HOW AND WHEN TO DECIDE SURGERY IN OTOSCLEROSIS ?

B. FRAYSSE

SHANGHAI
November 30th - December 4th , 2025

HISTORY PAST

- **VASALVA**

  - Stapes fixation

1715

- **MIOT**
  - Stapes mobilisation

1890

Miot C.
De la mobilisation de l'étrier
Rev. Laryngol., Paris, 1890, 10, 49-66, 83-89, 113-130, 145-162, 200-215

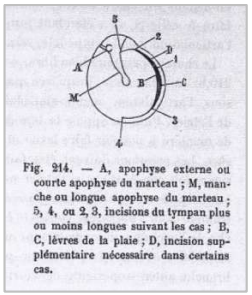
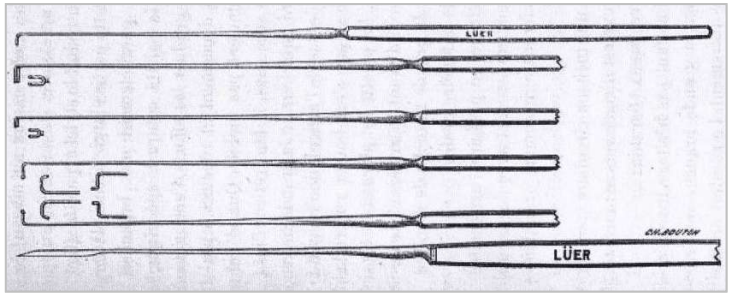


Fig. 214. — A, apophyse externe ou courte apophyse du marteau ; M, manche ou longue apophyse du marteau ; 5, 4, ou 2, 3, incisions du tympan plus ou moins longues suivant les cas ; B, C, lèvres de la plaie ; D, incision supplémentaire nécessaire dans certains cas.

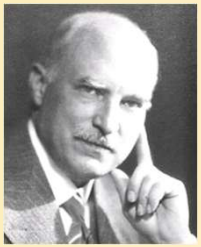


- **DENWER**
  - *« Hearing surgery has no future »*

1904

HISTORY

- **HOLMGREN** — 1922

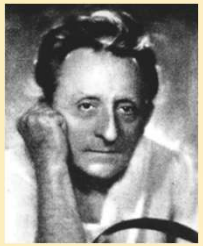


▶ Utilise des lunettes loupes dans la chirurgie de l'oreille

- **SOURDILLE** — 1929

▶ Fenestration surgery

- **LEMPERT** — 1938



▶ One stage fenestration

Lempert J.
« Improvement in hearing in cases of otosclerosis : a new one-stage surgical technic »
Arch. Otolaryngol.,1938; 28:42-97

HISTORY

ROSEN

▶ Stapes mobilisation

1953

Rosen S.
Mobilization of the stapes to restore hearing in otosclerosis
New-York, St. J. Med., 1953, 2650-2653

SHEA

▶ First stapédectomy

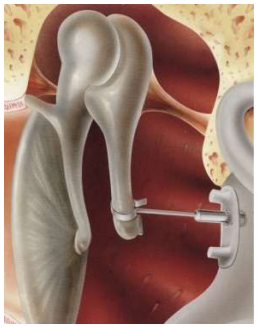
1956

Shea J.J.
Fenestration of the oval window
Ann. Otol. St Louis, 1958, 67, 932-951

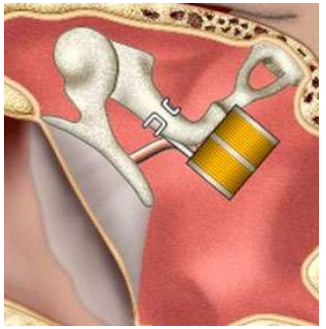
GOAL OF THE PRESENTATION

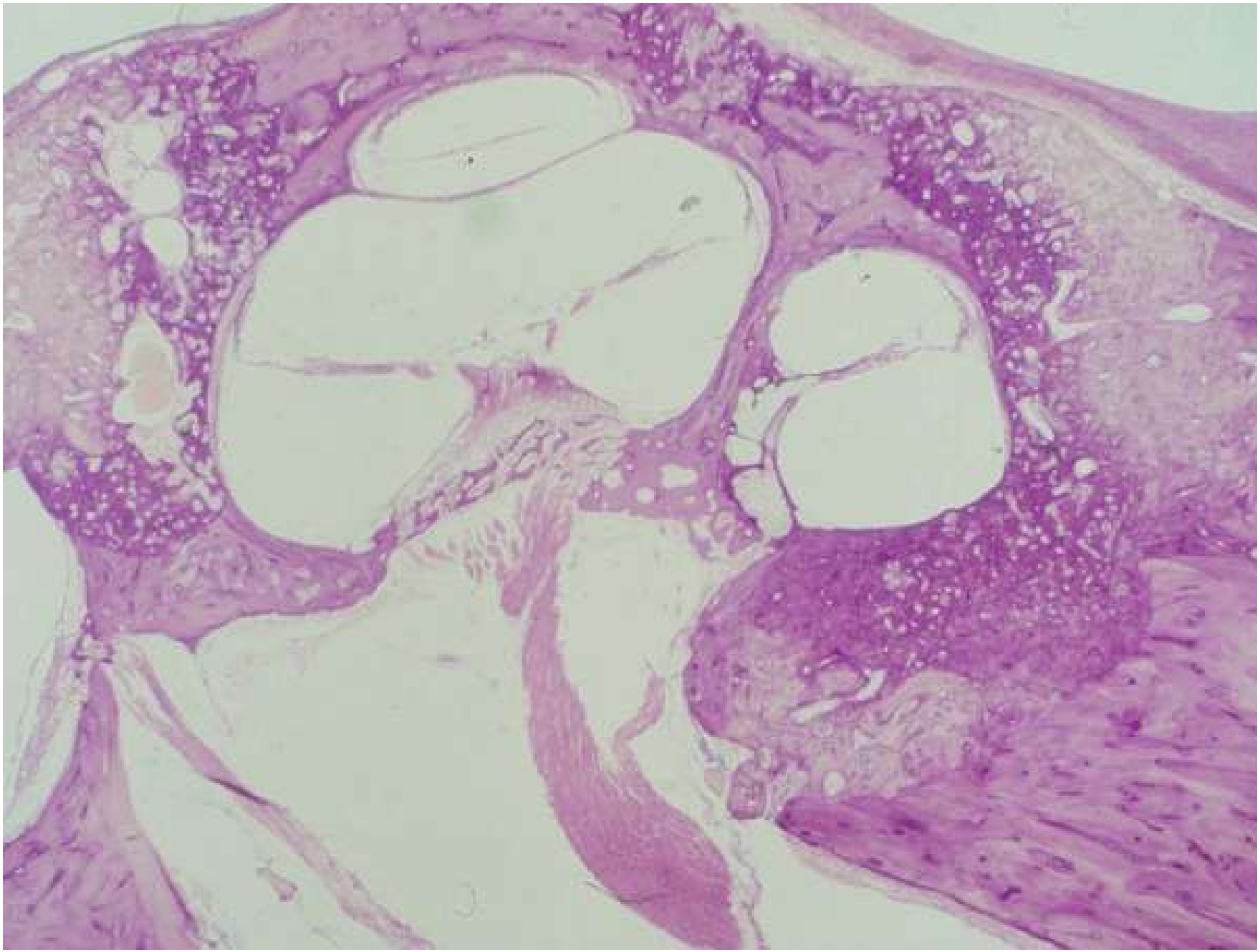
- To discuss the various factors which may influence the decision in councelling patient between :
  - Hearing aid

