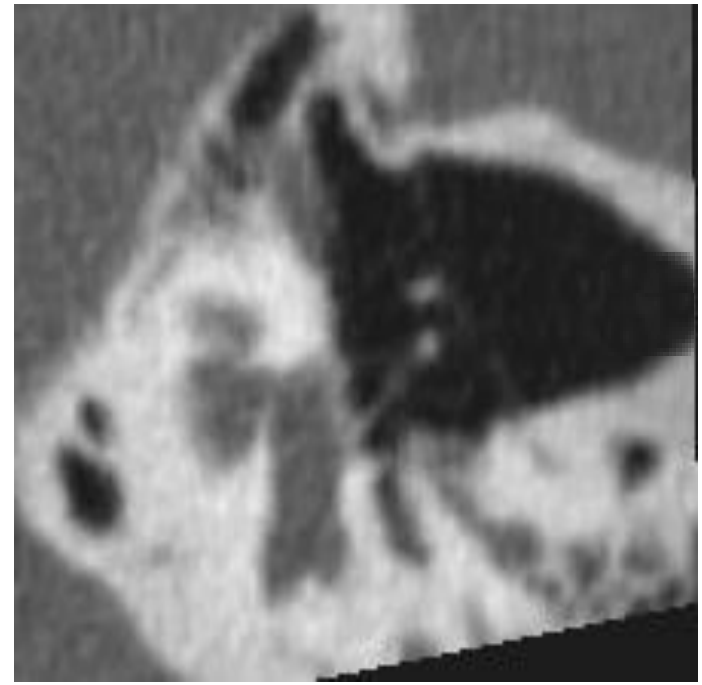


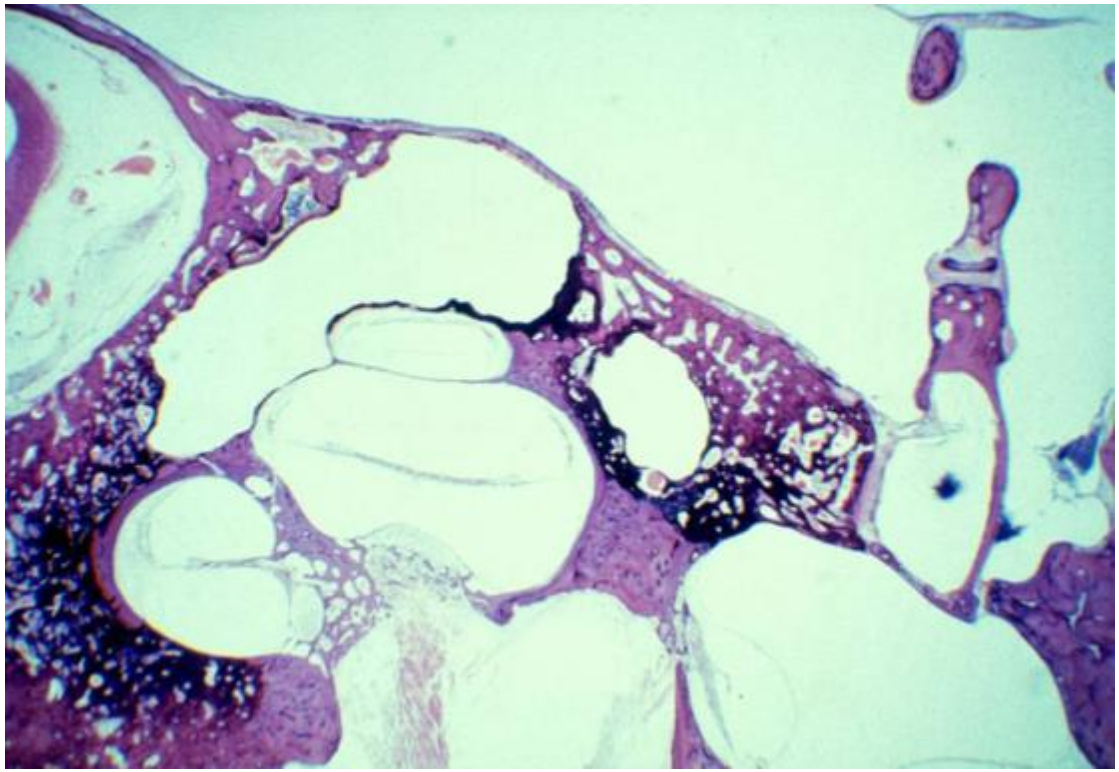
- Slice thickness 0.3/0.6 mm
- Parallel to the lateral canal
- Axial and coronal reconstruction
- With magnification

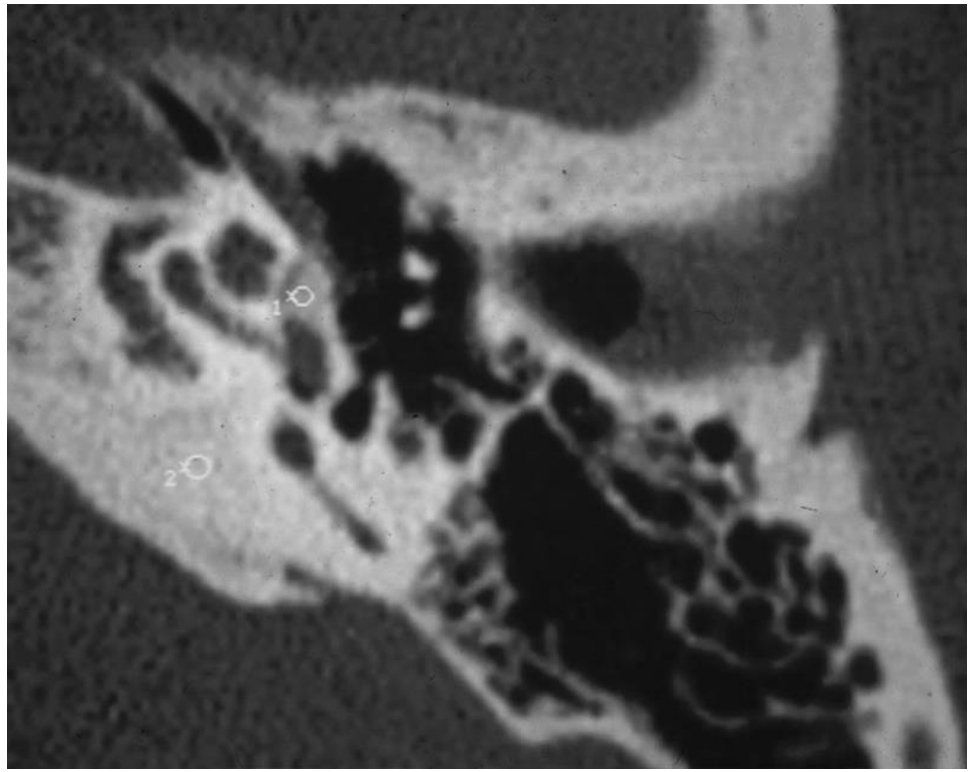




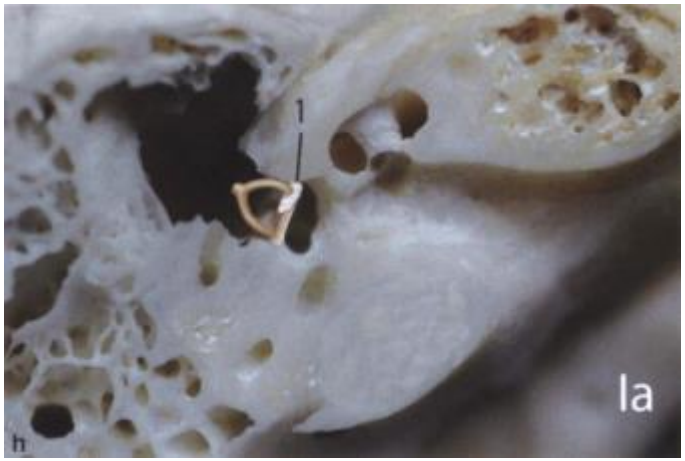

20 Sep 2006 11:19
140kV, 3
SC 150
SW 0.
P
C1
W1

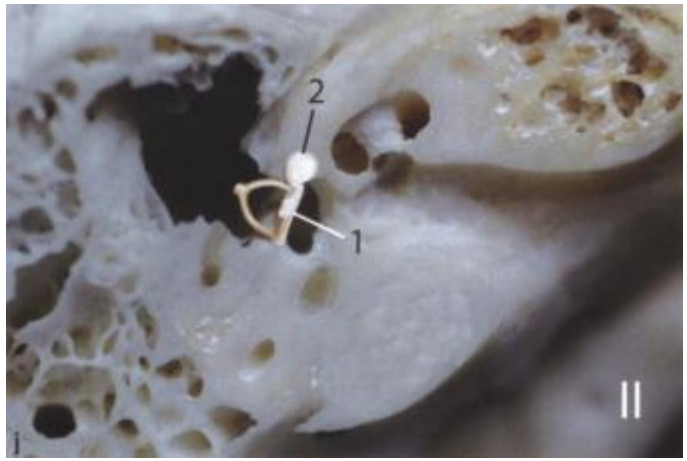


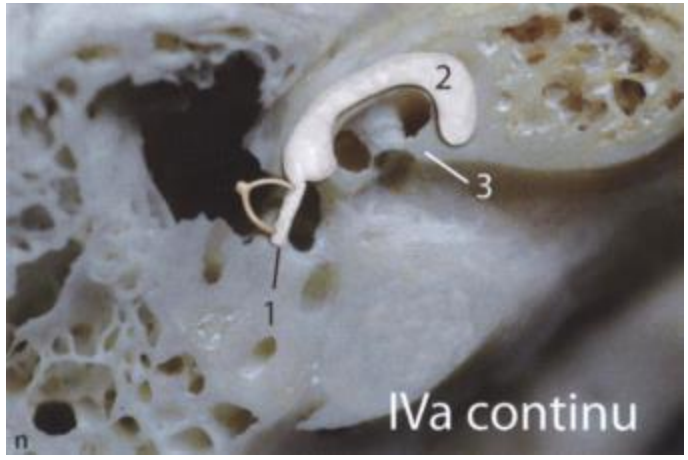



1
2

CLASSIFICATION







INTEREST OF IMAGING IN THE EVALUATION OF OTOSCLEROSIS

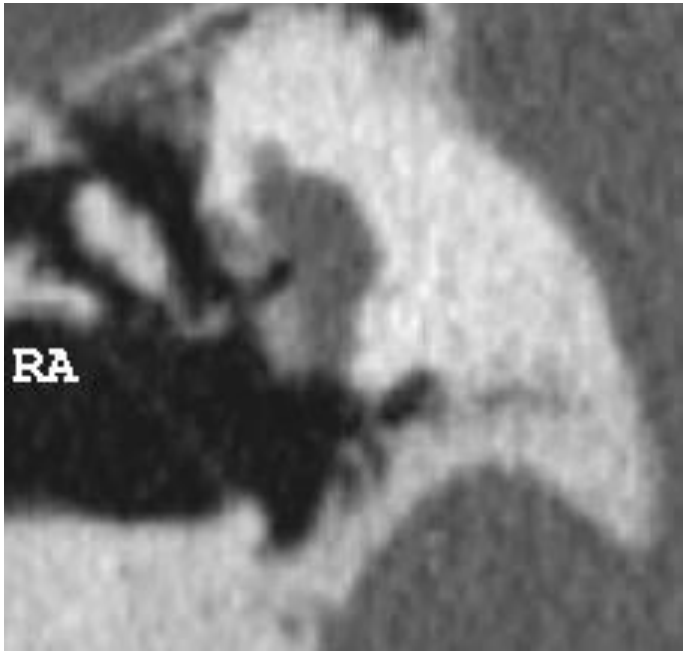
❶ **To define a surgical strategy in case of**

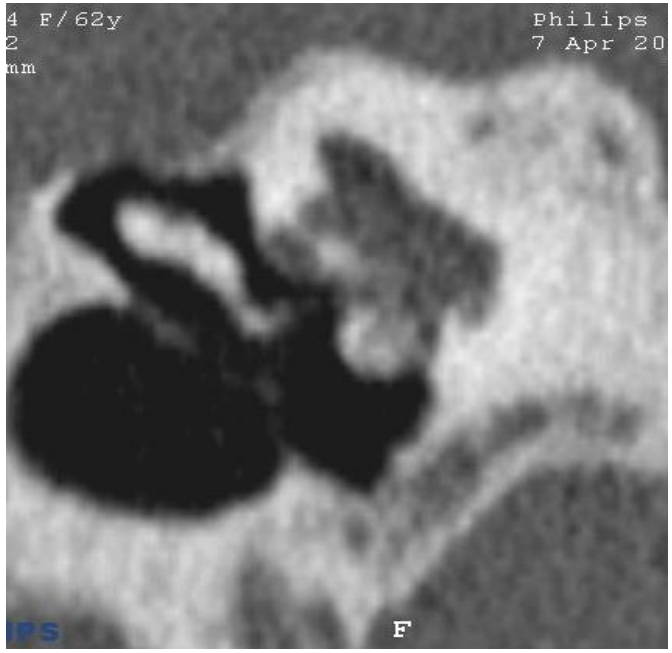
- Anatomical difficulties
- Negative CT-Scan

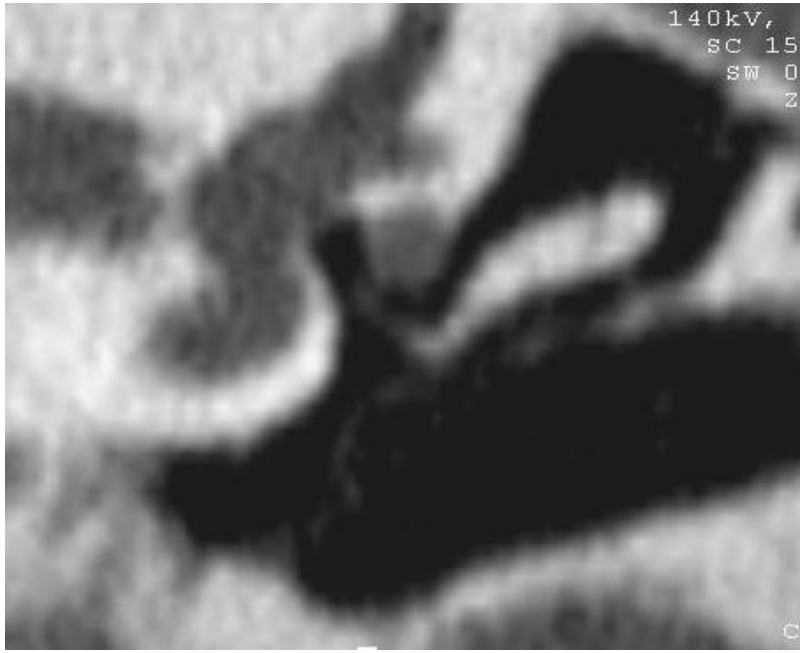
❷ **To anticipate the evolution of post operative bone conduction according to the extension and location of lesions**

❸ **To analyse the cause of failure**

ANATOMICAL DIFFICULTIES



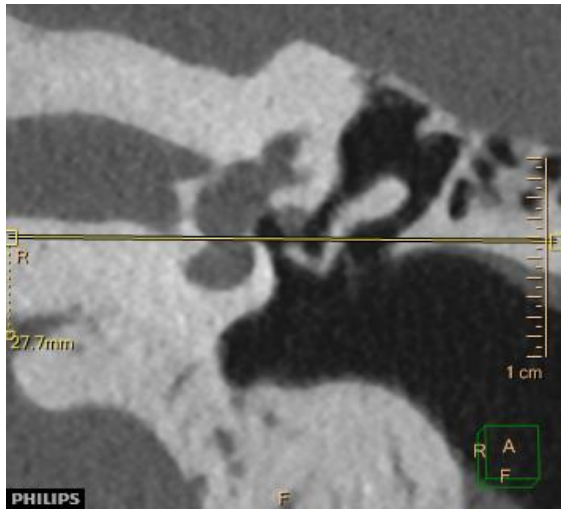


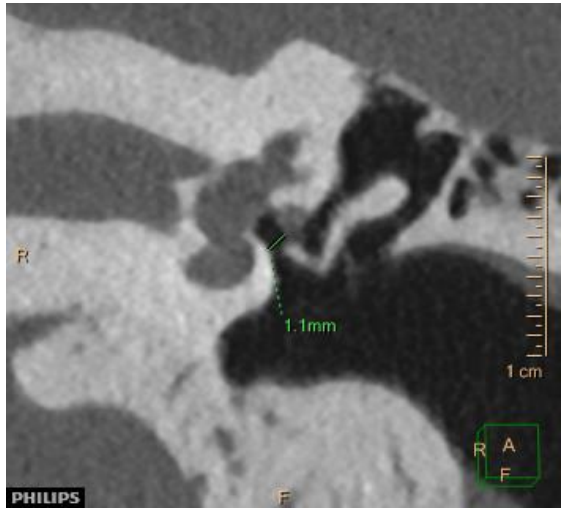


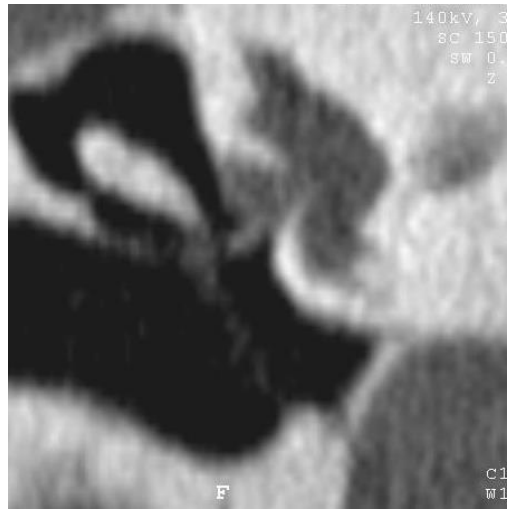
- Small fenestra
- Obliteration footplate
- Facial déhiscence