  - Stapes surgery

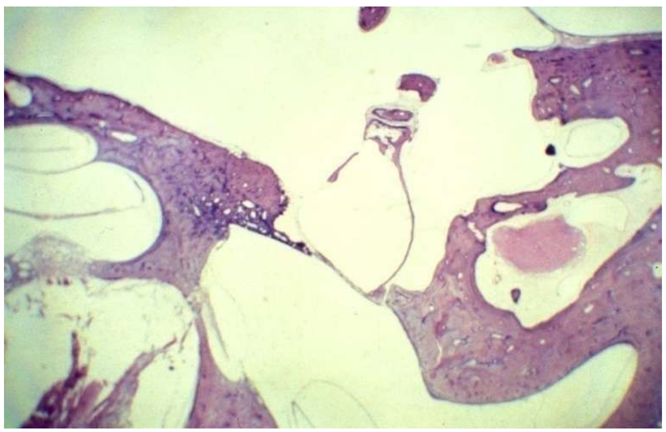


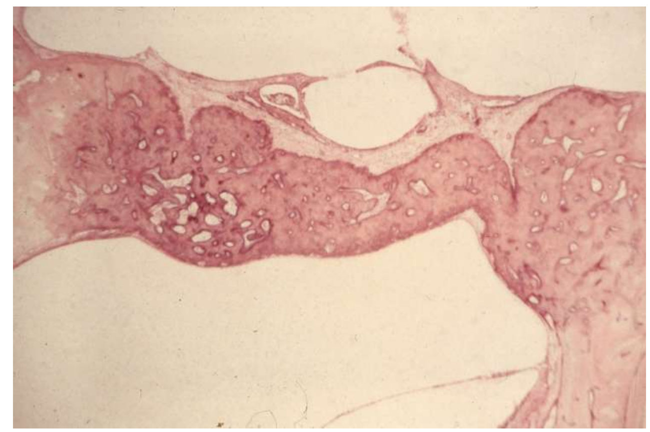
  - Auditory implant

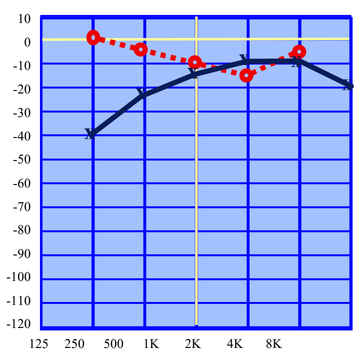


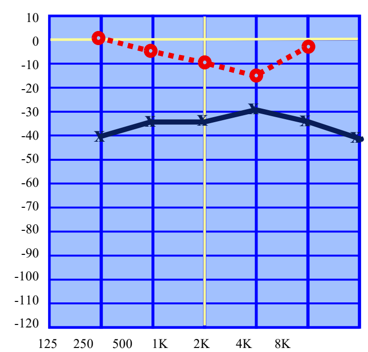


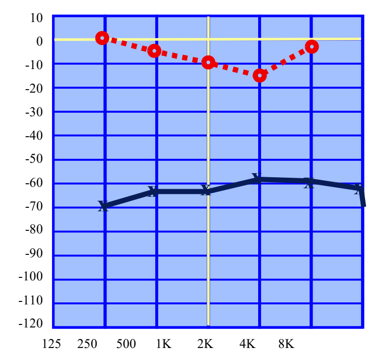
CONDUCTIVE HEARING LOSS
DEGREE OF STAPES FIXATION