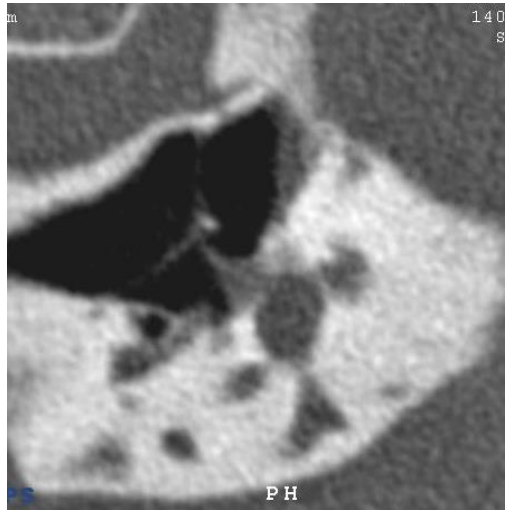
FACIAL NERVE / OVAL WINDOW

- Partial obliteration



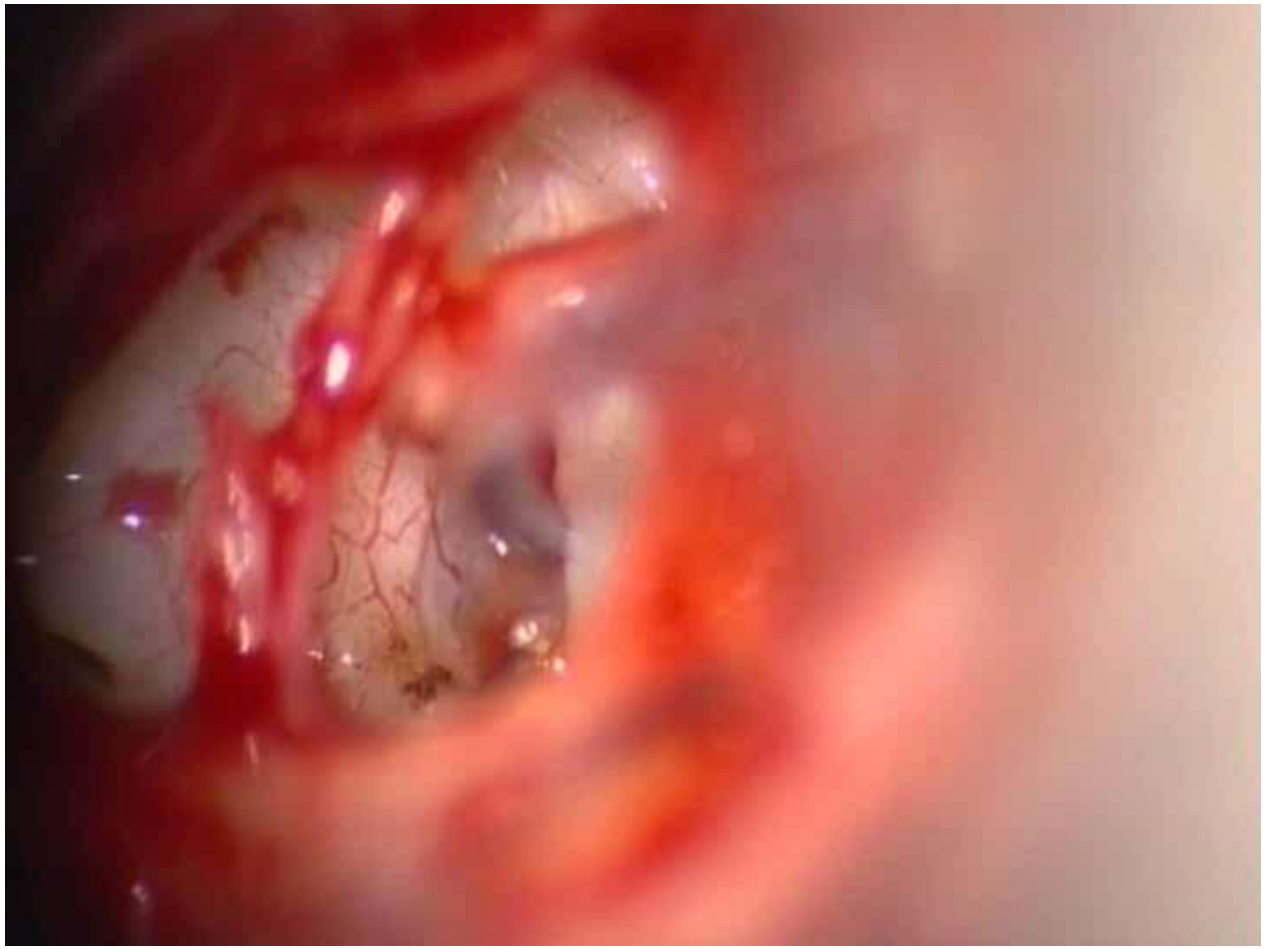




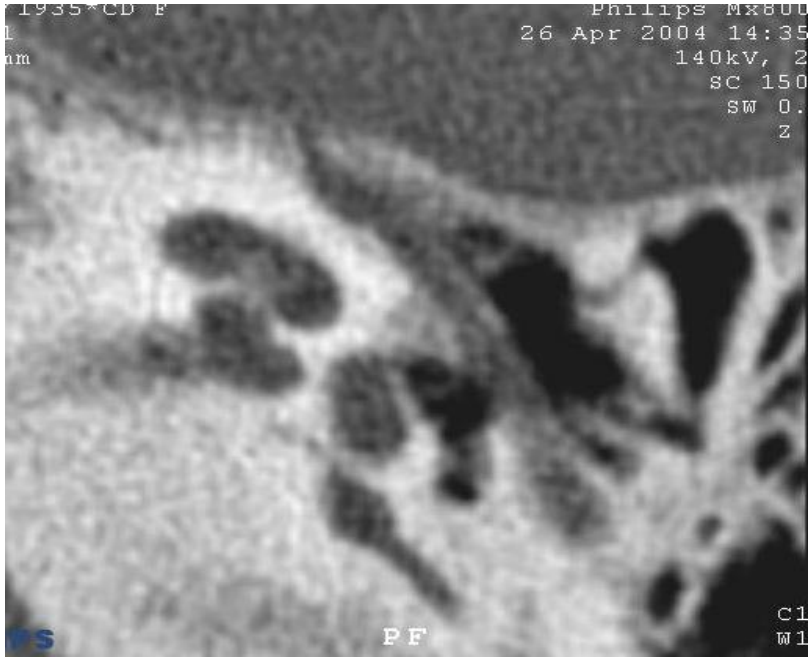


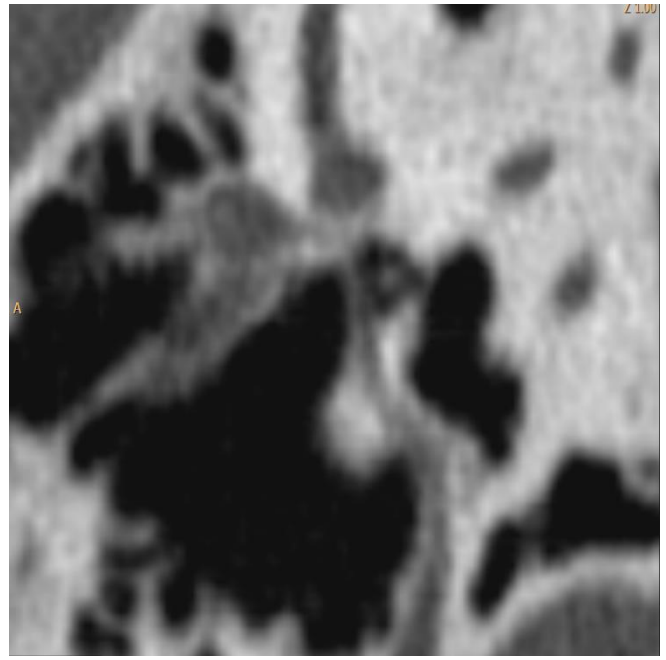
- Total obliteration

FACIAL NERVE



ANATOMICAL DIFFICULTIES





- Malleus fixation
- Incus fixation
- Stapedial artery

COUNSELING PATIENTS IN CASE OF NEGATIVE CT-SCAN

- Middle ear exploration **BUT**

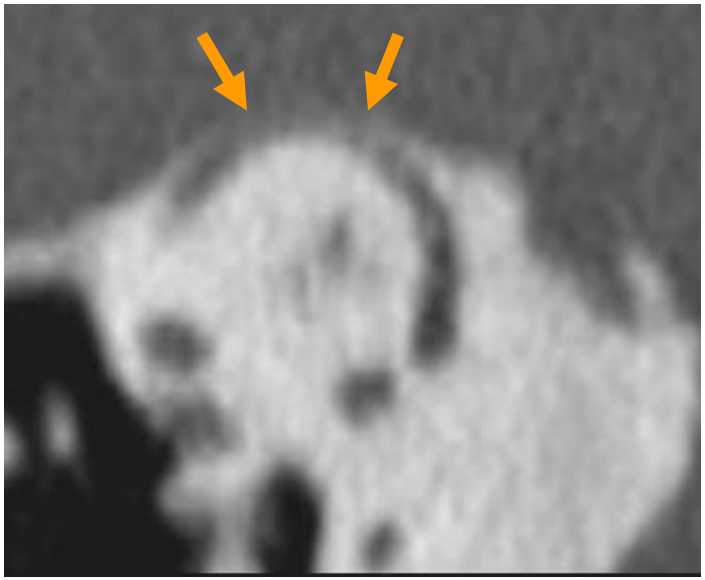
➔ **Risk of mobile footplate x 5**

- Early form with an incomplete fixation of the stapes

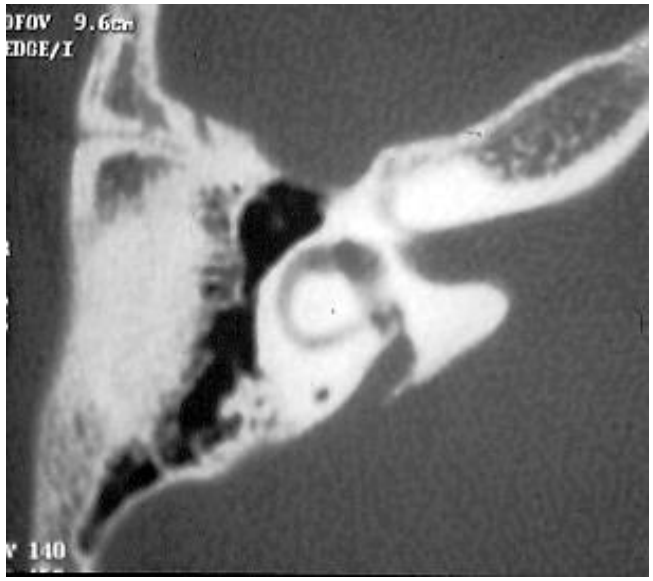
➔ **Possible inner ear conductive hearing loss due to :**

- An enlarged vestibular aqueduct
- Minor inner ear malformation
- Superior semicircular canal dehiscence
- Modiolus anomalies

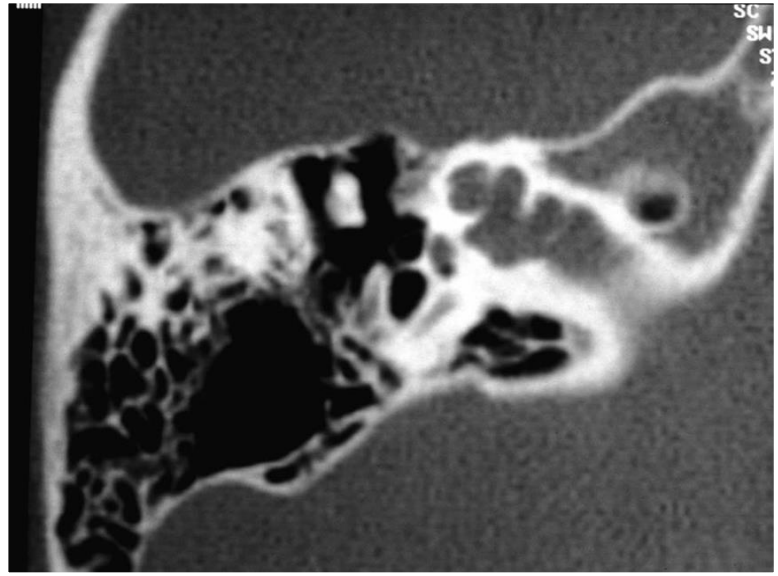
POSSIBLE INNER EAR CONDUCTIVE HEARING LOSS



▲ Superior semicircular canal dehiscence

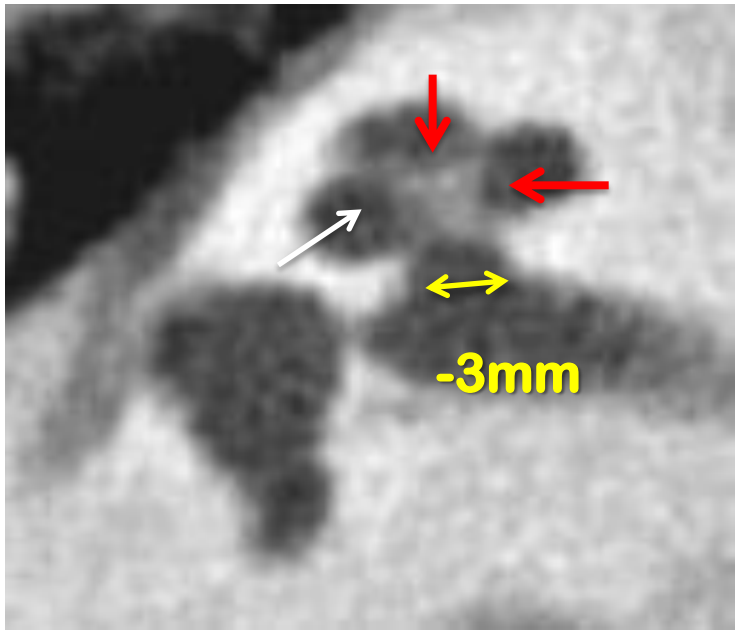


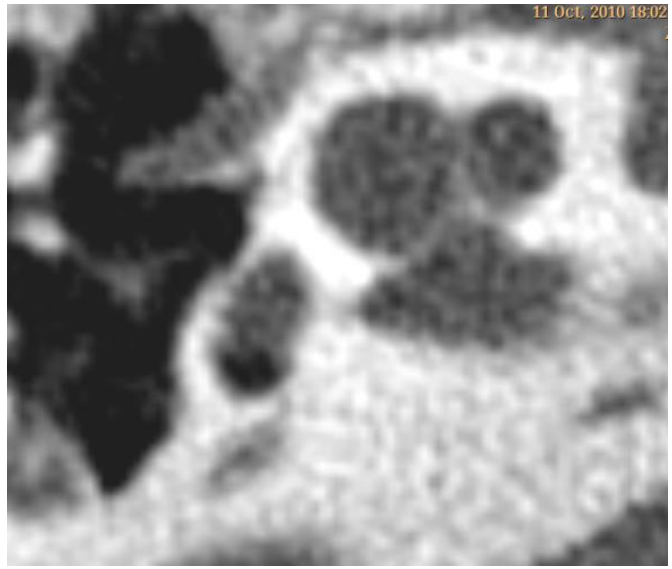
▲ Enlarged vestibular aqueduct

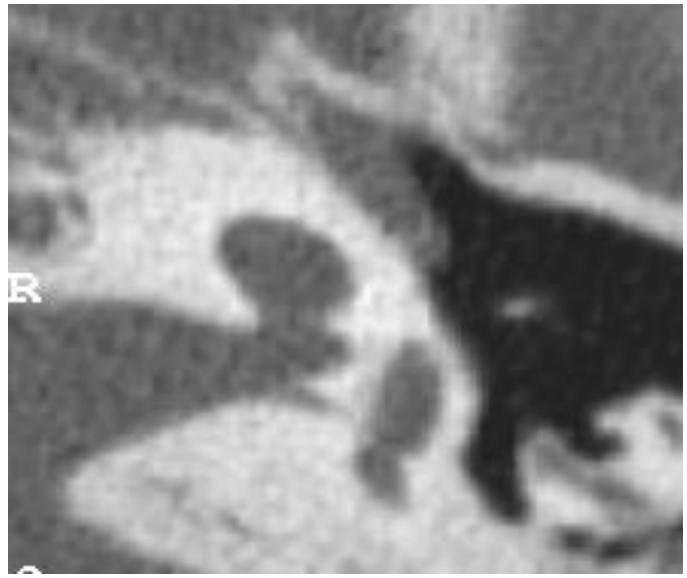


▲ Abnormal modiolus ▲

MODIOLUS MALFORMATION







INTEREST OF IMAGING IN THE EVALUATION OF OTOSCLEROSIS

❶ To define a surgical strategy in case of

- Anatomical difficulties
- Negative CT-Scan

❷ **To anticipate the evolution of post operative bone conduction according to the extension and location of lesions**

❸ To analyse the cause of failure

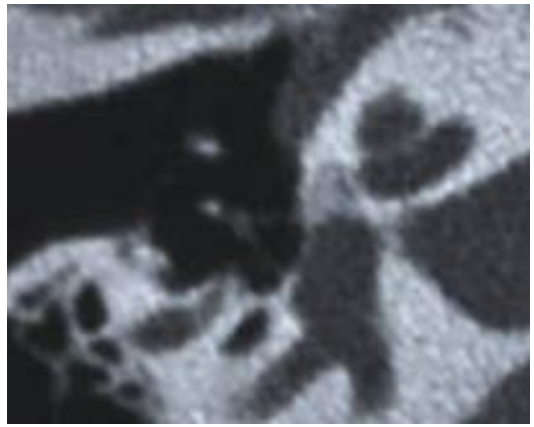
EXTENSION AND LOCATION OF LESIONS

Marx M., Lagleyre S., Escudé B., Demeslay J., Elhadi T.,Deguine O., Fraysse B.
Correlations between CT-Scan findings thresholds in otosclerosis
Acta Otolaryngol 2011;131:351-57

Group 1

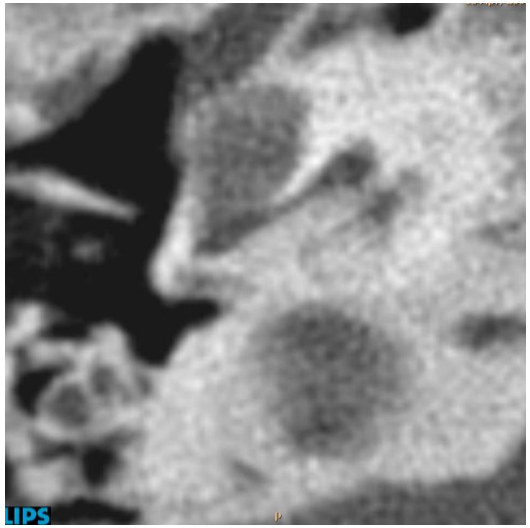
- Isolated fenestral otosclerosis

foci restricted to the oval window



Group 2

- Extensive otosclerosis
  - Endosteal extension
  - Round window obliteration
  - IAC involvement



ENDOSTEAL EXTENSION AND POSTOPERATIVE BONE CONDUCTION

- Improvement > 10 dB of BC was considered significant

	Group 1	Group 2
	Without Endosteal n 150	With Endosteal n 33
% of ears with more than 10 dB improvement	30/150 **20%**	1/35 **3%**

p < 0.05

- The chance of improvement was lower in extensive foci than in isolated otosclerosis

INTEREST OF IMAGING IN THE EVALUATION OF OTOSCLEROSIS

❶ To define a surgical strategy in case of

- Anatomical difficulties
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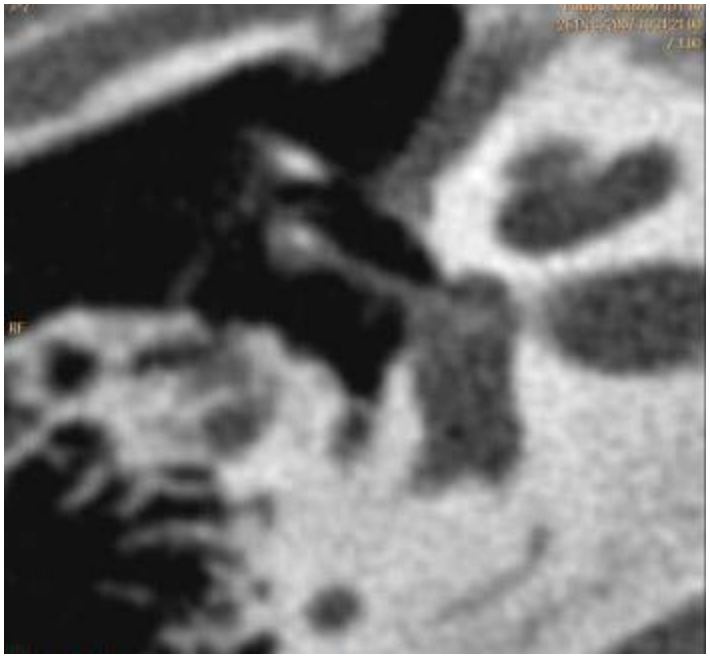
❷ To anticipate the evolution of post operative bone conduction according to the extension and location of lesions

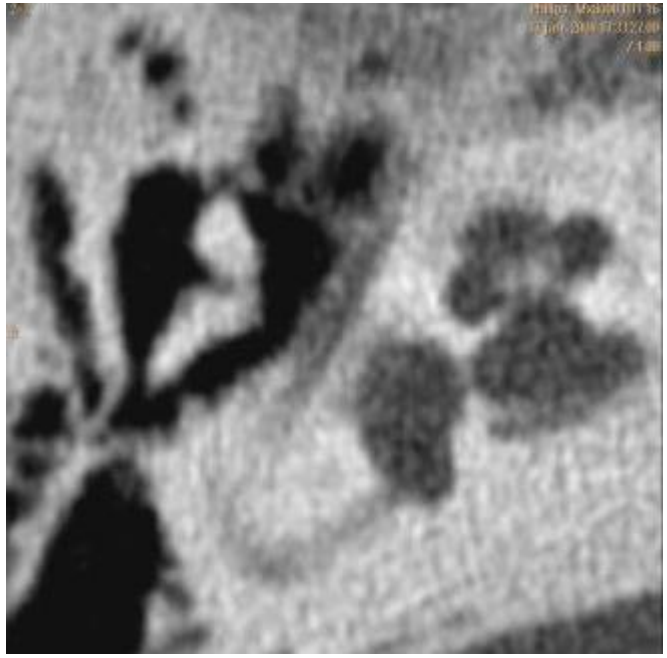
❸ **To analyse the cause of failure**

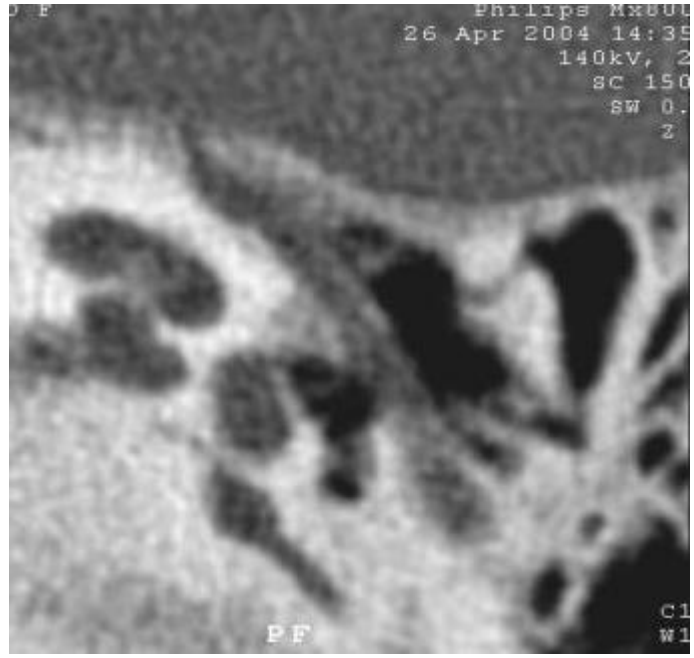
CAUSE OF FAILURE

- Persistence of conductive hearing loss
- Secondary conductive hearing loss
- Sensorineural complications

PERSISTENCE OF A CONDUCTIVE HEARING LOSS

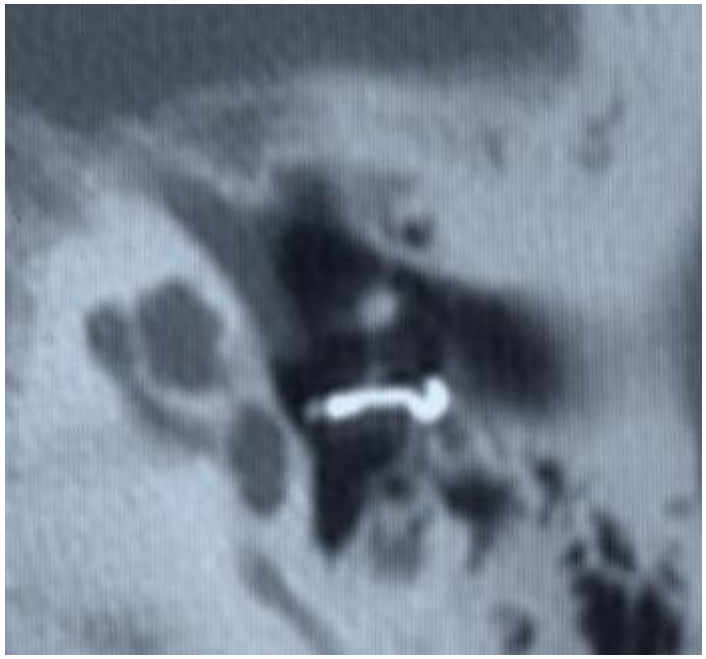


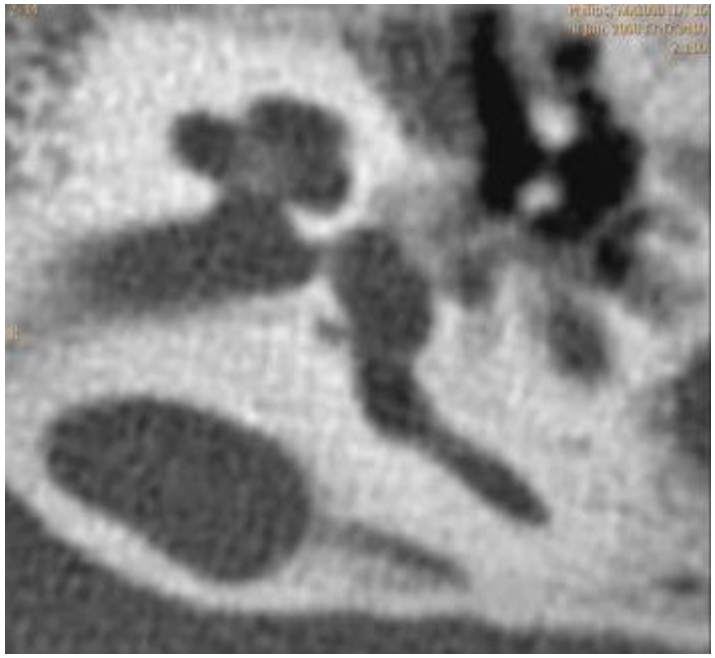




- Prosthesis in place, no focus
- Dysjonction
- Malleus fixation

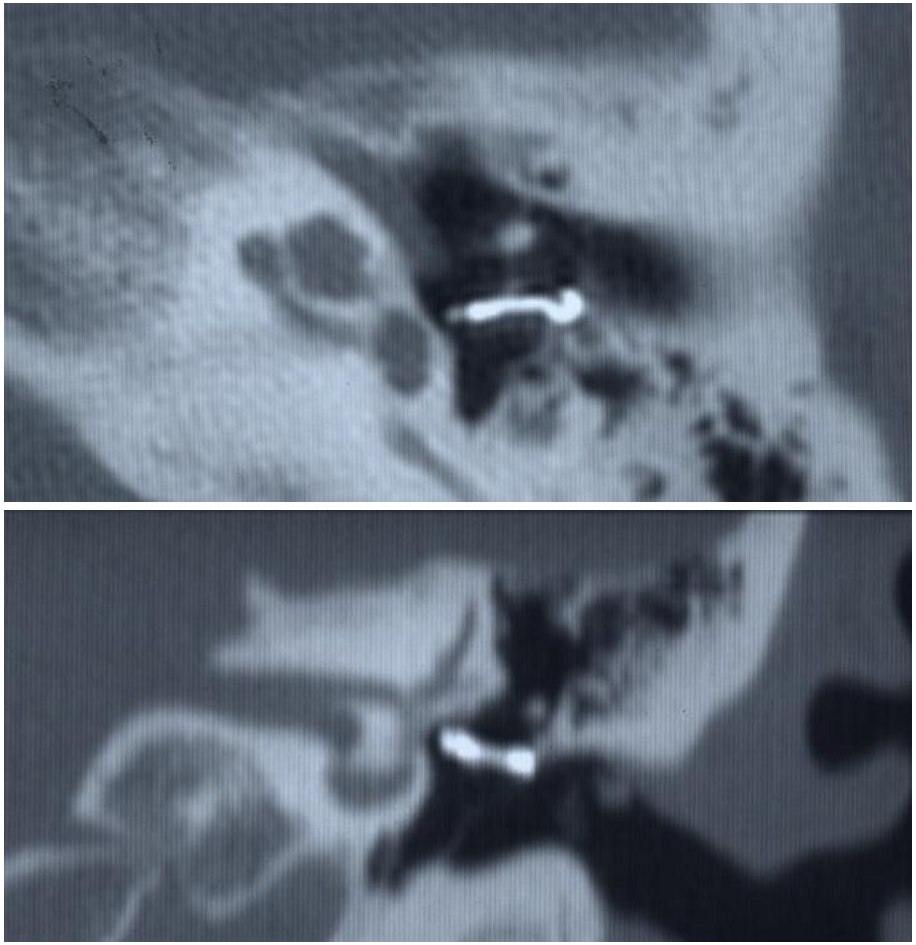
SECONDARY CONDUCTIVE HEARING LOSS



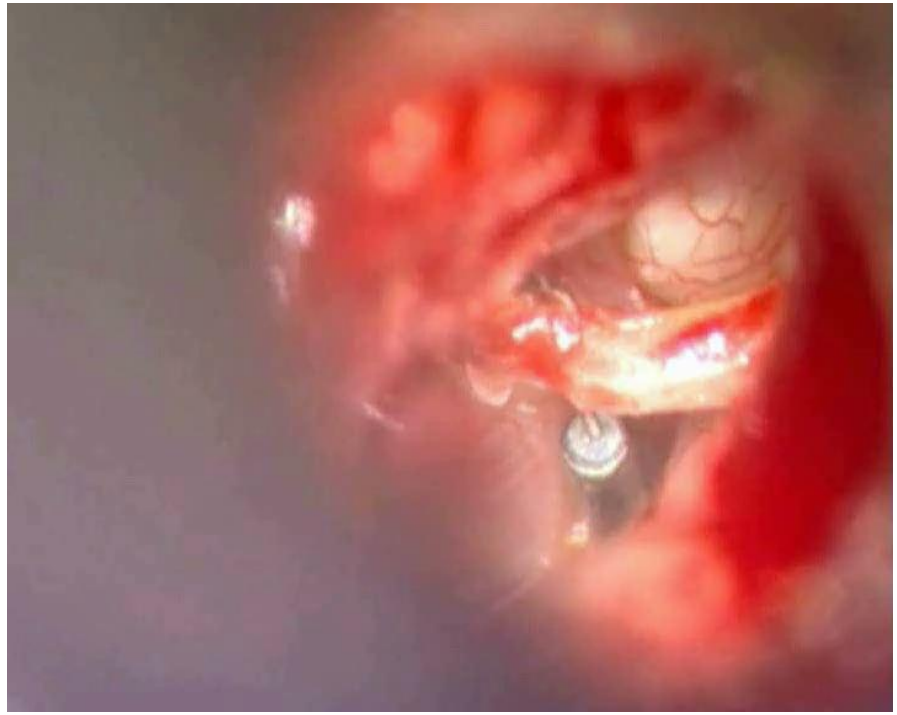


- Prosthesis displacement
- Lateralization syndrome
- Reossification

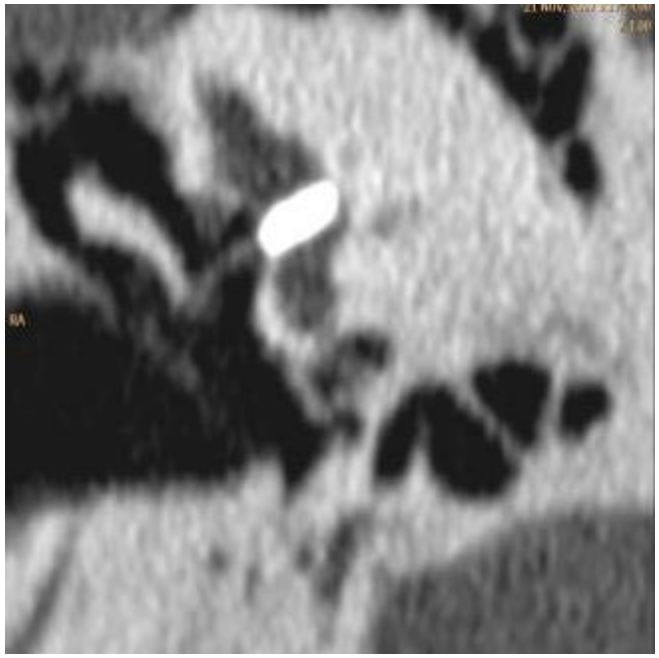
LATERALIZATION SYNDROME



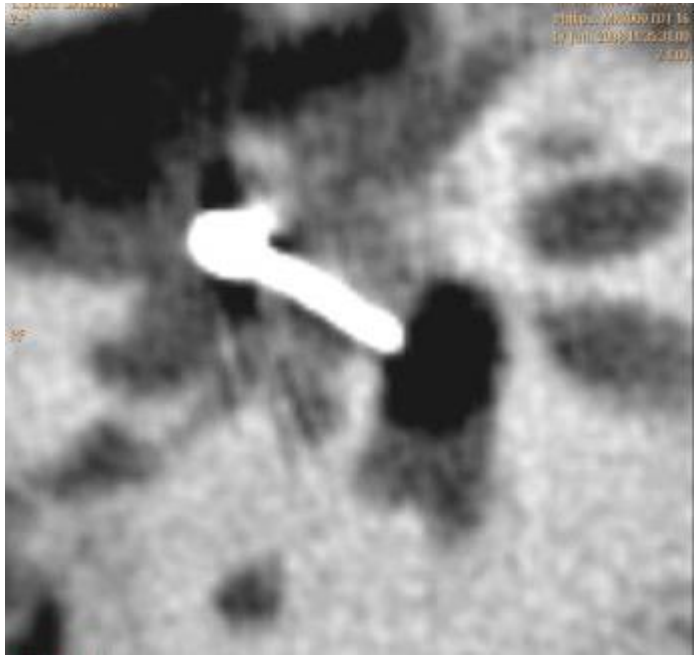
Otol Neurotol. 2009 Dec; 30(8):1138-44.
Revision stapes surgery : the "lateralized piston syndrome"
LAGLEYRE S, CALMELS MN, ESCUDE B, DEGUINE O, FRAYSSE B.



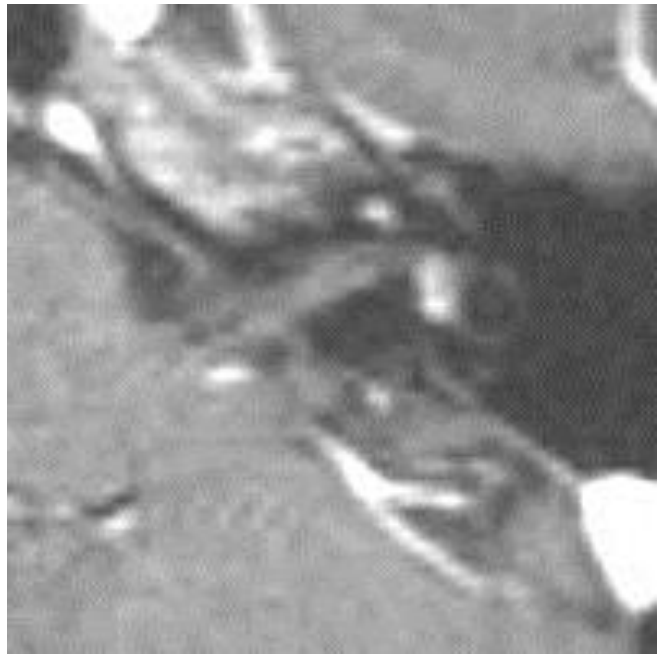
SENSORINEURAL COMPLICATIONS



- Intravestibular prosthesis

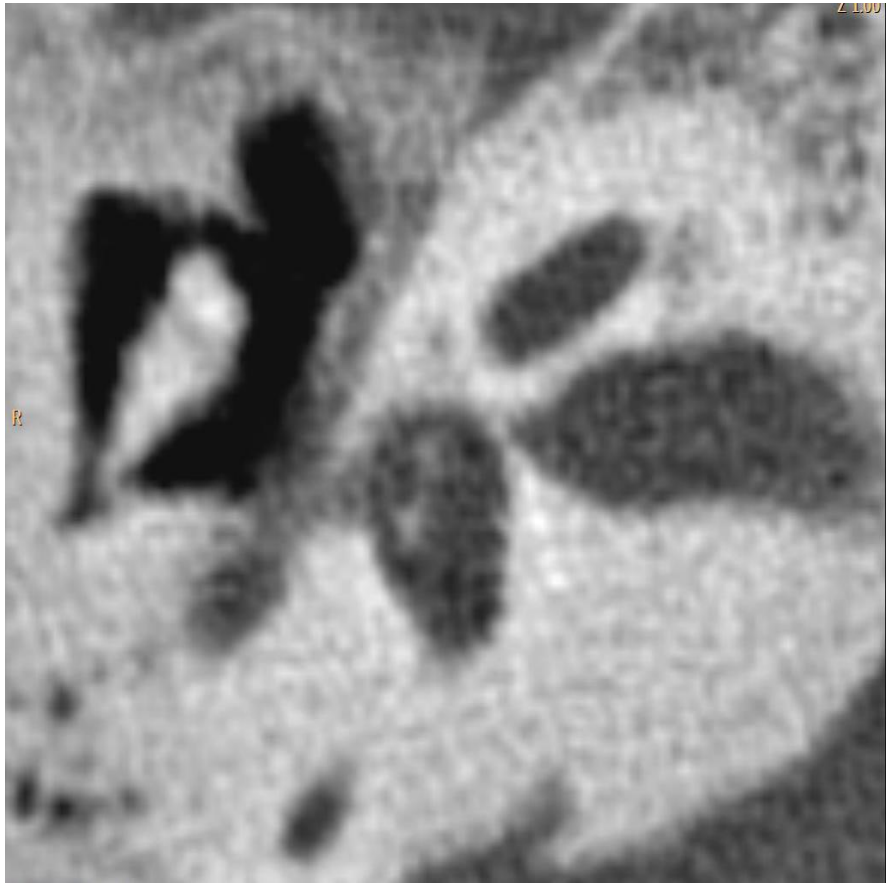


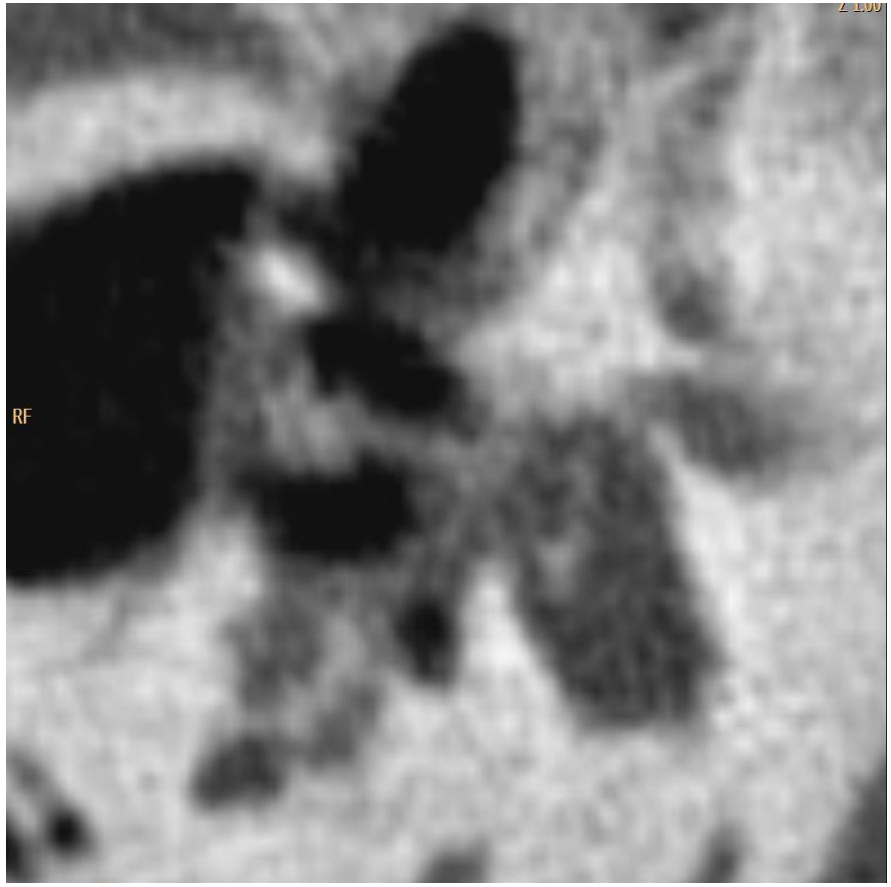
- Fistula with air



- Labyrinthitis

FLOATTING STAPES





CONE BEAM COMPUTED TOMOGRAPHY APPLICATIONS IN OTOSCLEROSIS

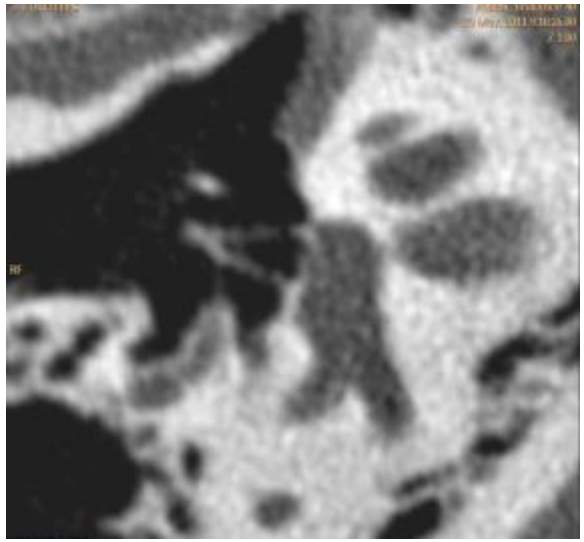
- Cone Beam computed tomography is an X-Ray based volume acquisition method providing 3D images of the head
- The spatial and density resolution appears to be equivalent or better than a CT high resolution, with :
  - Lower radiation
  - Lower cost

Cone Beam computed tomography

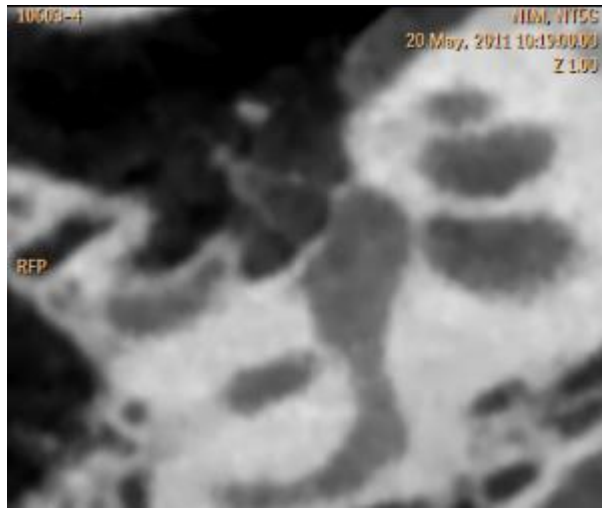
CT-Scan

FOOTPLATE AND STAPES

- CT-SCAN

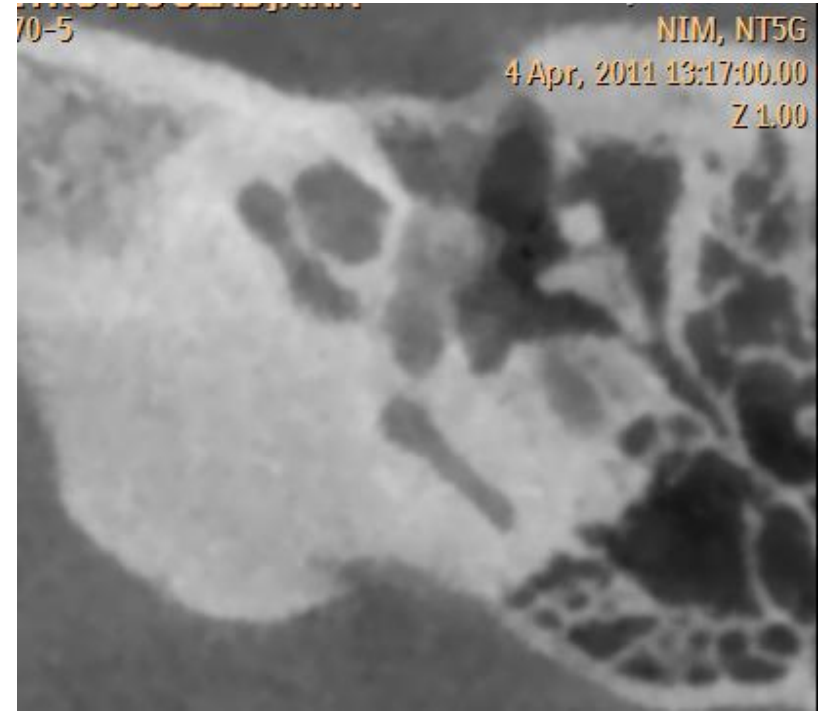


- CONE BEAM



	MSCT			CBCT			
Structure	Mean	Median	SD	Mean	Median	SD	p
Anterior footplate thickness	2.08	2.00	0.67	2.75	3.00	0.45	**0.009**
Posterior footplate thickness	1.91	2.00	0.70	2.73	3.00	0.65	**0.009**