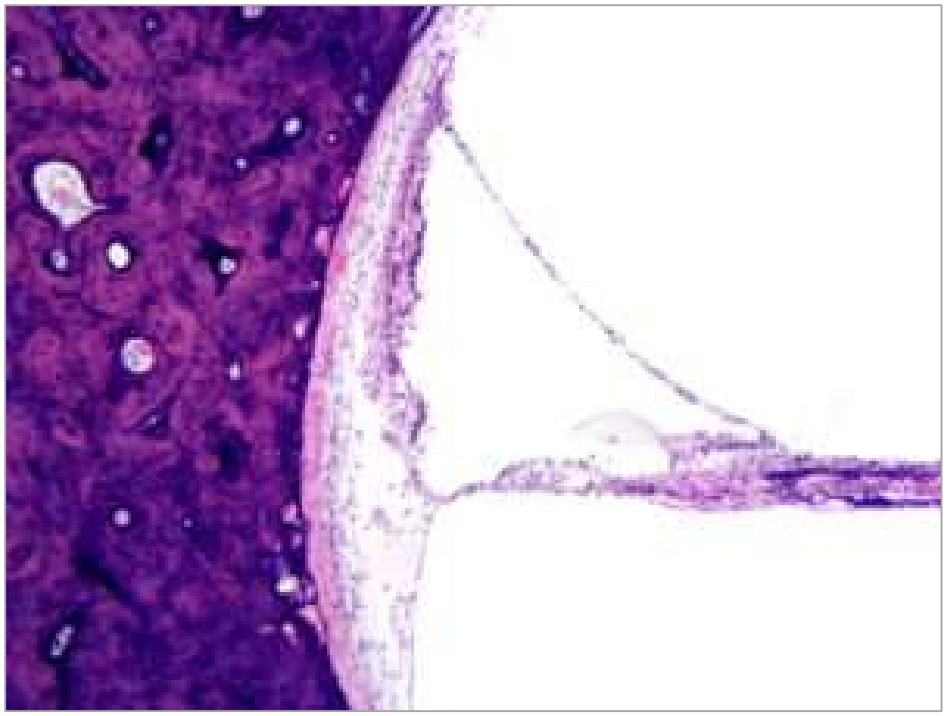


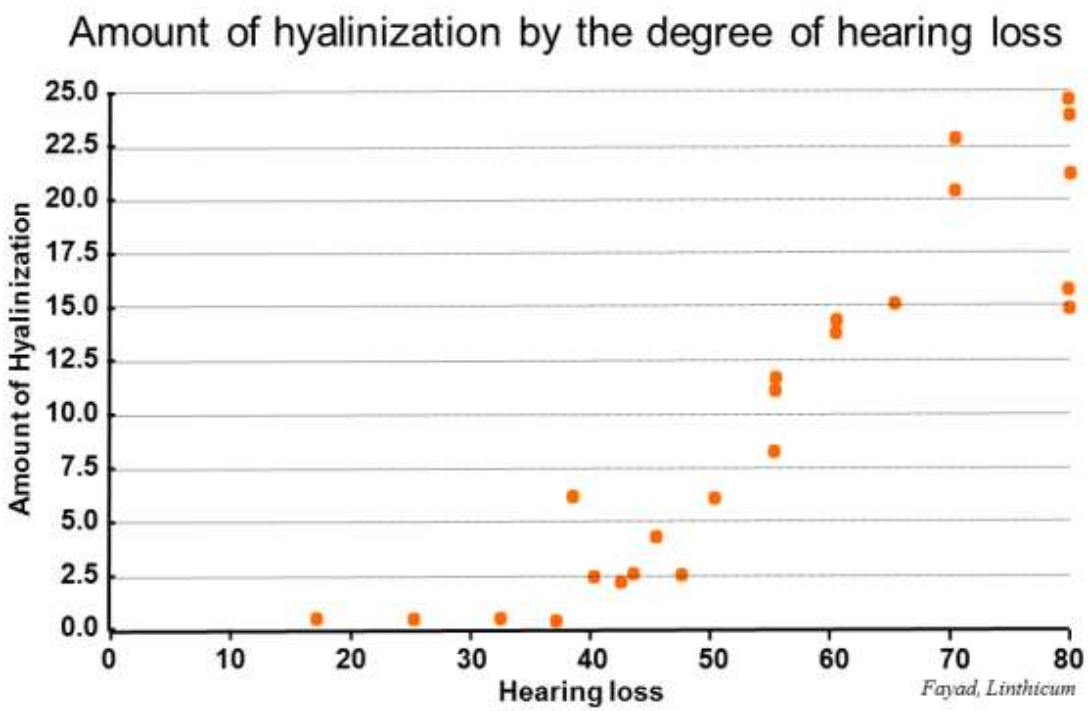






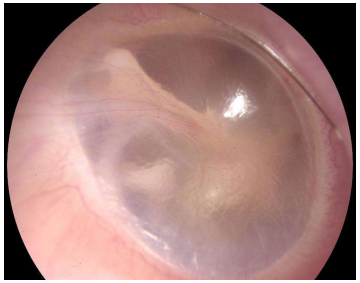
SENSORINEURAL HEARING LOSS
DEGREE OF HYALINIZATION

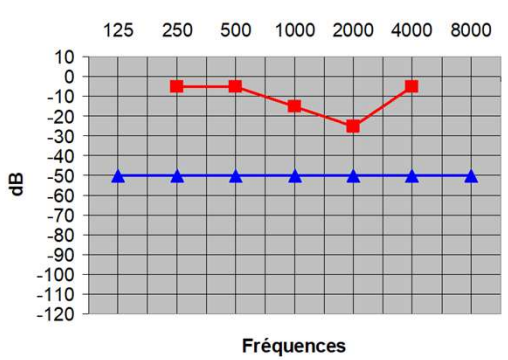


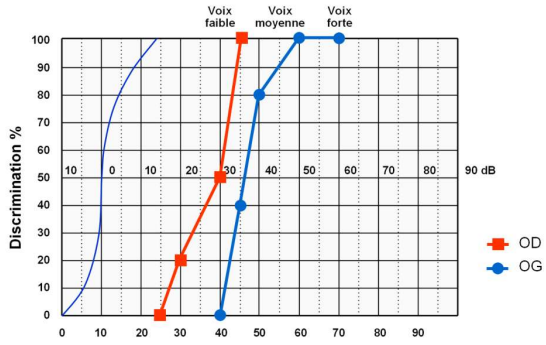


THE DIAGNOSIS OF OTOSCLEROSIS IS MAINLY CLINICAL

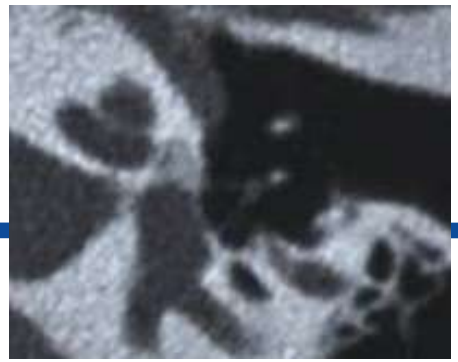
- Clinical history
- Tuning fork
- Clinical audiometry

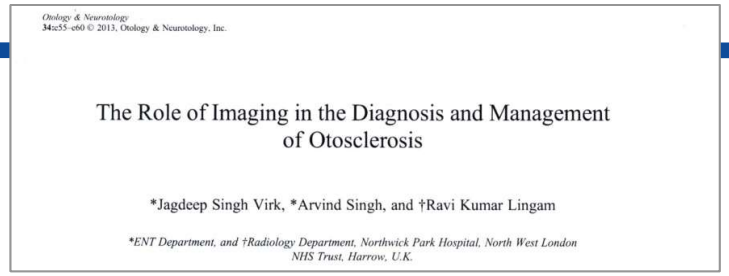






DO WE NEED A CT-SCAN IN THE MANAGEMENT OF OTOSCLEROSIS PATIENT ?





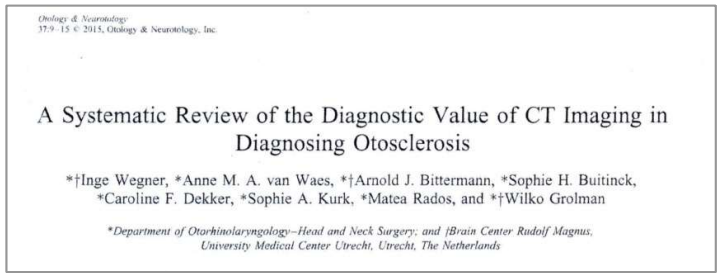
Otology & Neurotology
34:e55–e60 © 2013, Otology & Neurotology, Inc.

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.

- **It is obvious than the diagnosis of otosclerosis is mainly based on clinical history, otoscopic examination and audiometric testing.**



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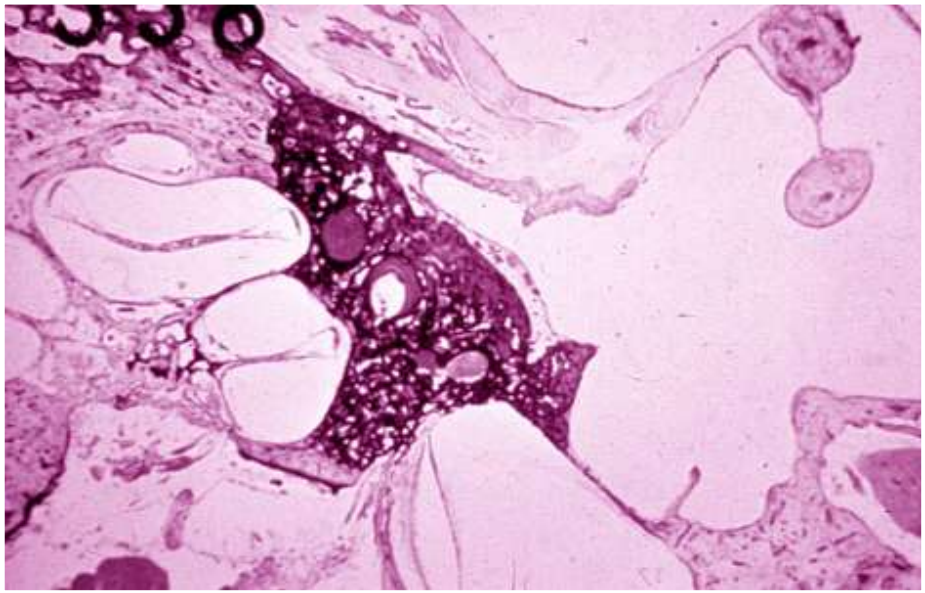
A Systematic Review of the Diagnostic Value of CT Imaging in Diagnosing Otosclerosis

*†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

- **But the role of CT-Scan in the preoperative evaluation of potential surgical candidat is multiple**
  1. **To confirm a doubtful diagnosis**
  2. **Anticipate the surgical difficulties**
  3. **To analyse the cause of failure**



SPECIFICITY / SENSITIVITY

Otology & Neurotology
30:1152–1159 © 2009, Otology & Neurotology, Inc.

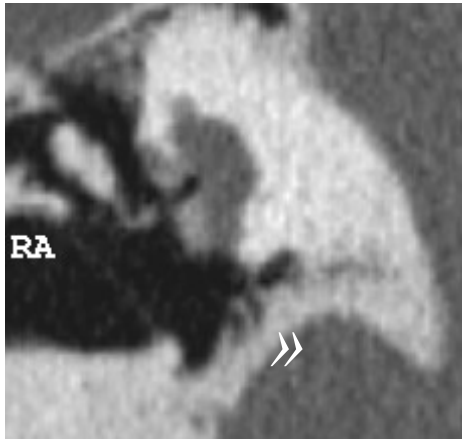
Reliability of High-Resolution CT Scan in Diagnosis of Otosclerosis

*Sebastien Lagleyre, *Tommaso Sorrentino, *Marie-Noelle Calmels, *Young-Je Shin, †Bernard Escudé, *Olivier Deguine, and *Bernard Fraysse