4 Apr, 2011 13:17:00.00
Z 1.00
R


NIM, NT5G
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9270-8
NIM, NT5G
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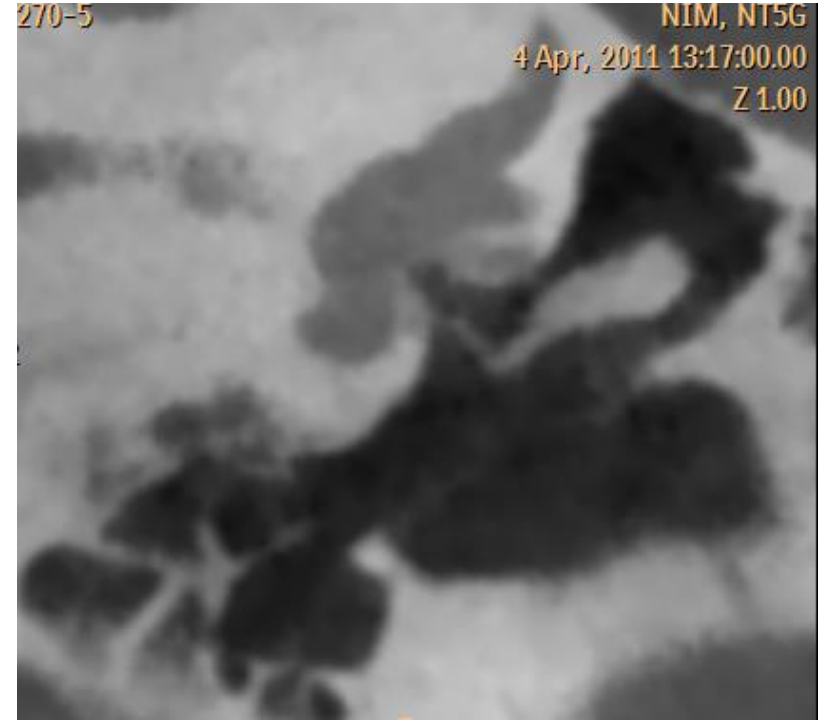
RH


NIM, NT5G
4 Apr, 2011 13:17:00.00
Z 1.00

THERAPEUTIC OPTION

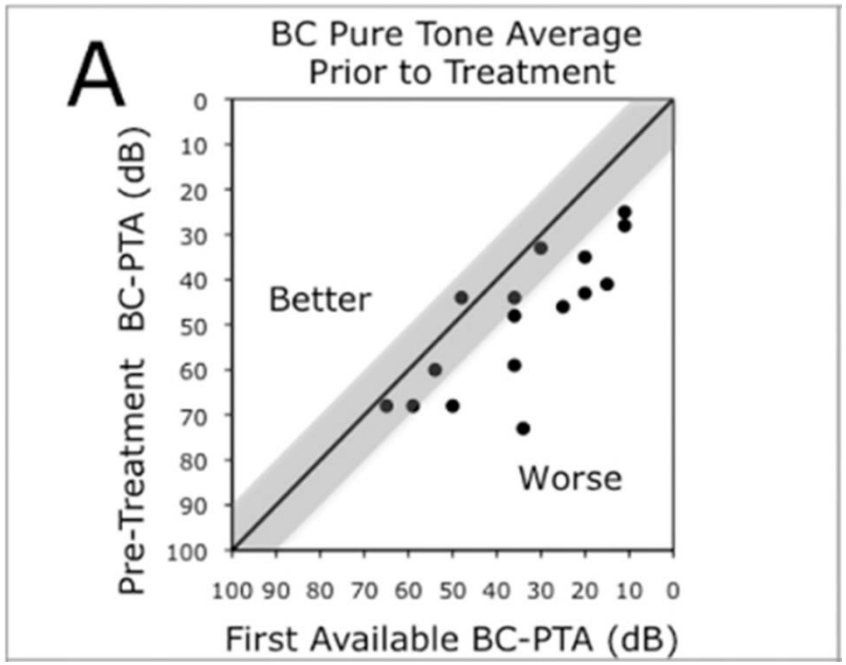
- Medical treatment
- Hearing aid
- Surgery
- Auditory implants
  - BAHA
  - Middle ear implant
  - DACS
  - Cochlear implant

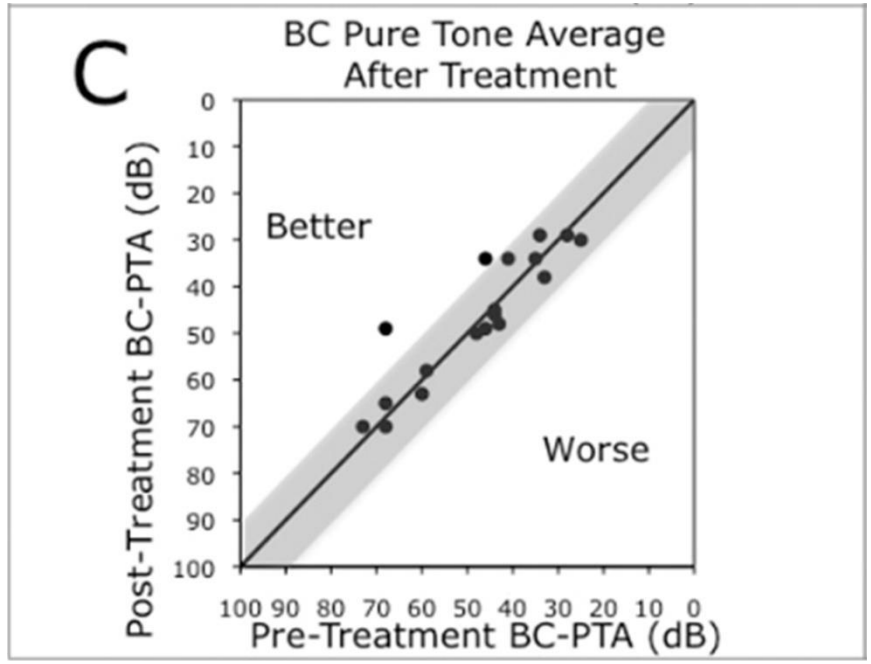
MEDICAL TREATMENT

Otology & Neurotology
33:1308–1314 © 2012, Otology & Neurotology, Inc.

Third-Generation Bisphosphonates for Treatment of Sensorineural Hearing Loss in Otosclerosis

*†Alicia M. Quesnel, ‡Margaret Seton, *†Saumil N. Merchant,
†§Christopher Halpin, and *†Michael J. McKenna

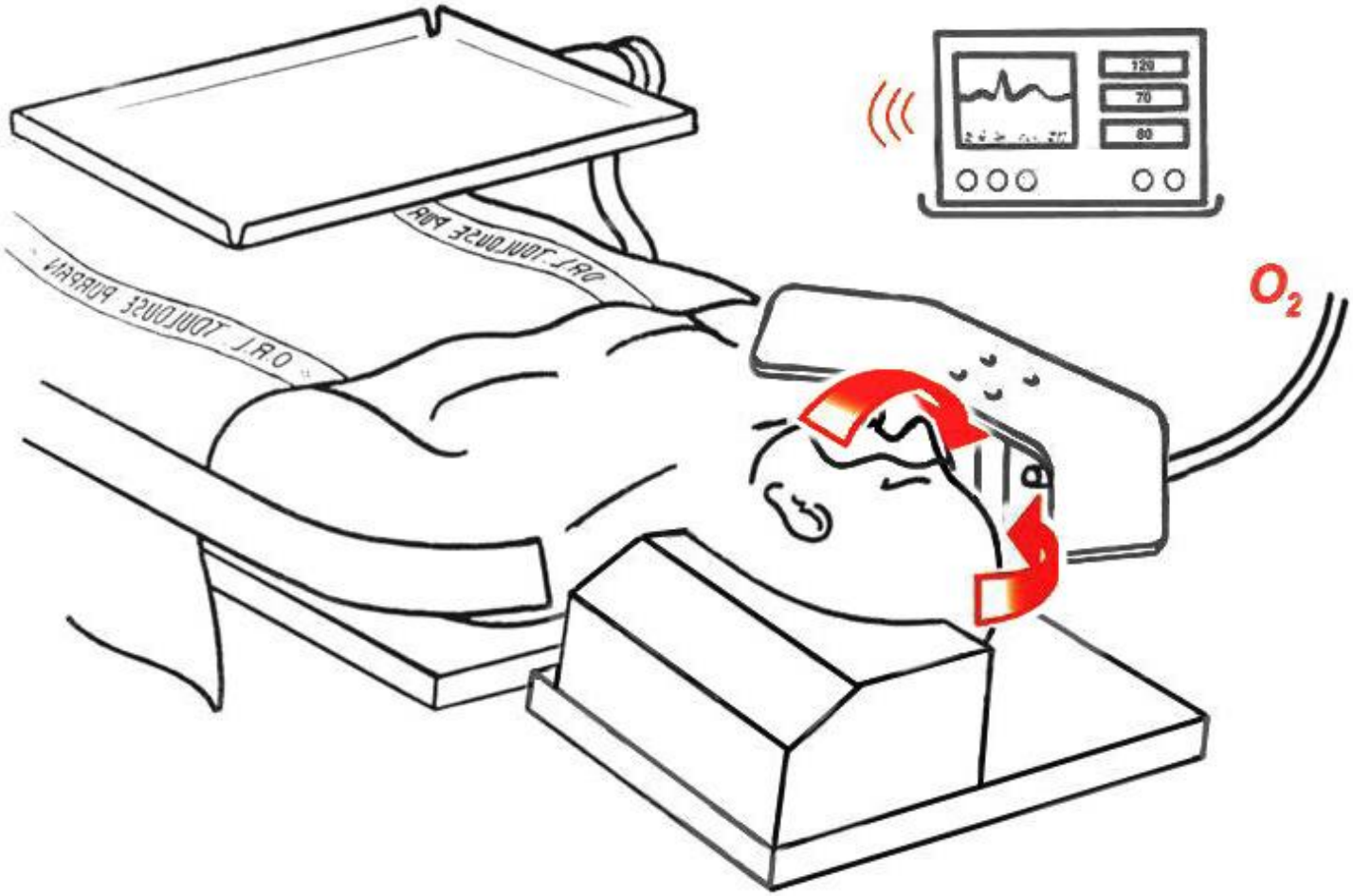


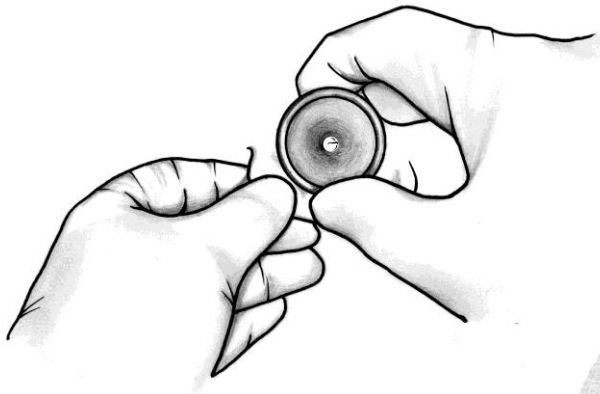


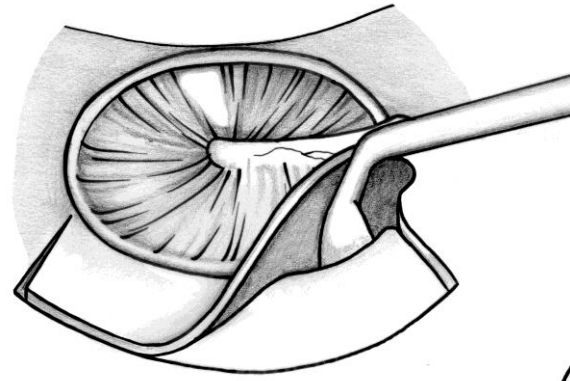
HEARING AID AMPLIFICATION IN CONDUCTIVE AND MIXED HEARING LOSS

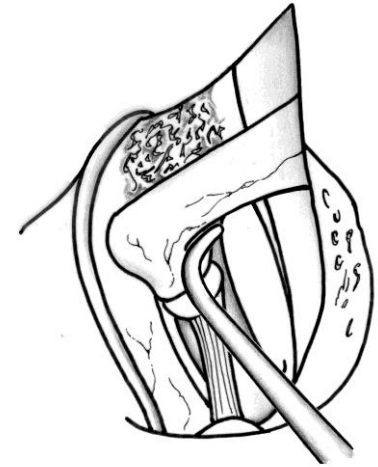
- The adaptation is easiest due to the good cochlear function
- The hearing aid amplification should
  - Compensate the sensorineural part of the loss
  - Additional gain at each frequency to correct the conductive loss
  - Due to the conductive component on low frequency an occluded ear mold may be used

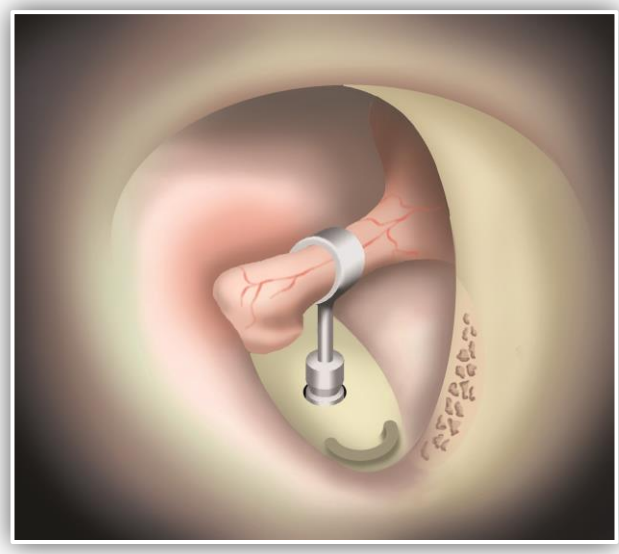
SURGICAL TECHNIQUE

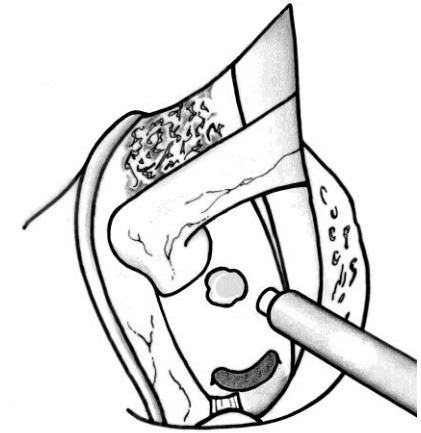








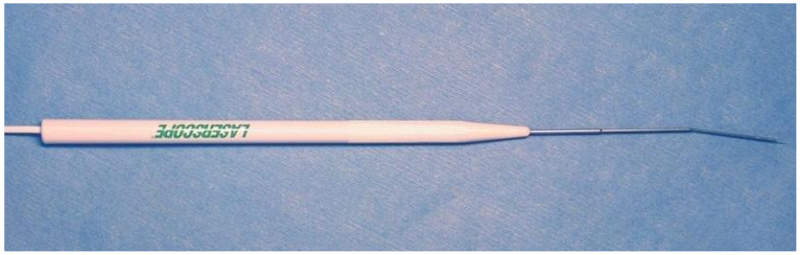




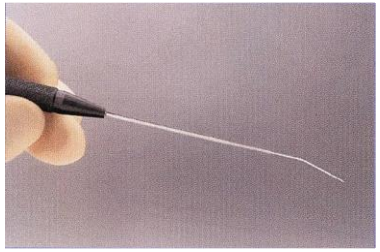
LASER

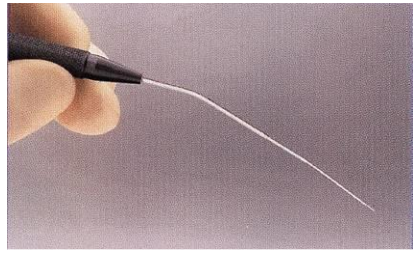
Material

- KTP LASER (532 nm)



- Short or long angle

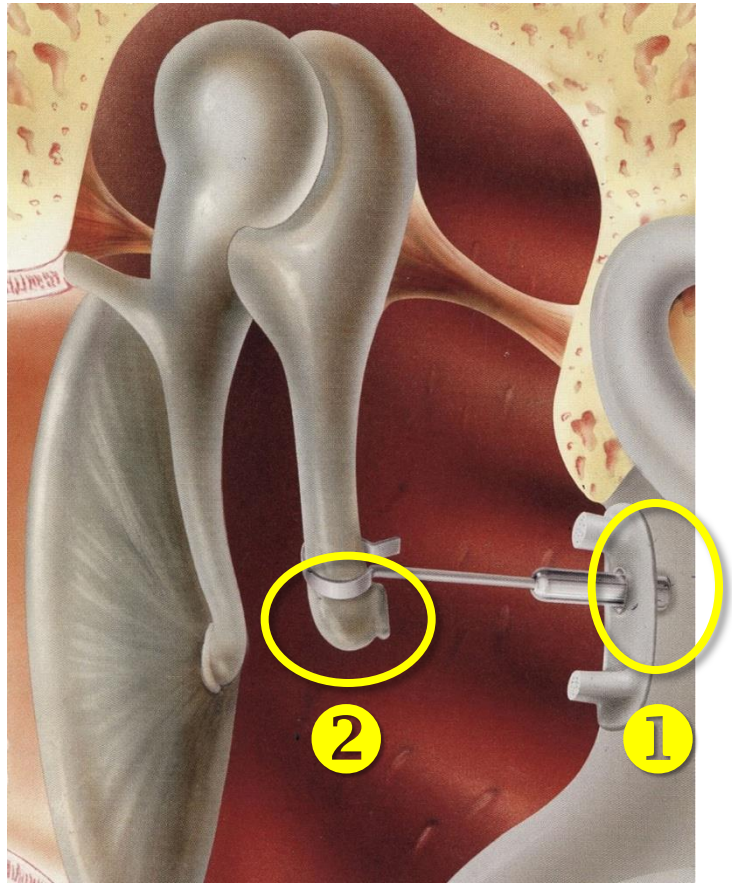


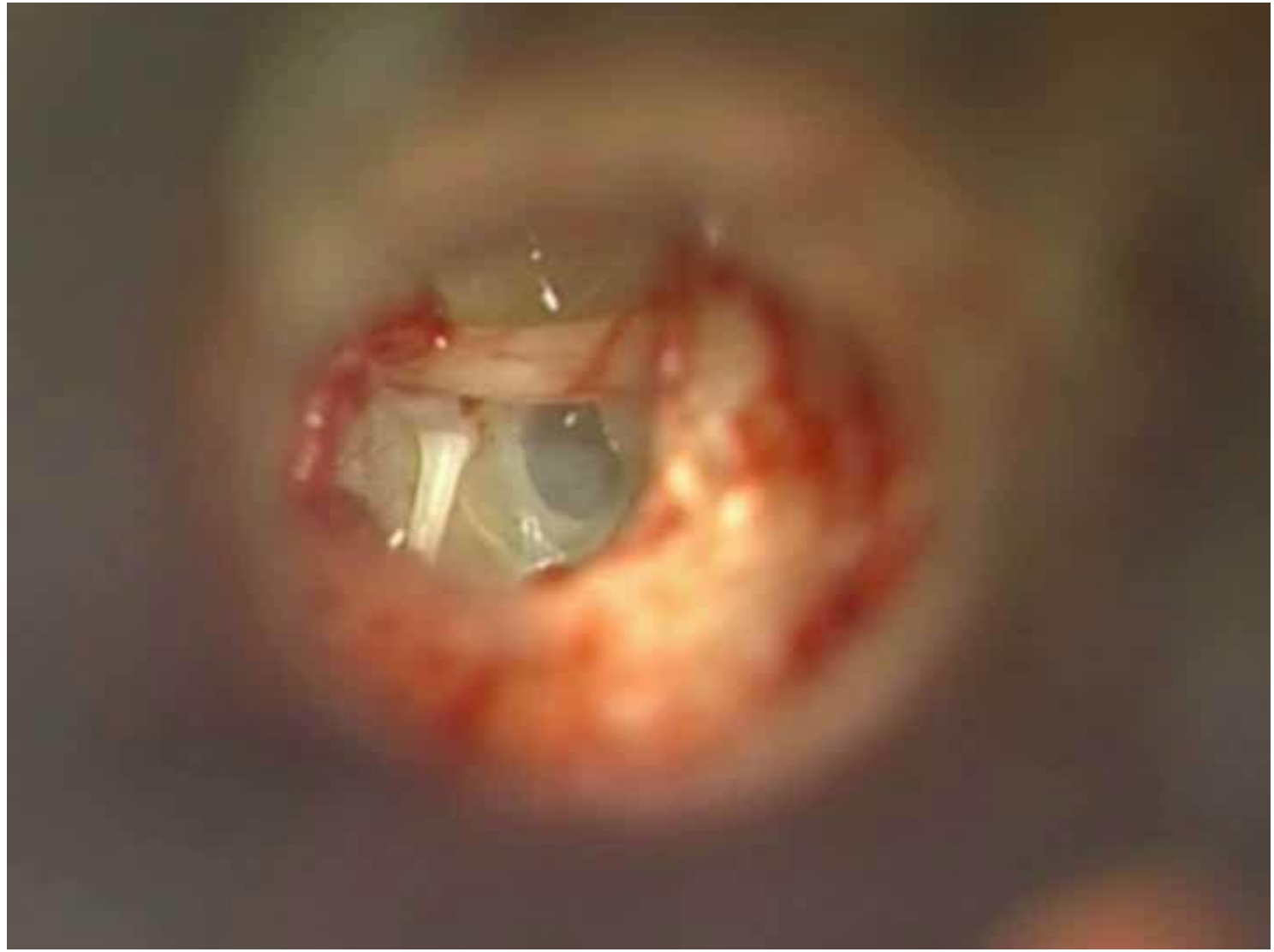


Vaporization of the stapedial crus : 1 W - 0,2 s

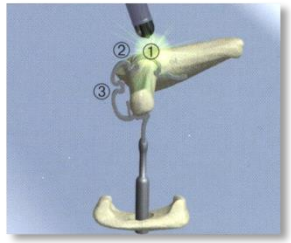
LENGTH OF THE PROSTHESIS AND COUPLING

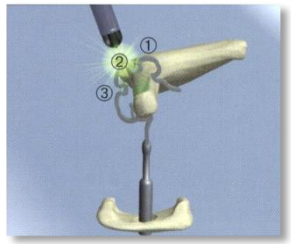
- Incorrect prosthesis **sizing ❶** and **crimping ❷** are important causes of stapedotomy failure

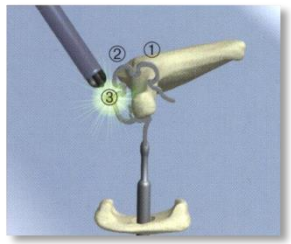


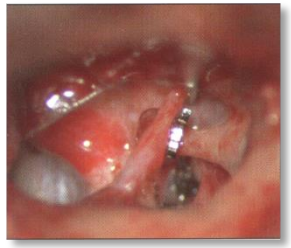


SELF CRIMPING PROSTHESIS





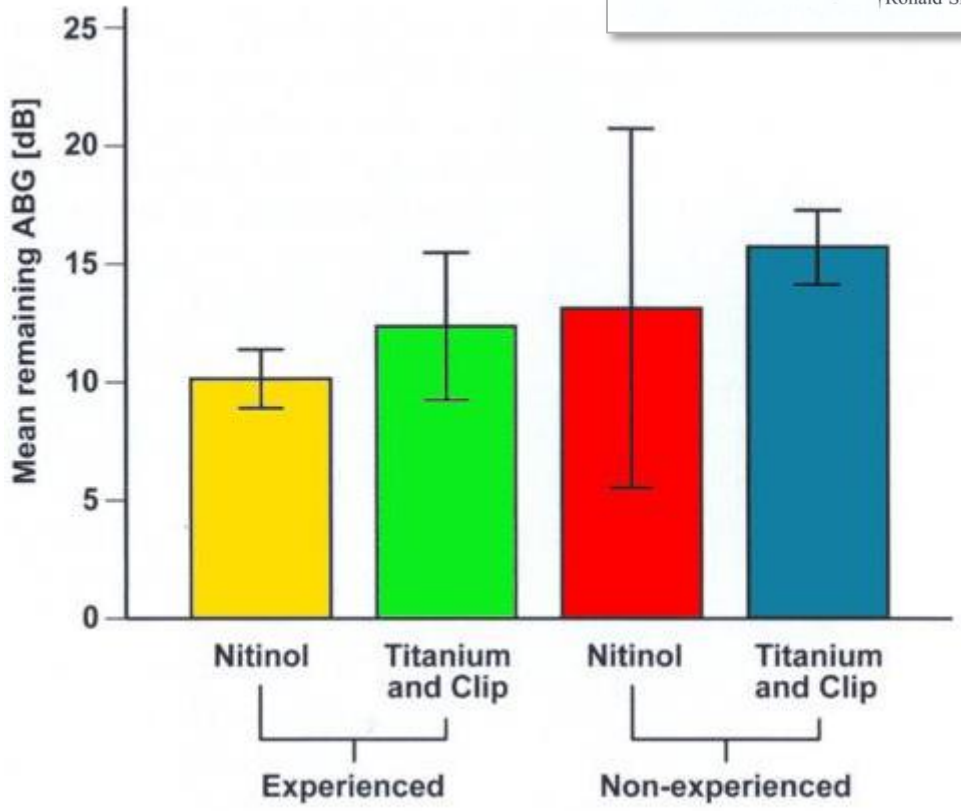




Otology & Neurotology
34:1571–1575 © 2013, Otology & Neurotology, Inc.

Promising Clinical Results of an Innovative Self-Crimping Stapes Prosthesis in Otosclerosis Surgery

*Florian Schrötzlmair, *†Fabian Suchan, *Ulrich Kisser, *John-Martin Hempel, †Ronald Sroka, and *Joachim Müller



DECISION MAKING

- Clinical history and examination
- Audiometrical evaluation and binaural function
- Anticipation of surgical difficulties and surgeon experience

CLINICAL HISTORY AND EXAMINATION

- Main complain and level of disability
- Patient expectation

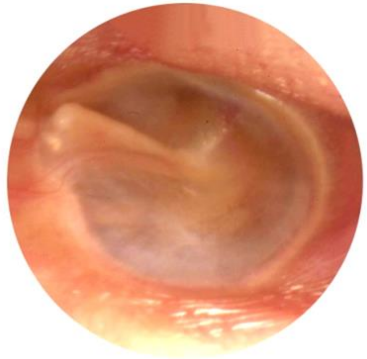
PORMS

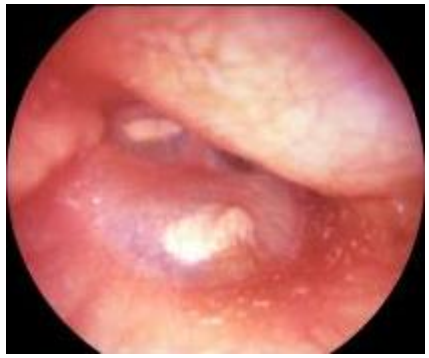

J Am Acad Audiol 8: 27–43 (1997)

Client Oriented Scale of Improvement (COSI) and Its Relationship to Several Other Measures of Benefit and Satisfaction Provided by Hearing Aids

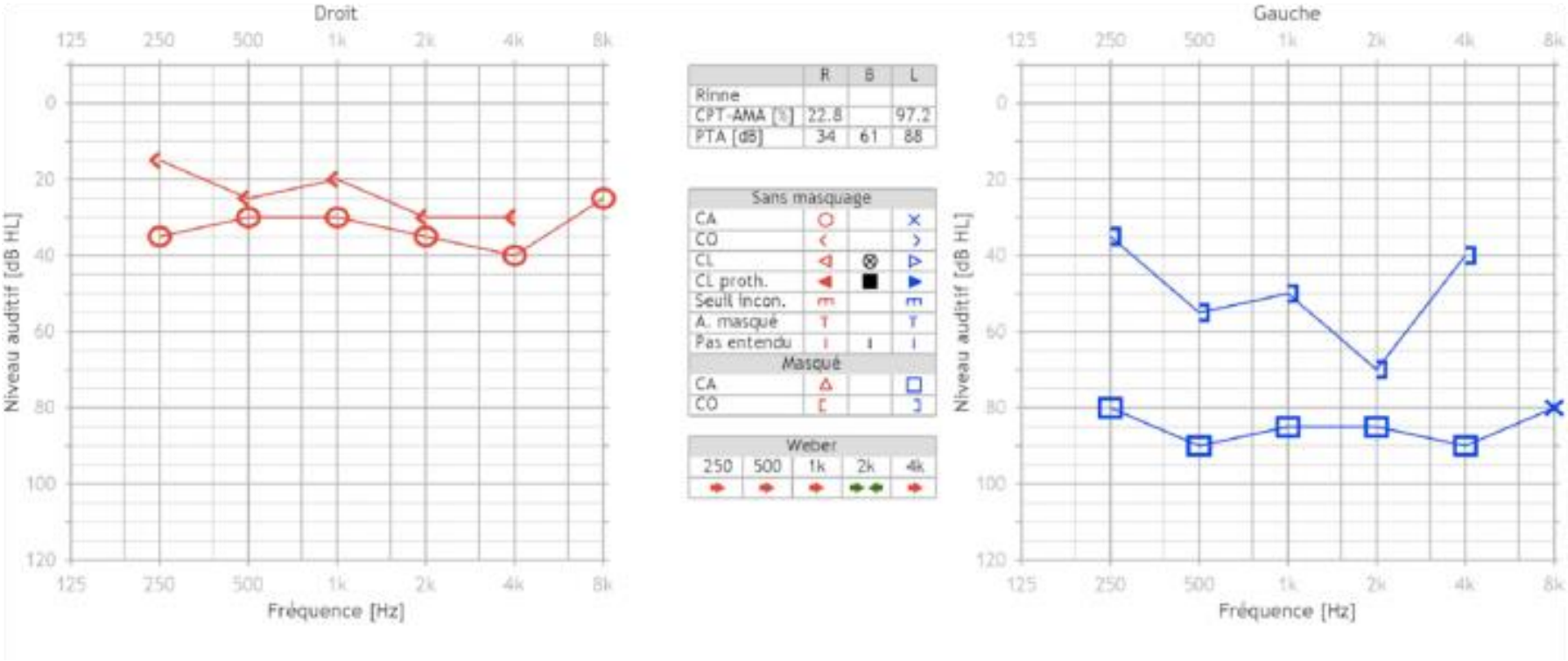
Harvey Dillon*
Alison James†
Jenny Ginis‡

- Risk and benefit between hearing aid and surgery
- Otoscopic examination

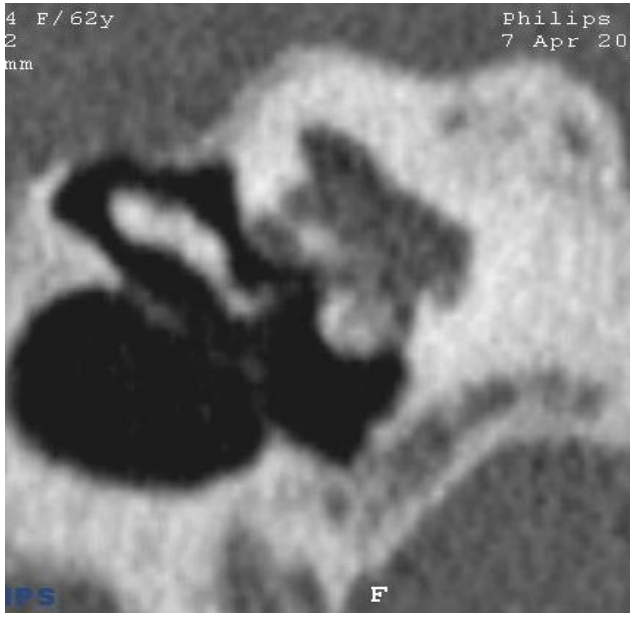




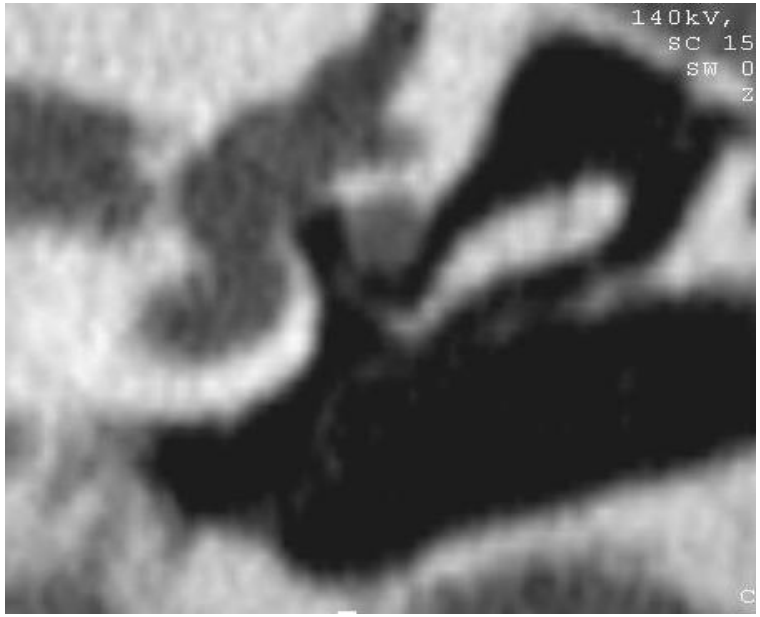
AUDIOMETRICAL EVALUATION



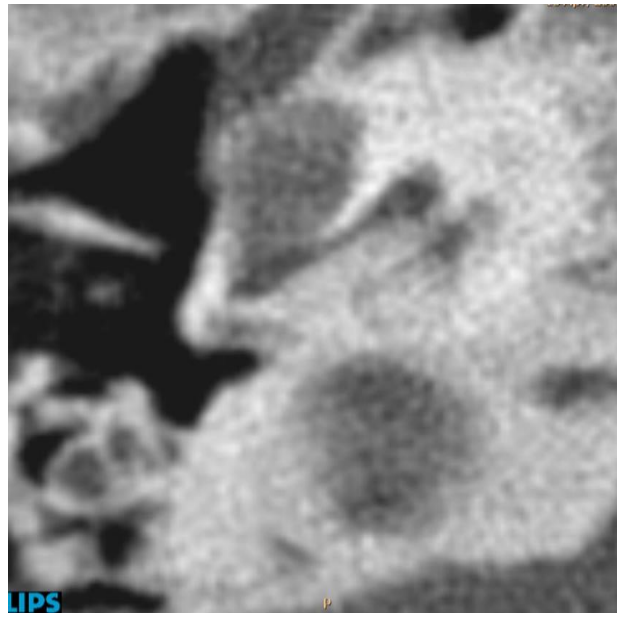
CT-SCAN EXAMINATION



- Obliteration footplate



- Facial déhiscence



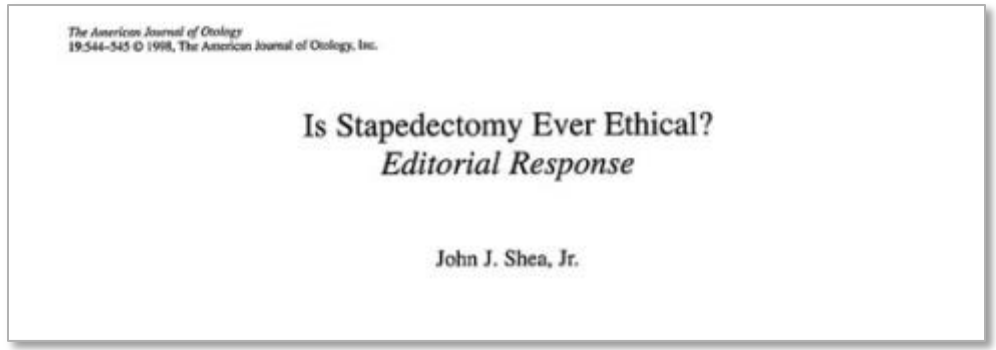
- RW obliteration

CLINICAL SITUATION AND THERAPEUTIC OPTIONS

1 Hearing aid is the only option due to surgical **contra indication**

2 The two options are needed due to restaure **binaural** hearing

3 The two options are **possible**



The American Journal of Otology
19:544–545 © 1998, The American Journal of Otology, Inc.

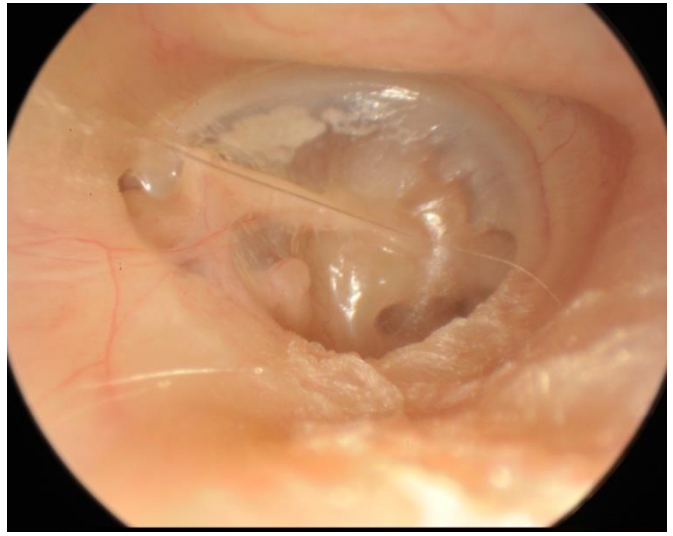
Is Stapedectomy Ever Ethical?
Editorial Response

John J. Shea, Jr.

SURGICAL CONTRAINDICATIONS

Absolute

- Severe tubal dysfunction
- Pure sensorineural hearing loss
- Patient refuse any risk
- History of sudden hearing loss