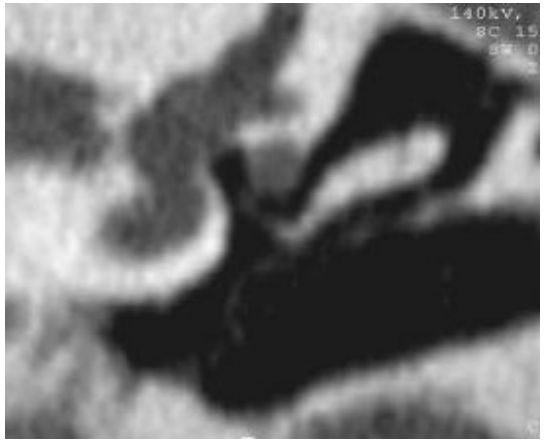
CY-SCAN	N	POSITIVE SURGICAL OTOSCLEROSIS	OTHER DIAGNOSIS	
POSITIVE CT-SCAN	194	193	**1**	**Specificity 99.1%**
NEGATIVE CT-SCAN	15	**10 ***	5	**Sensitivity 95%**
TOTAL	209		6	

* The high specificity may be due to the inclusion criteria and advancement in scanner

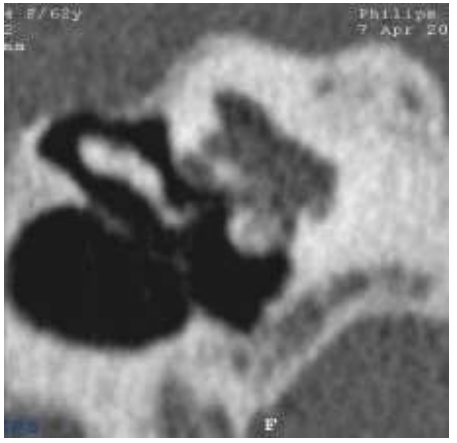
ANATOMICAL DIFFICULTIES



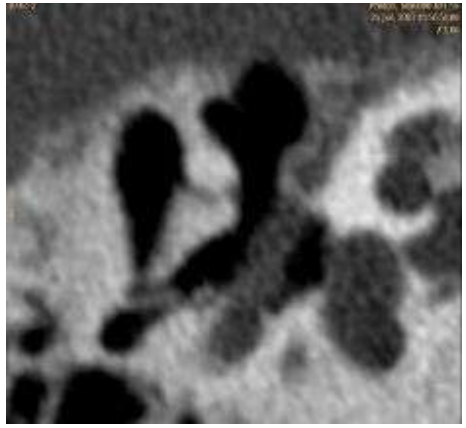
- Small fenestra



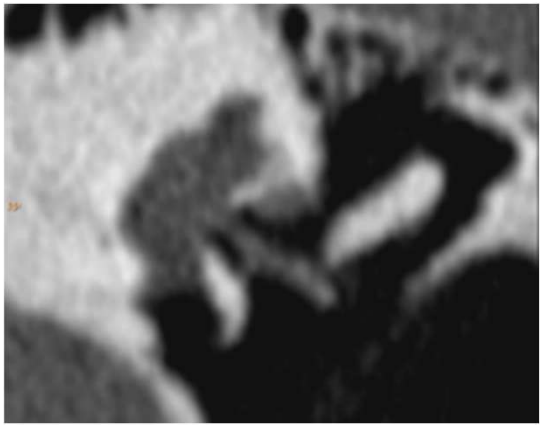
- Facial déhiscence



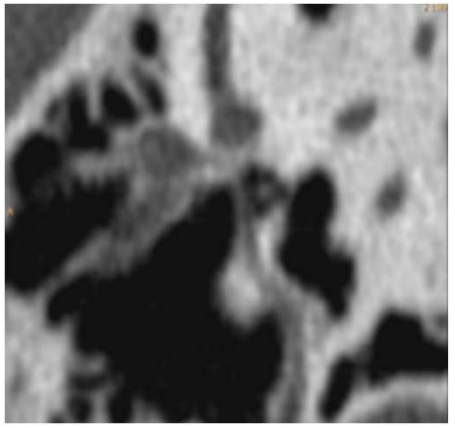
- Obliteration footplate



- Malleus fixation



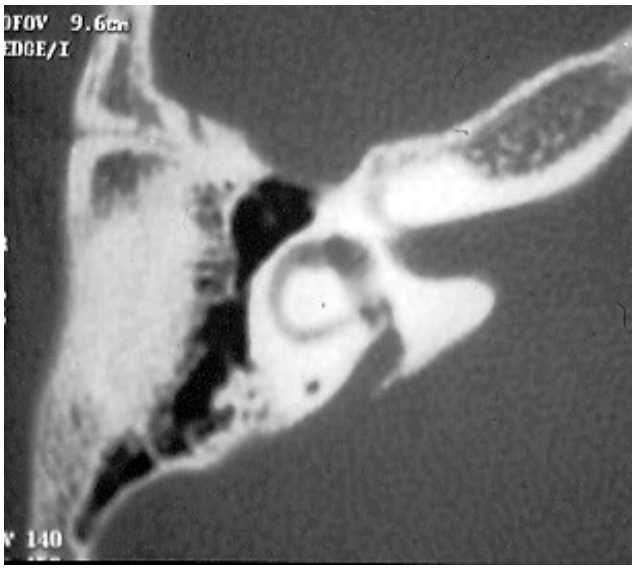
- Lysis of incus



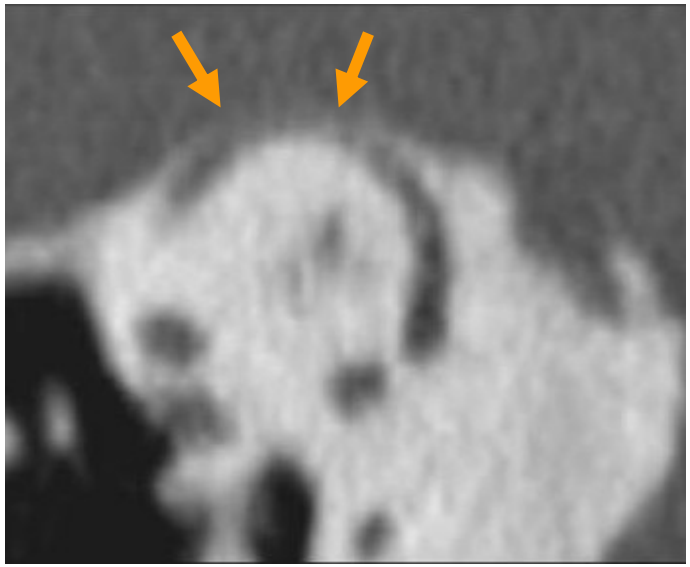
- Stapedial artery

COUNSELING PATIENTS IN CASE OF NEGATIVE CT-SCAN

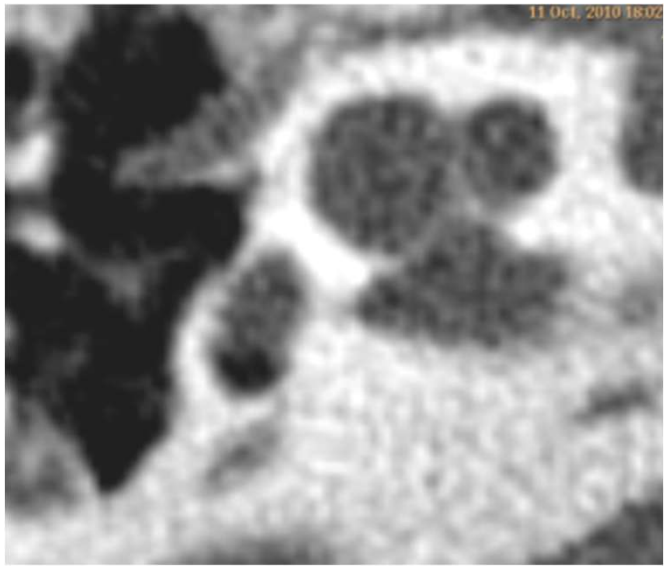
Inner ear conductive HL



▲ Enlarged ▲
vestibular aqueduct



▲ Superior semicircular ▲
canal dehiscence



▲ Modiolus malformation ▲

PHOTON-COUNTING CT vs HIGH RESOLUTION CT

HRCT :

- In HRCT, photons are first converted into visible light by a scintillator and then into an electrical signal.
- This multistep process introduces signal noise

PCCT :

- In contrast, in this case the photons are directly converted into electrical signals

INTEREST PCCT vs HRCT

Imaging Case of the Month

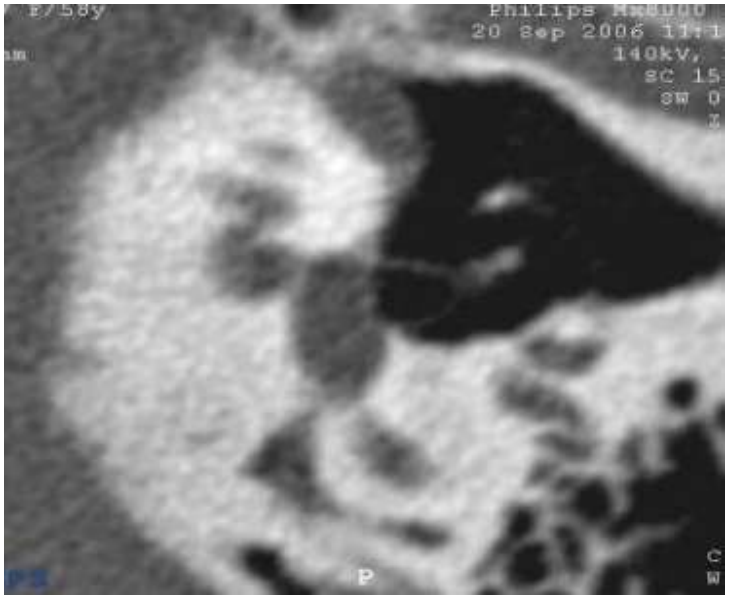
Photon-Counting CT Reveals Radiologically Occult Otospongiosis : A Case Report

Anna Dordonnat, Neil Grislain, Gabriel Garcia, Jean-Noël Vallée, Michael Eliezer

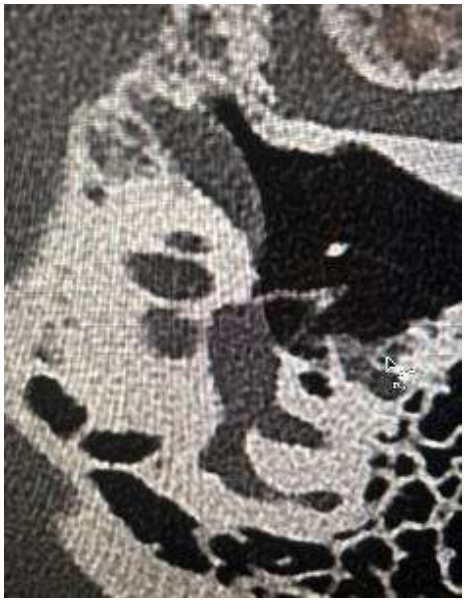
- Better resolution : 0,2mm/0,6mm
- Reduction of artefacts
- Better contrast
- Less radiation ↘ 50%