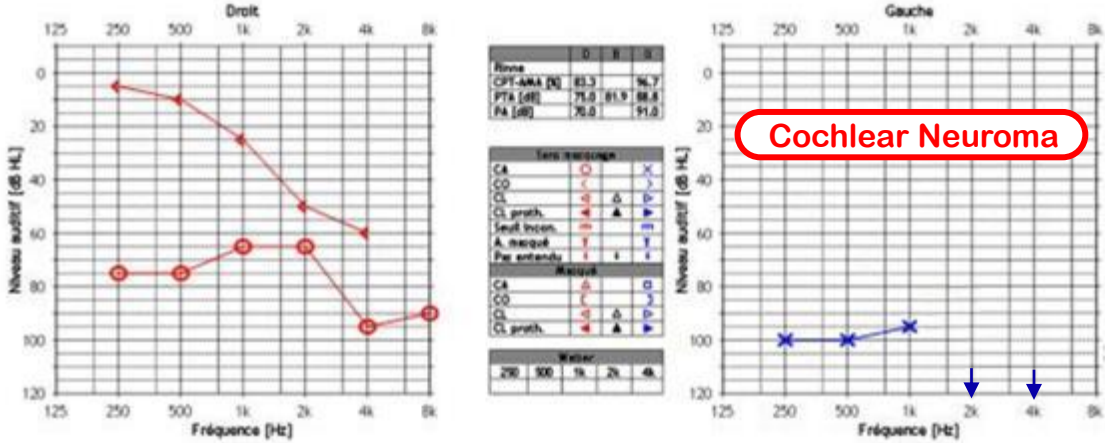
Relative

- Only hearing ear *

ONLY HEARING EAR IN THE ERA OF CI

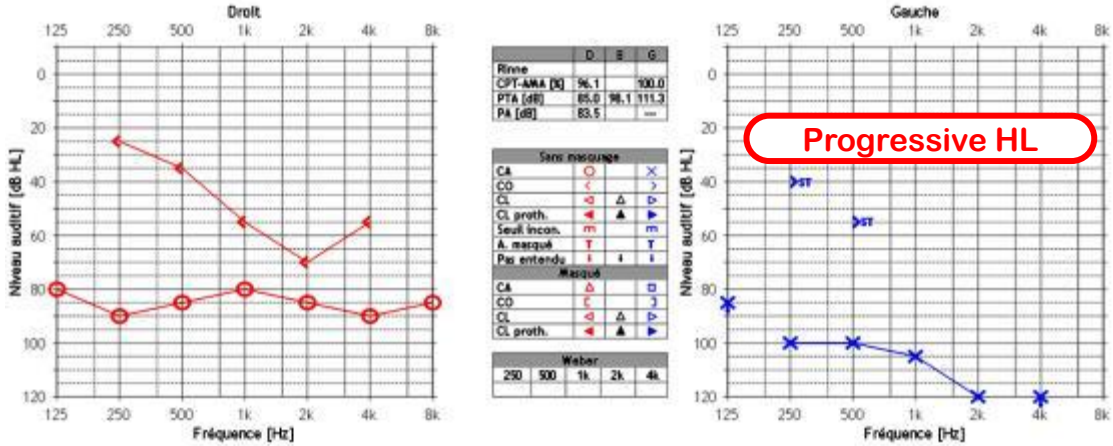
Case 1

- M – 49 years old



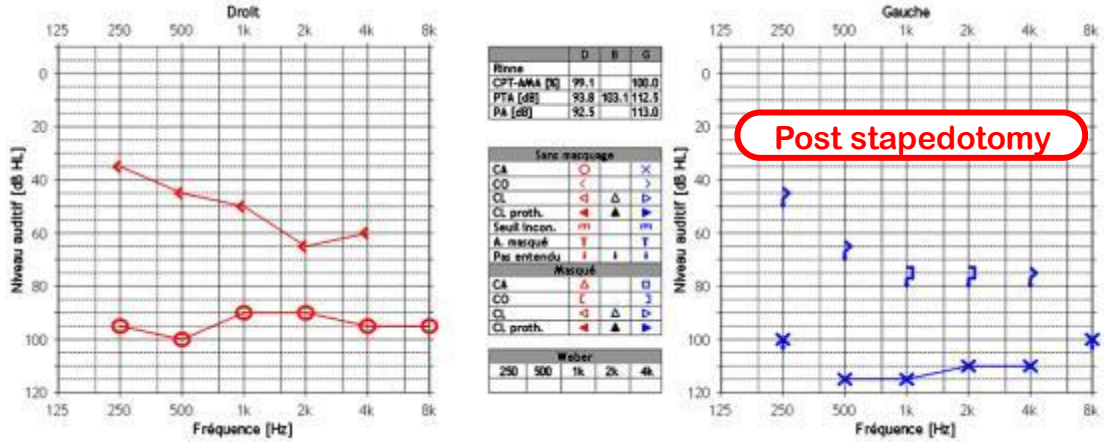
Case 2

- W – 55 years old



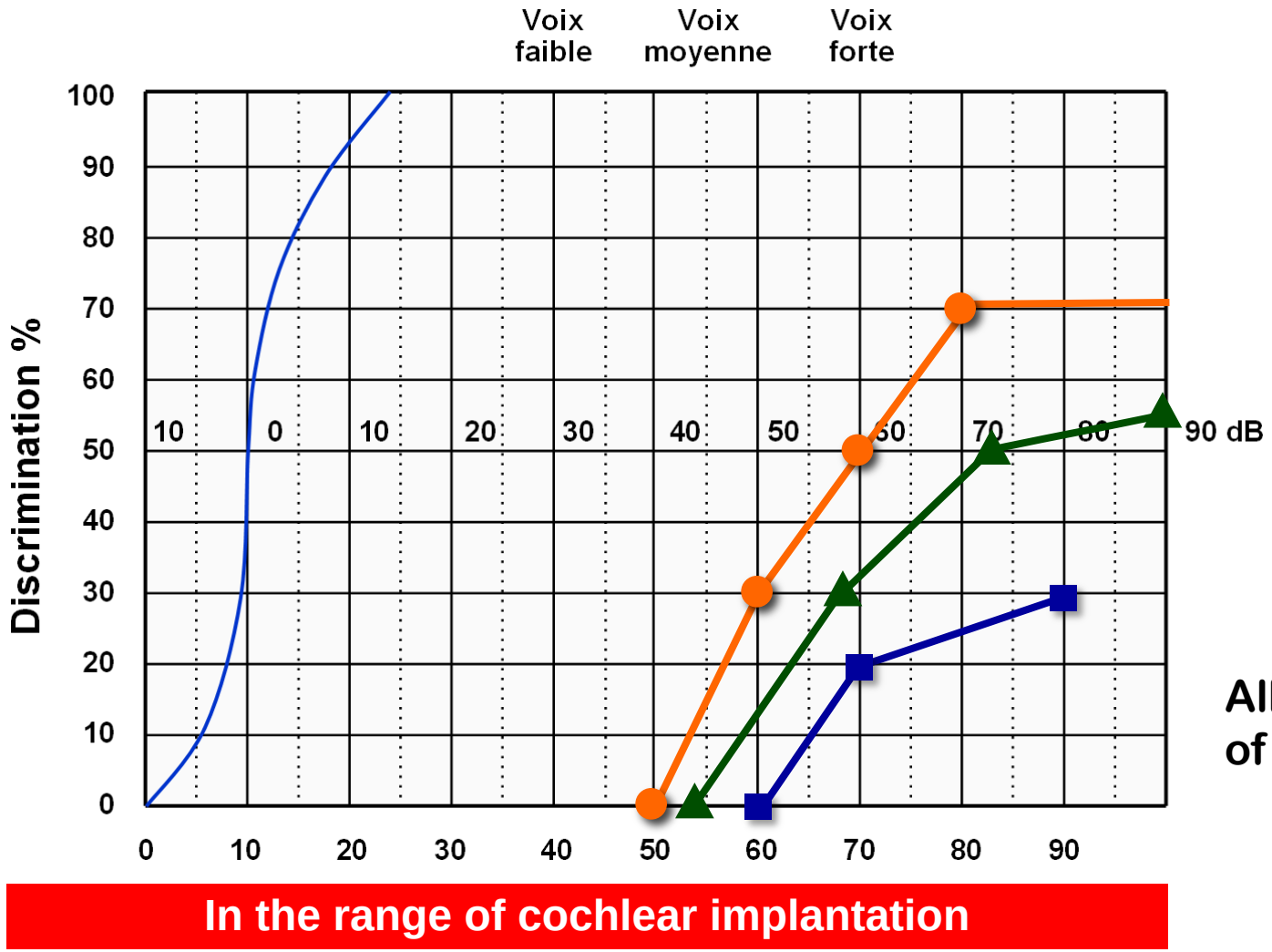
Case 3

- W – 65 years old



SPEECH DISCRIMINATION WITH POWERFULL HEARING AID

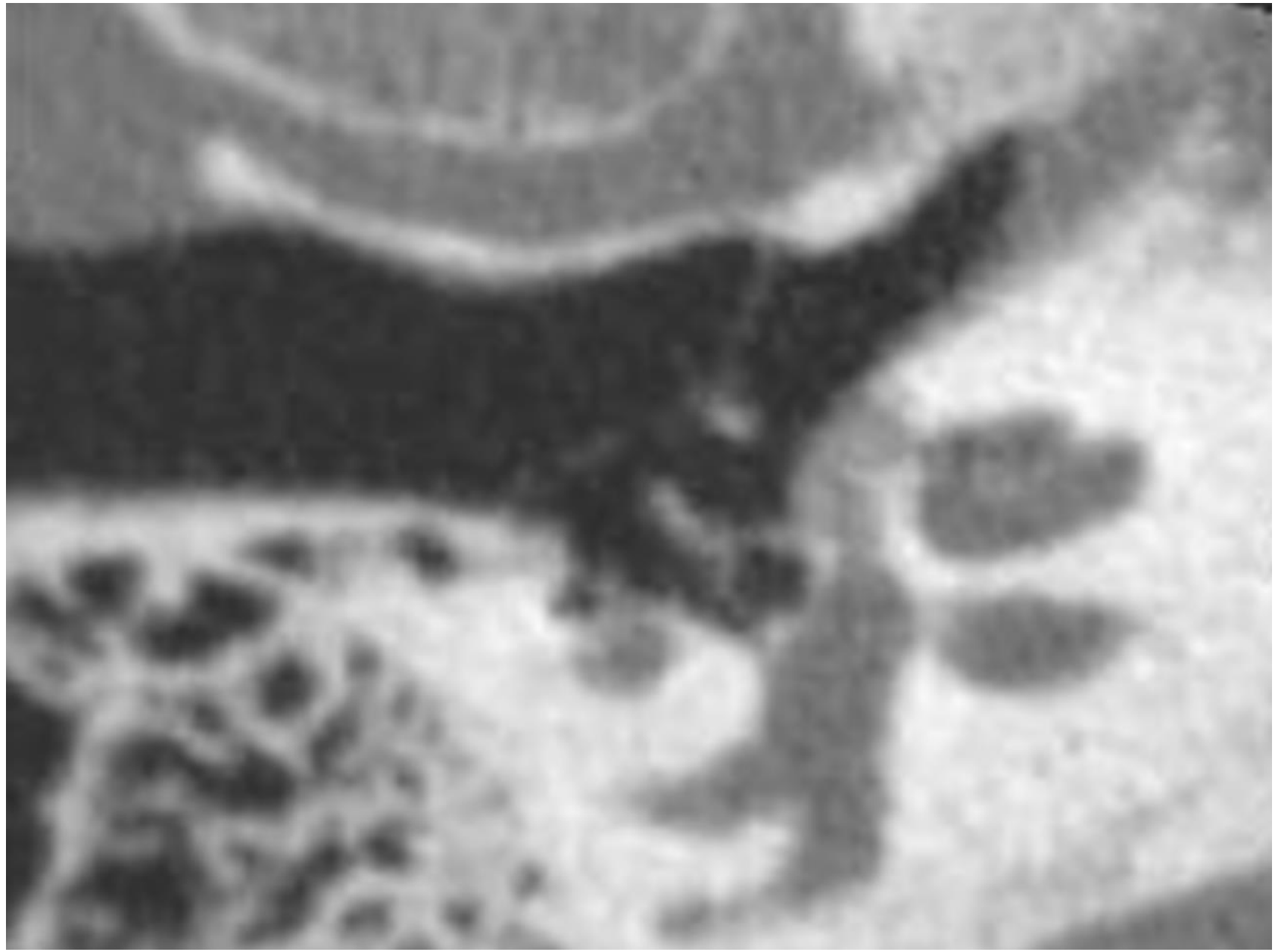
Powerfull hearing aid



In the range of cochlear implantation

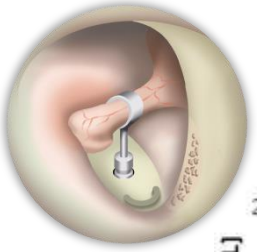
No improvement
with BAHA Cordelle

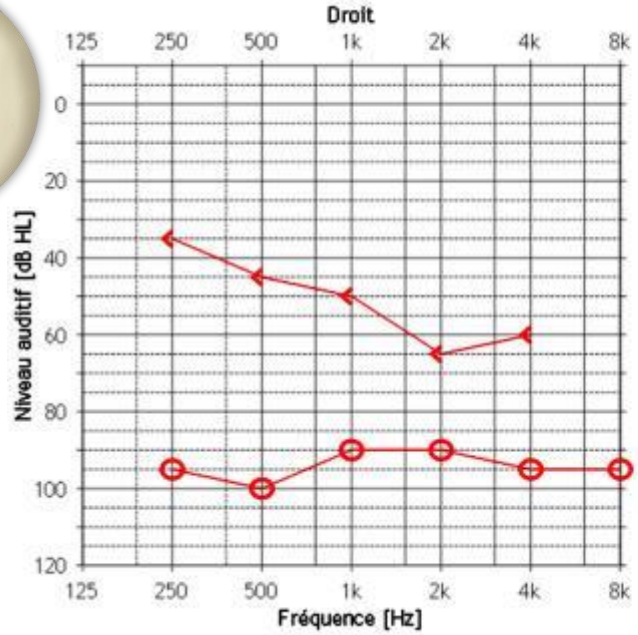
All 3 patients in a range of cochlear implant



SURGICAL DECISION

Second stage : Stapedotomy



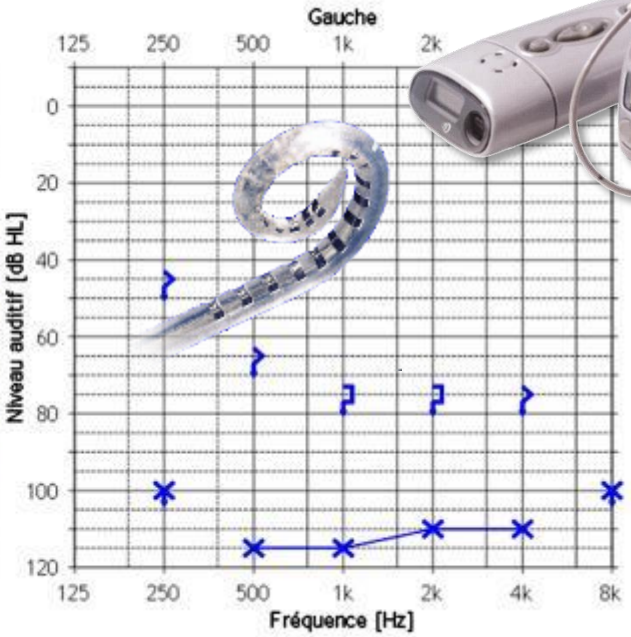


	D	B	G
Rinne			
CPT-AMA [%]	99.1		100.0
PTA [dB]	93.8	103.1	112.5
PA [dB]	92.5		113.0

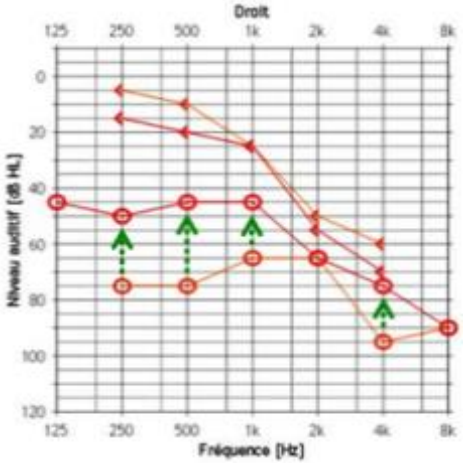
Sans masquage			
CA			
CO			
CL			
CL proth.			
Seuil incon.			
A. masqué			
Pas entendu			
Masqué			
CA			
CO			
CL			
CL proth.			

Weber				
250	500	1k	2k	4k

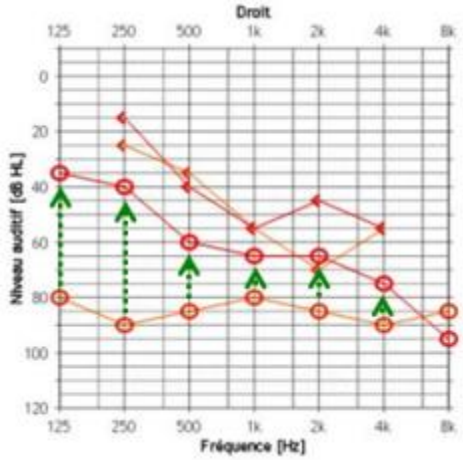
First stage : CI



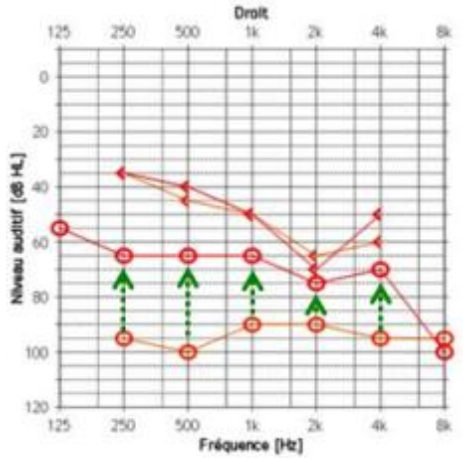
SURGICAL RESULTS



Case 1

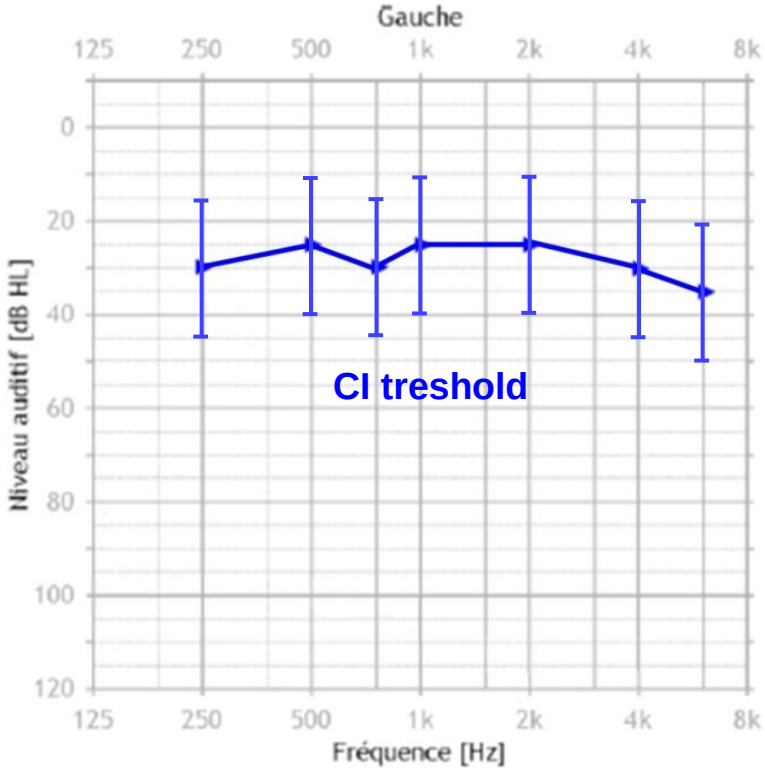


Case 2

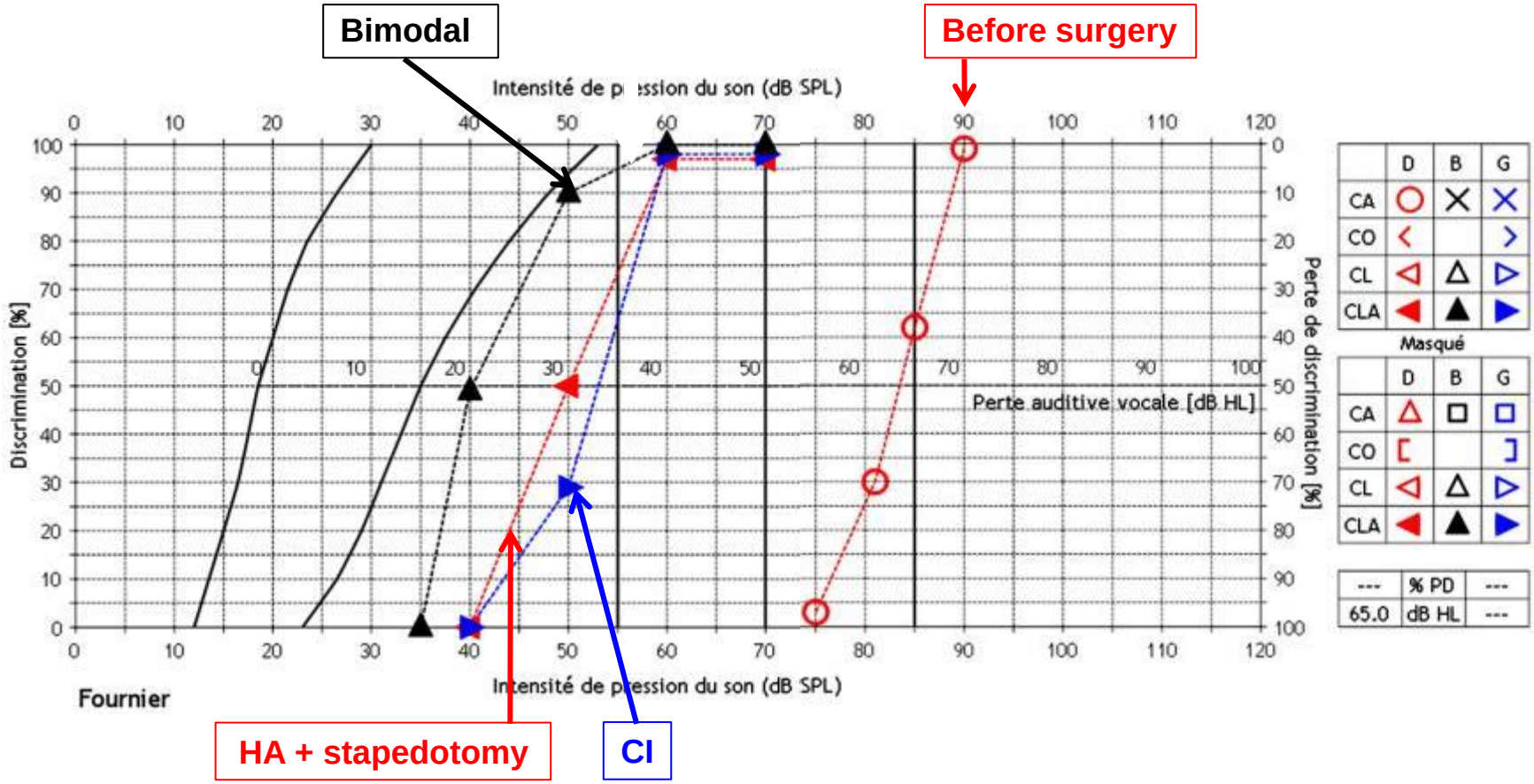


Case 3

Cochlear Implant



SPEECH DISCRIMINATION RESULTS



SYNTHESIS

- Patient choice was always to select the worse ear for CI first
- The improuvement of speech discrimination in noise was always significant in bimodal condition
- Quality of sound, music perception, melody recognition was better on the stapedotomy side

3 CLINICAL SITUATIONS

Hearing aid is the only option due to surgical **contra indication**

Varions options are needed due to restaure hearing

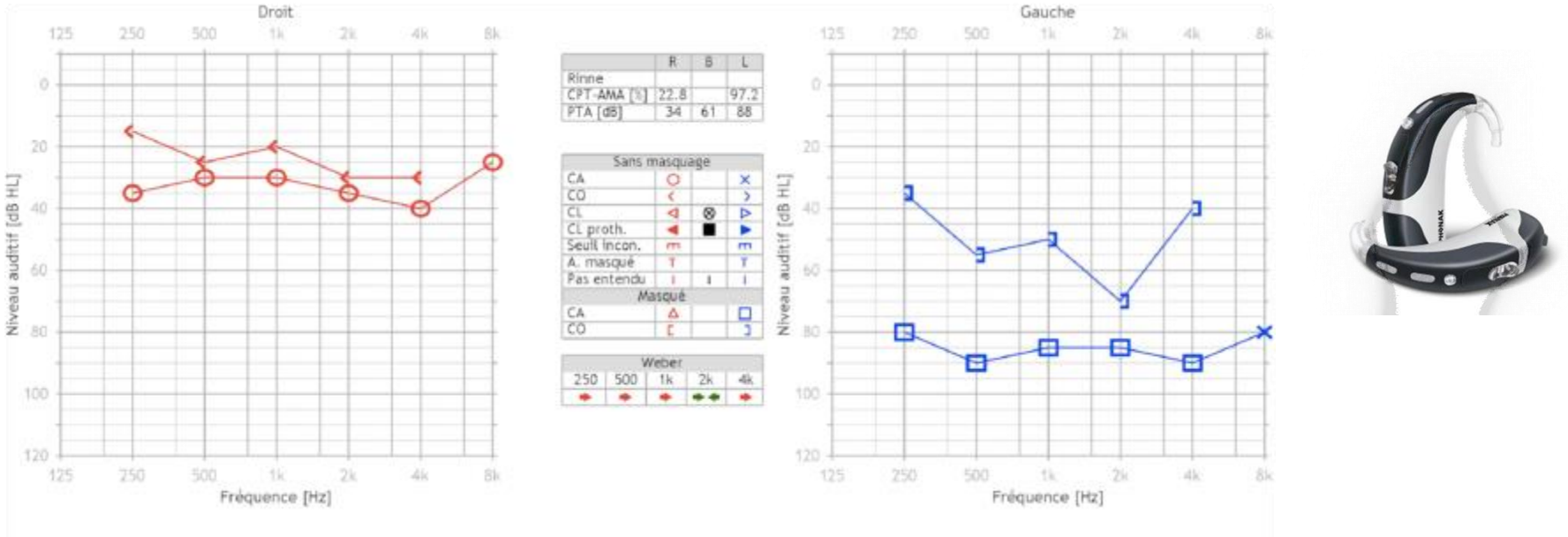
The two options are **possible**

VARIOUS OPTIONS ARE NEEDED TO RESTAURE HEARING

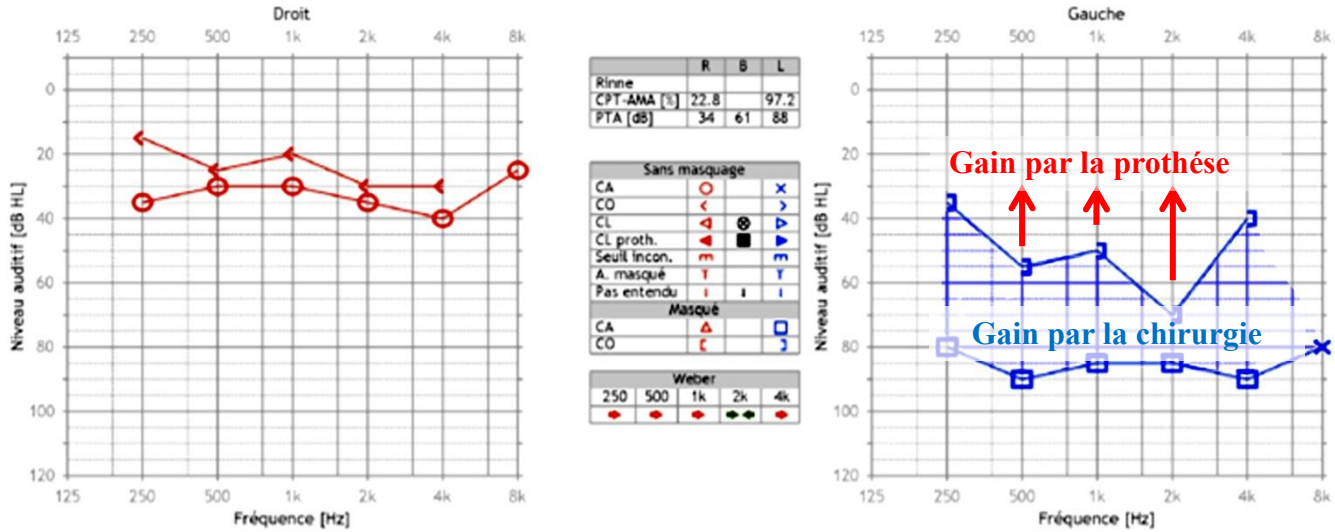
- Hearing aid + surgery to obtain binaural hearing
- Bone conduction, MEI
- CI in severe hearing loss