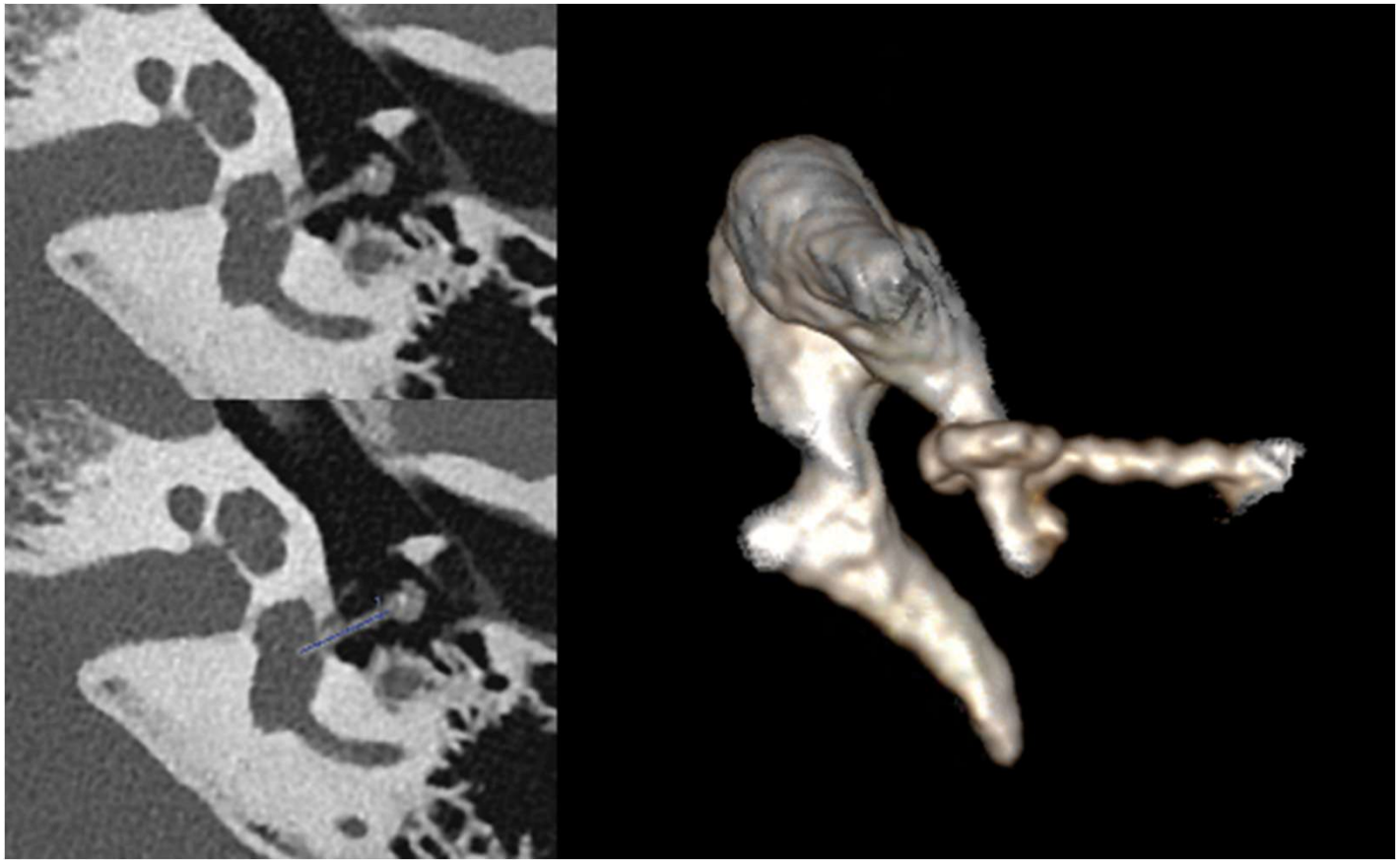
Histology

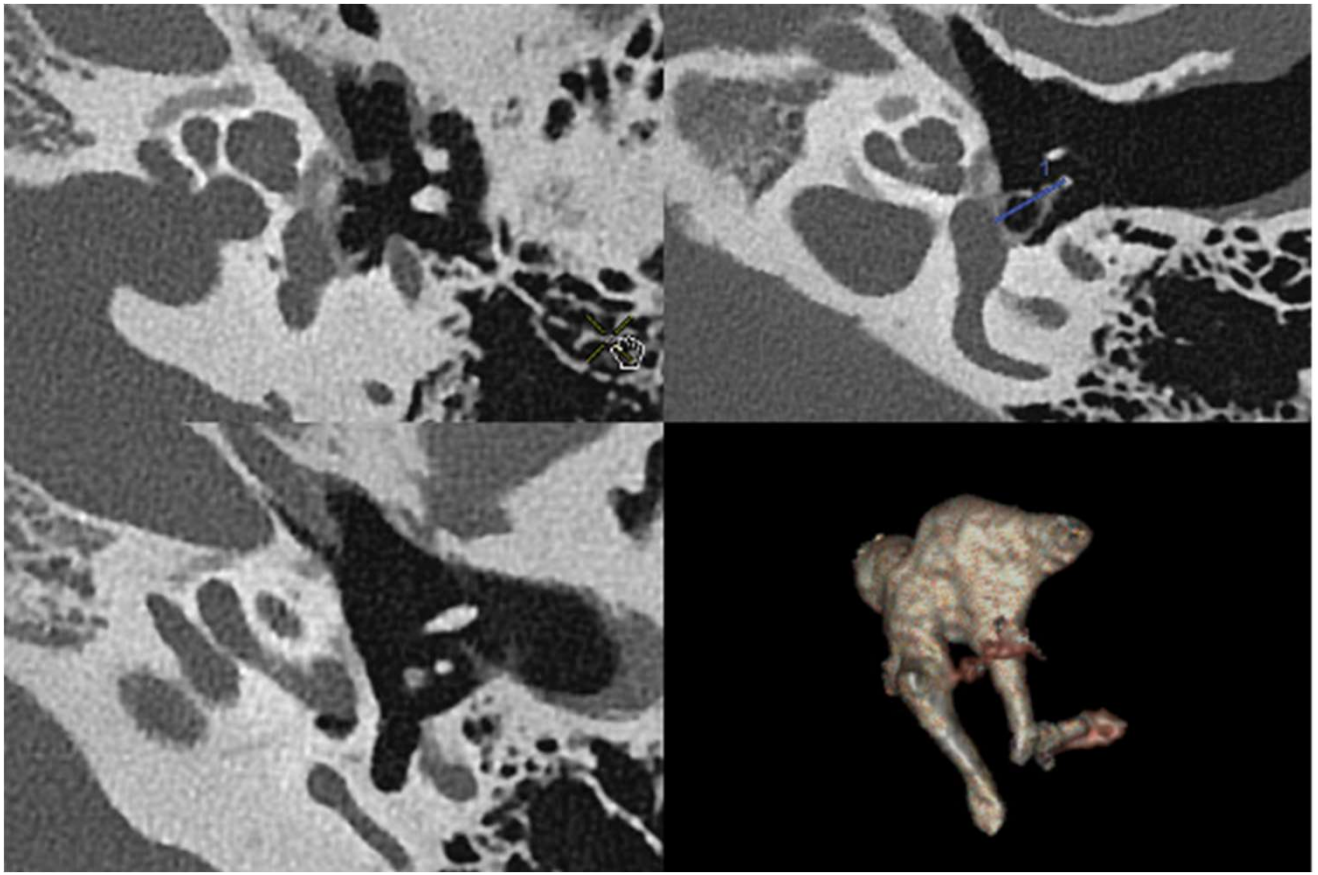
HRCT



PCCT

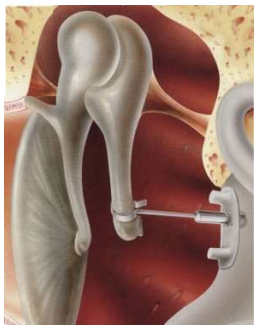






THERAPEUTIC OPTION

- Medical treatment
- Hearing aid
- Surgery
- Auditory implants



MEDICAL TREATMENT