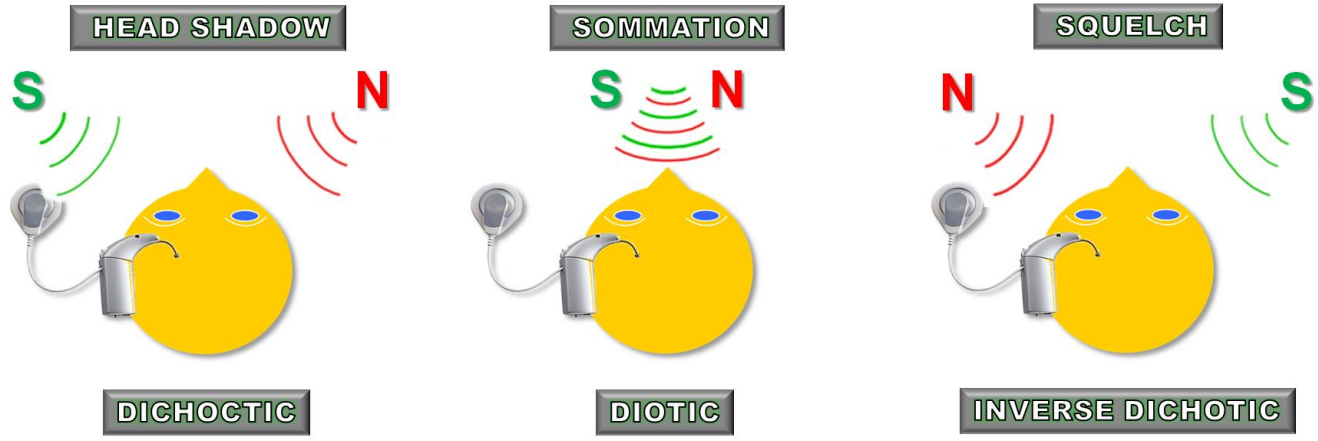
SURGERY + HEARING AID

- 59 years old woman
  - The optimal gain provide undesirable audiometric effects
  - It is not possible to provide enough gain to compensate



SURGERY + HEARING AID





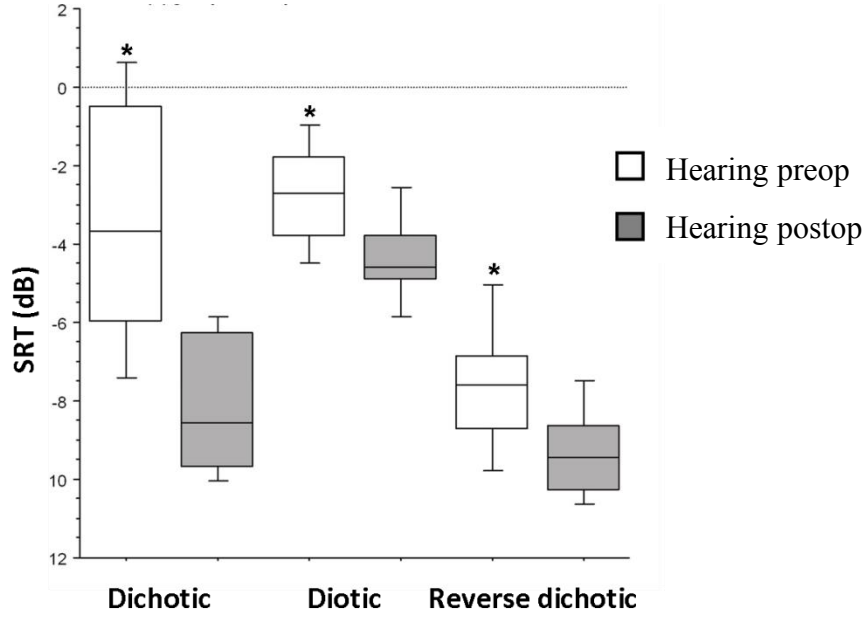
Improve 8-10 dB

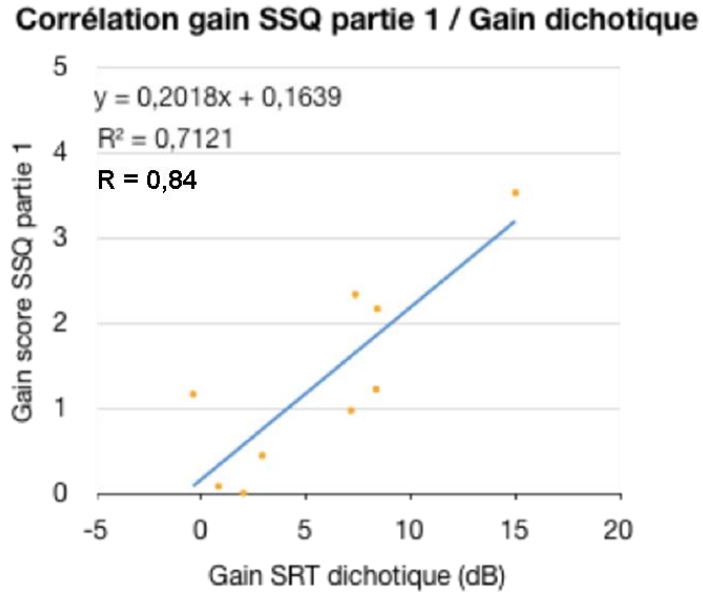
Binaural redundancy - Improve 2-3 dB

Binaural demasking - 2 dB

BINAURAL HEARING IN OTOSCLEROSIS

B. LESCURE : 39 unilateral otosclerosis



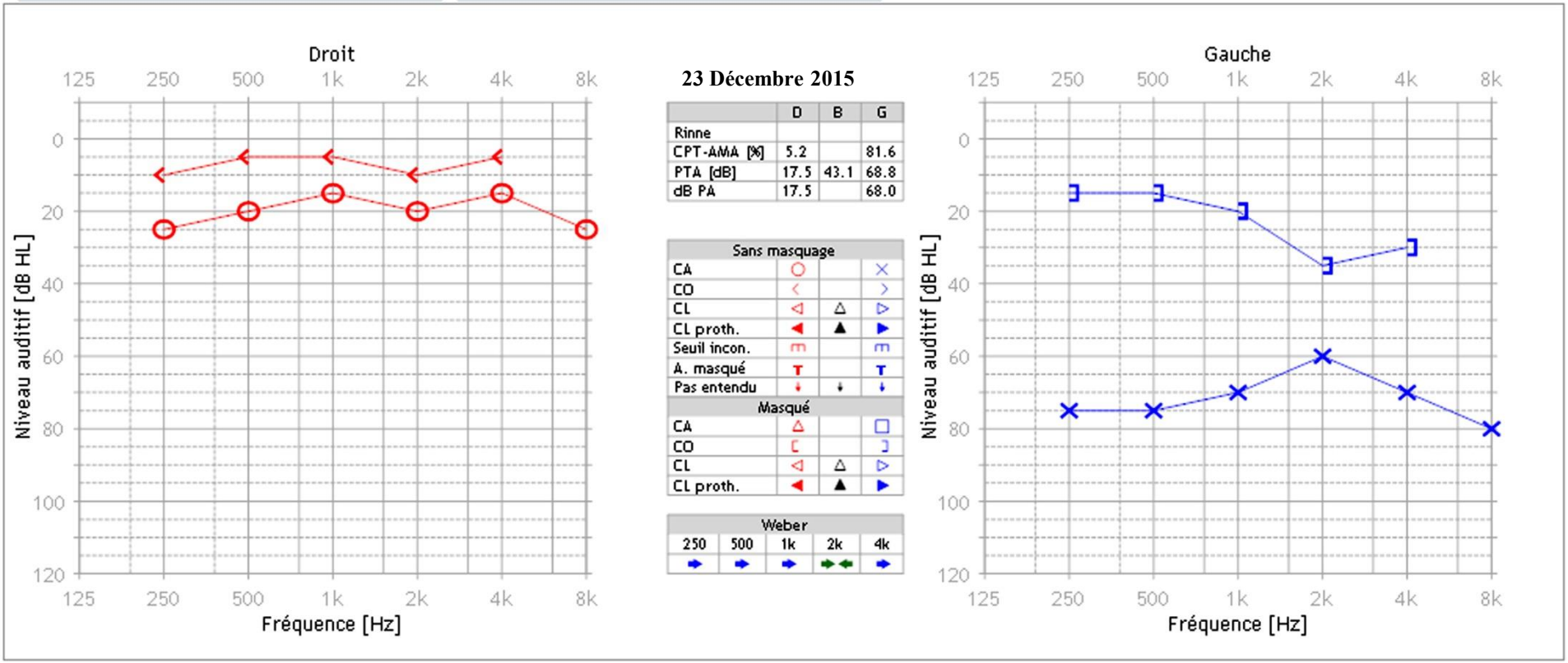


- Improvement of binaural effect in all cases event whithout a complete symetrical hearing
- Strong correlation between gain and quality of live (SSQ)

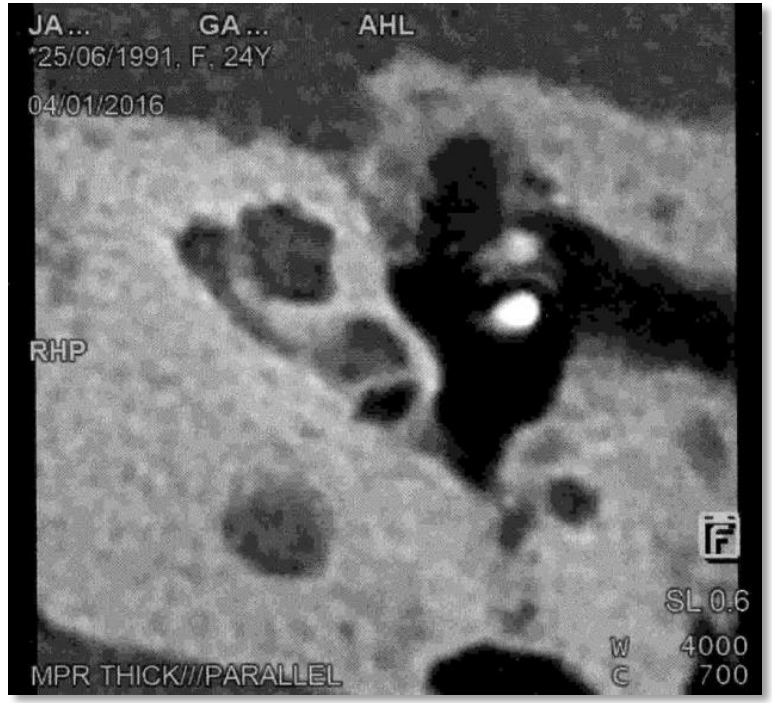
BONE CONDUCTION

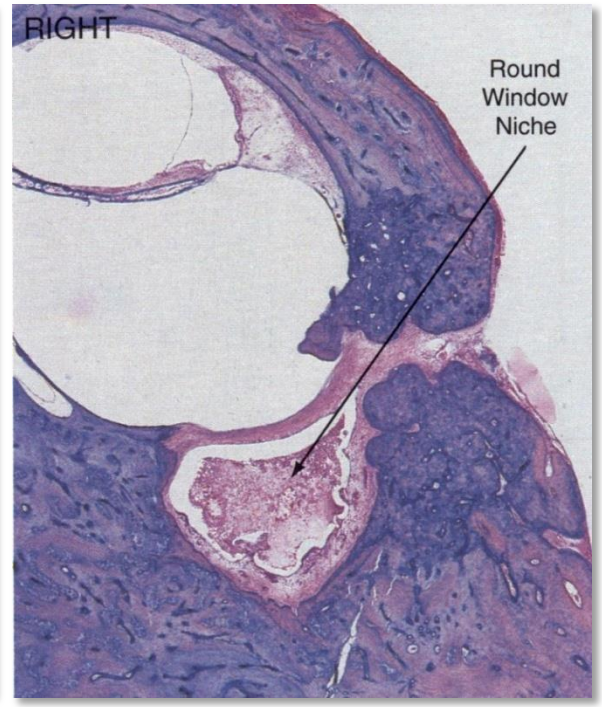
- JA…, 25 yo, stapedotomy + hearing aid failure
  - No gain

Why ?



POST OPERATIVE CT-SCAN





- Prothesis in place
- Obliteration of RW
- Option bone conduction

MEI CODACS VS CI

Hear Res 2016

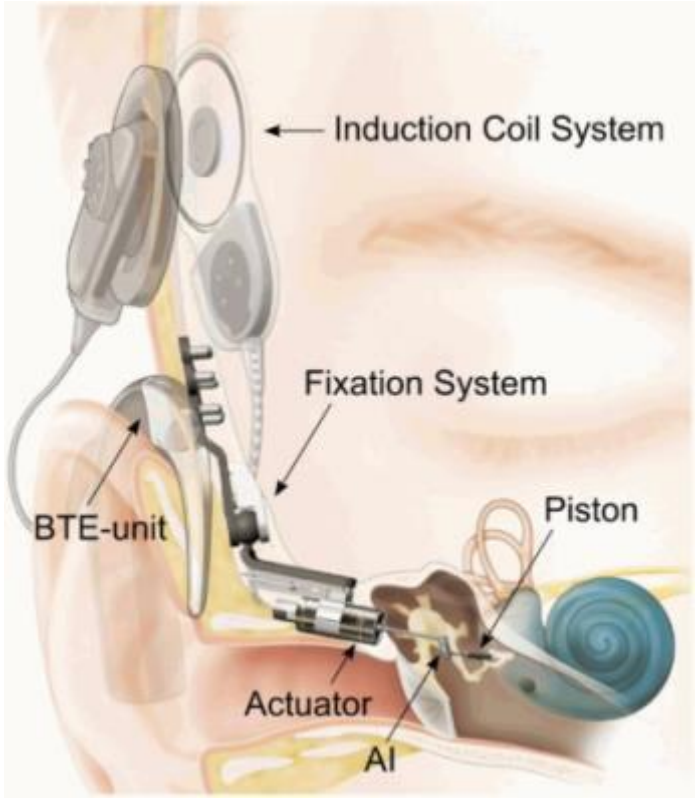
Indication of direct acoustical cochlea stimulation in comparison to cochlear implants

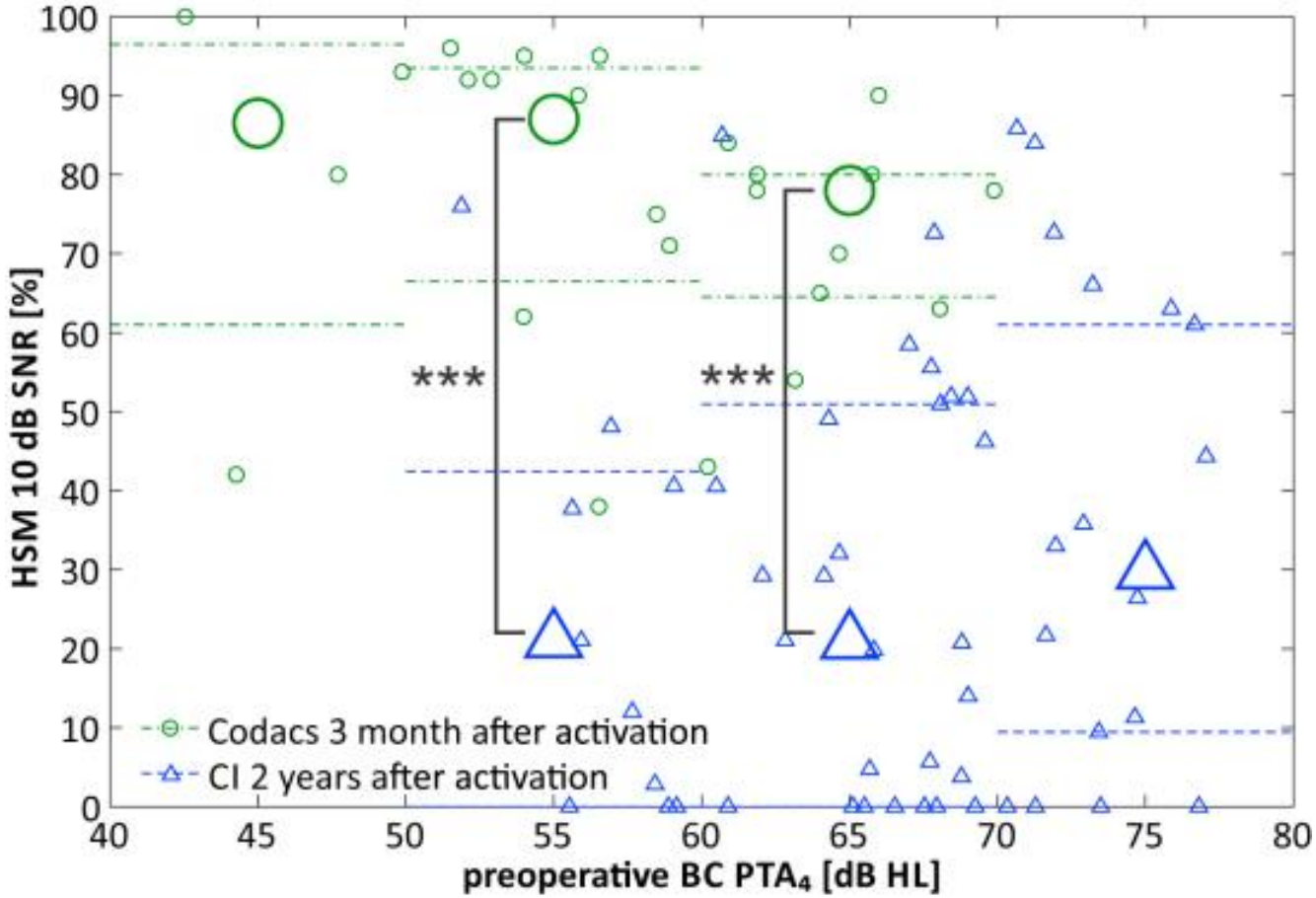
Kludt E and al

Otol Neurotol. 2013

Multicenter study with a direct acoustic cochlear implant

Lenarz T





Speech in noise : Hochmair-Schulz-Moser (HSM) sentence test at +10 dB SNR

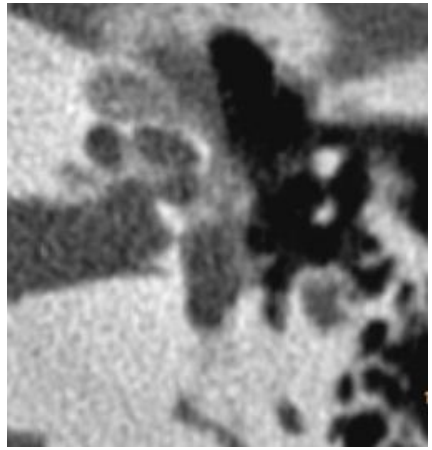
CI IN ADVANCED OTOSCLEROSIS

Audiological criteria

- All patients within the cochlear implant range *(guideline HAS)*
  - Pure tone average *(PTA)* > 85 dB
  - Word discrimination score *(WDS)* ≤ 50% at 60 dB

Imaging criteria

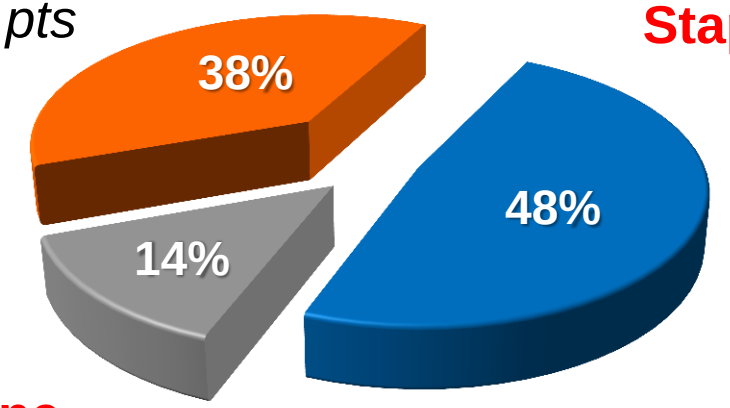
- CT Scan evidence of otosclerosis focus



POPULATION

N : 66

Stapedotomy + CI
25 *pts*



Stapedotomy alone
32 pts

CI alone
9 *pts*

Preop data

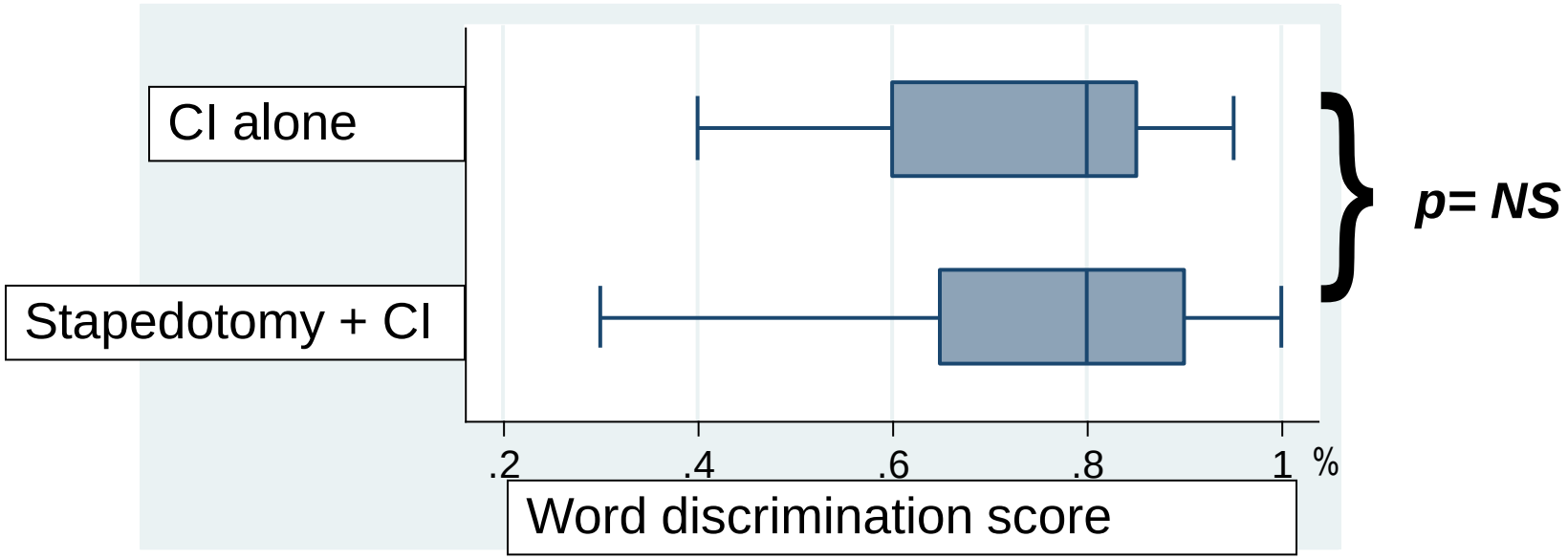
	Air Conduction		Word Discrimination Score		Bone Conduction	
Group A : Stapedotomy	104,5 dB	*NS*	12%	*NS*	64 dB	***p <0.001***
Group B + C CI alone / CI + Stapedotomy	109 dB		12%		69,5 dB	

OVERALL RESULTS

N : 22

	Mean Word Discrimination Score	% Patients scoring ≥ 50%
Group A : Stapedotomy	**50,6%**	60%
Group B + C CI alone / CI + S	**72.8%**	89%
	p = 0.002	*p= 0.027*

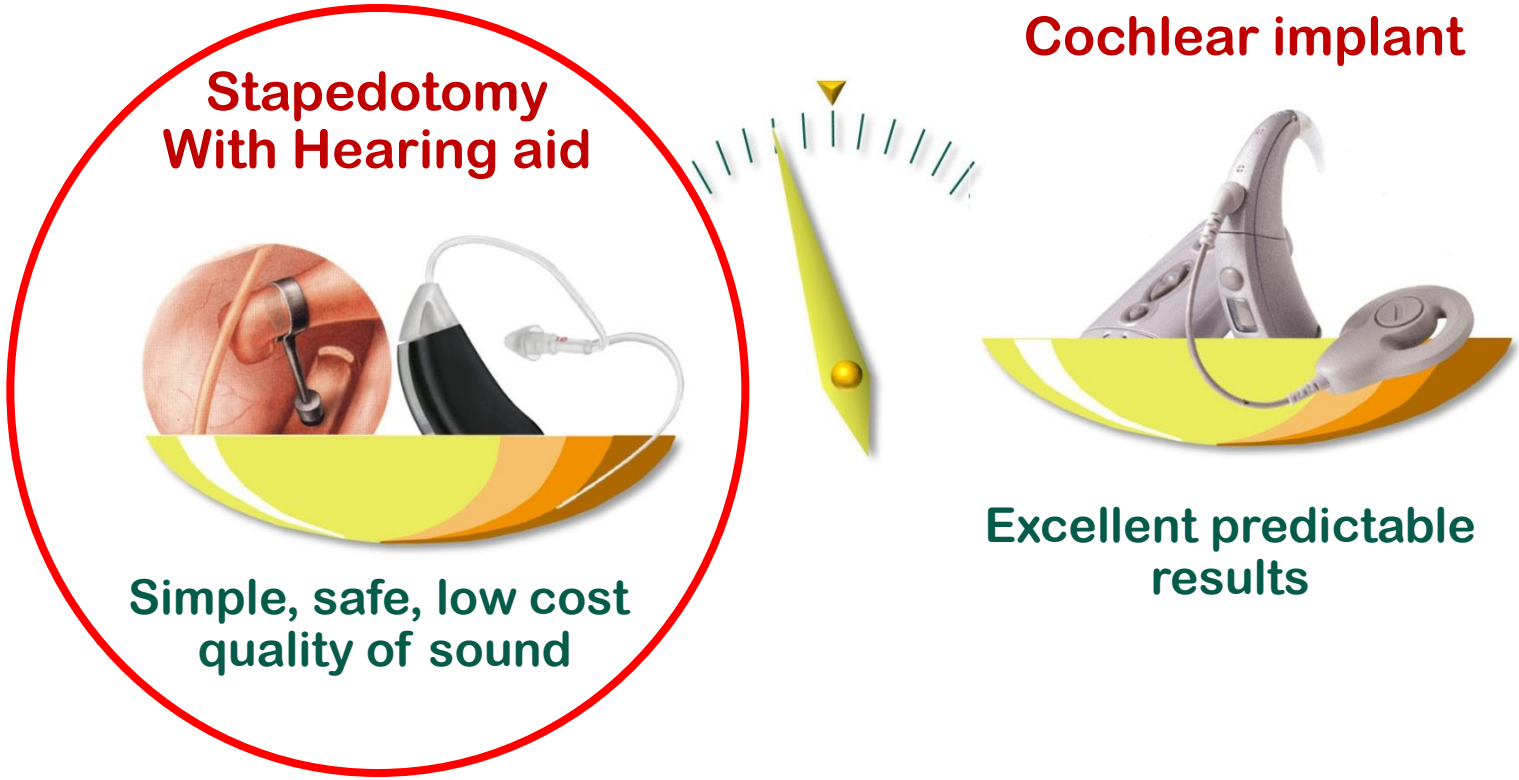
PREDICTIVE FACTORS OF COCHLEAR IMPLANT OUTCOMES



➔ **Previous stapedotomy has No impact on Cochlear implant outcome**

ALGORITHM FOR MANAGEMENT

- Success of stapedotomy cannot be predicted pre-operatively
- Previous stapedotomy has no impact on cochlear implant results

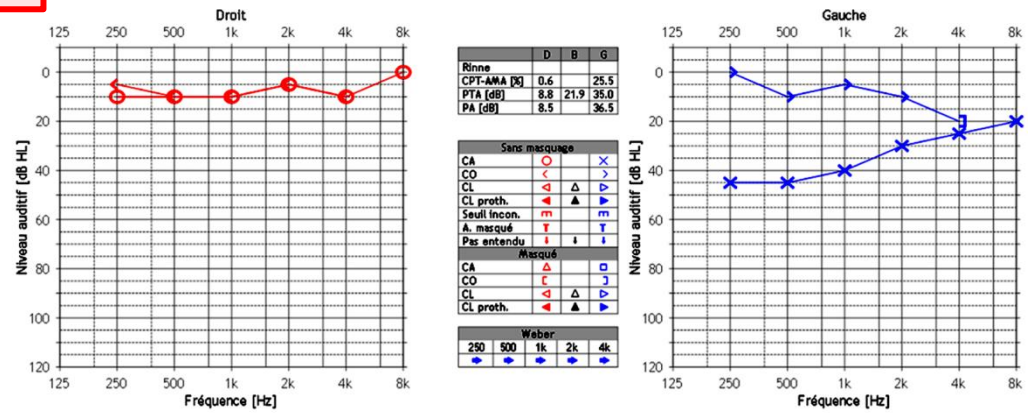


3 CLINICAL SITUATIONS

Hearing aid is the only option due to surgical **contra indication**

The two options are needed due to restaure **binaural** hearing

The two options are **possible**



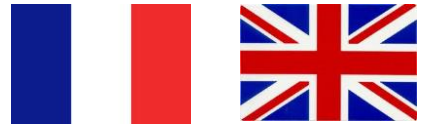
BOTH OPTIONS ARE POSSIBLE

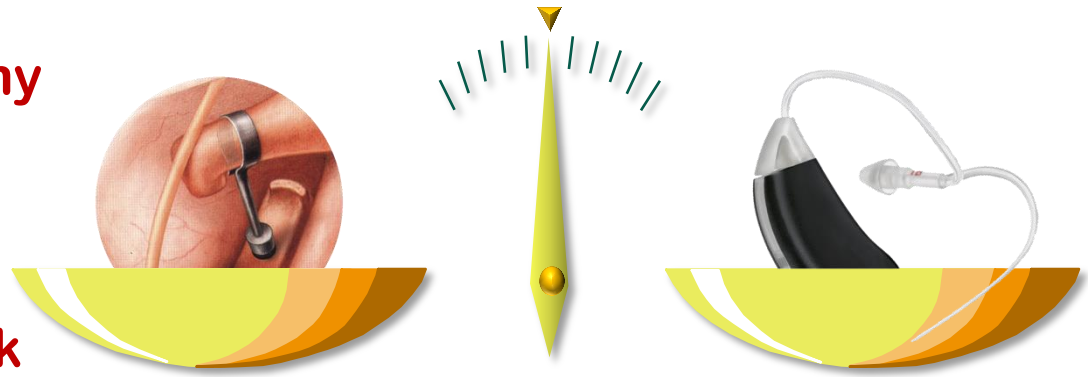
The American Journal of Otology - 19:541-543 © 1988

Editorial : Is Stapedotomy Ever Ethical ?

Matthew L. Howard

- Risks due to surgery:
  - Information content to the patient
- No risk with hearing aid for a similar result ?
  - Do we have to propose hearing aid in first intention ?
- Economic data: Health cost support





DO THE AUDIOLOGICAL RESULTS ARE COMPARABLE ?

Inclusion criteria

- Patient candidat for surgery with a conductive hearing loss > 30 dB and normal contralateral ear. First two months HA and then surgery

Study design

- Prospective longitudinale study comparing audiological outcomes with hearing aid then stapedotomy at 2 months on 30 patients

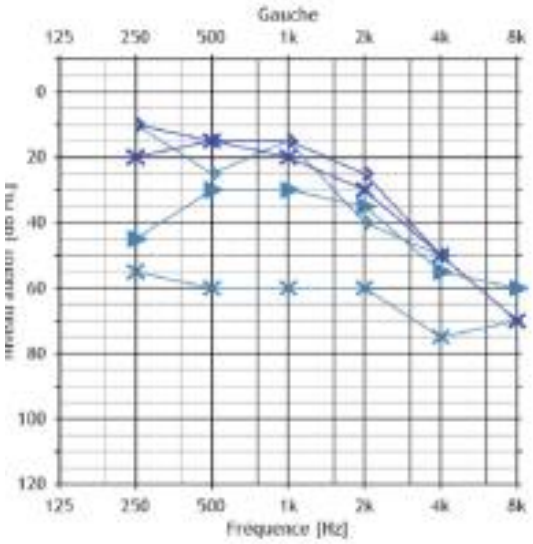
Evaluation

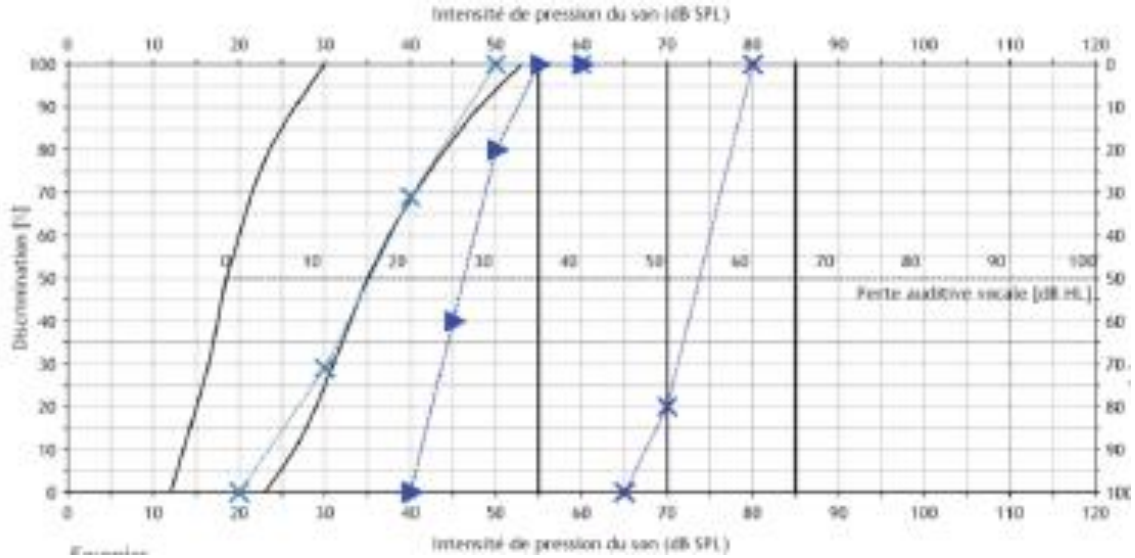
Preliminary results

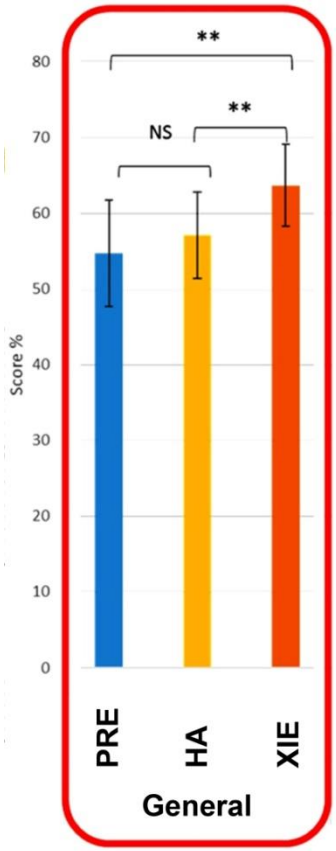
- Main criteria : → Improvement from 0 → 100 (GHSI) S
- Secondary criteria : → Hearing threshold S
  → Sound localisation S

PRELIMINARY RESULTS

N = 22





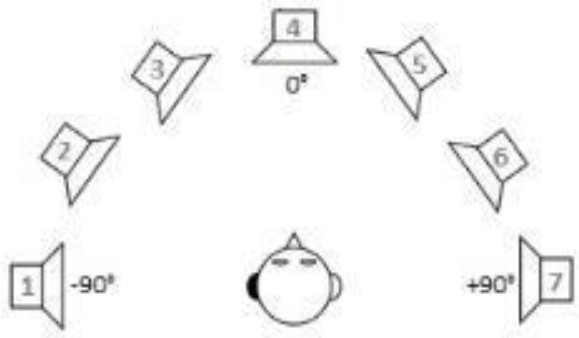


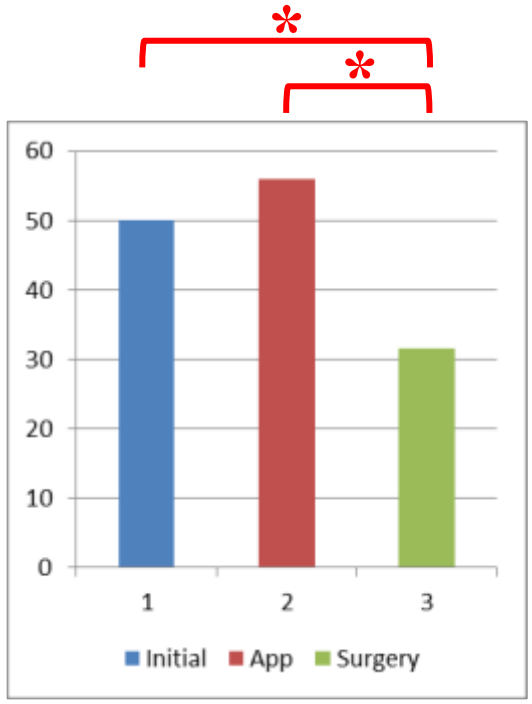
- PTA
- Discrimination
- GHSI

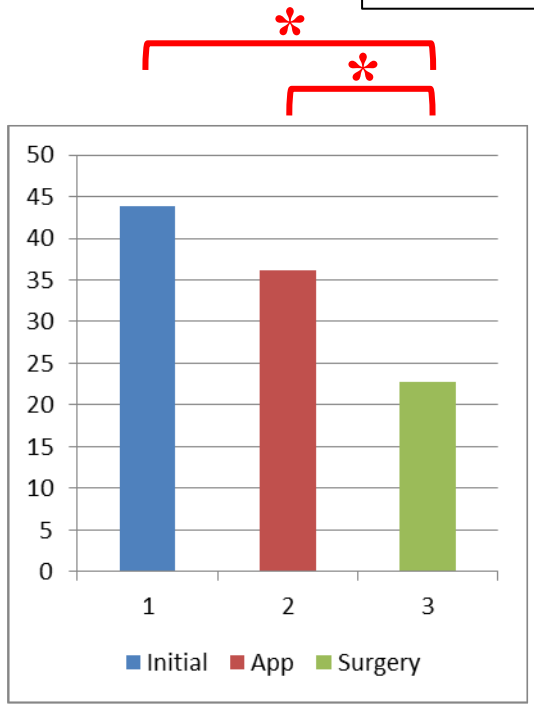
Significant improvement of quality of live after surgery

SOUND LOCALISATION

N = 22



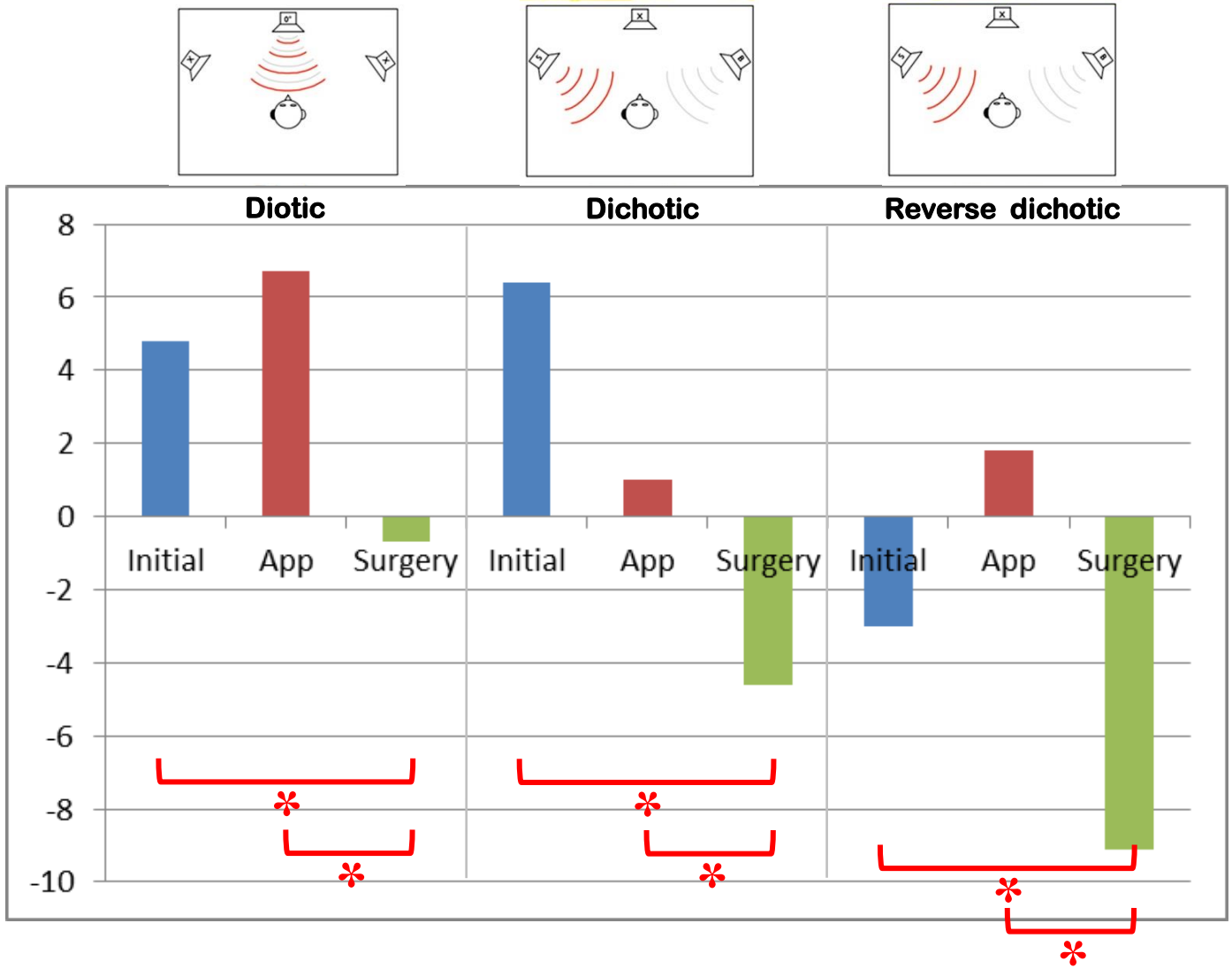




- **Localisation**
- **Total score**
- **Root main square**

Significant improvement of quality of sound localization

BINAURAL HEARING / MATRIX



CONCLUSION

- High resolution CT-Scan may be useful in the diagnosis of otosclerosis when the clinical symptoms are not indicative enough
- Imaging CT may also help in counseling patients with anatomical difficulties and extensive otosclerosis

ASOCIACION PANAMERICANA DE OTORRINOLARINGOLOGIA Y CABEZA Y CUELLO

Thank you for your attention