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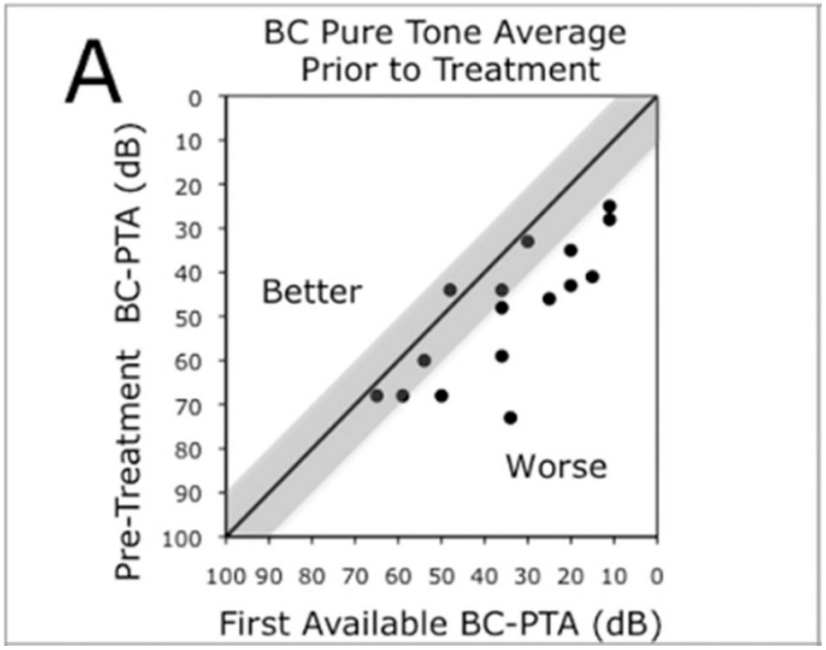
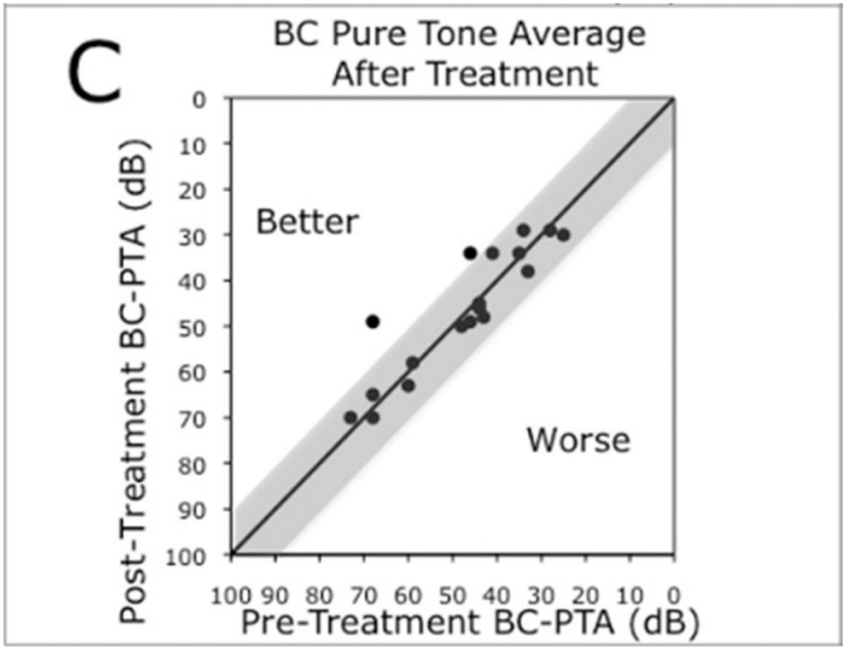
Third-Generation Bisphosphonates for Treatment of Sensorineural Hearing Loss in Otosclerosis

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



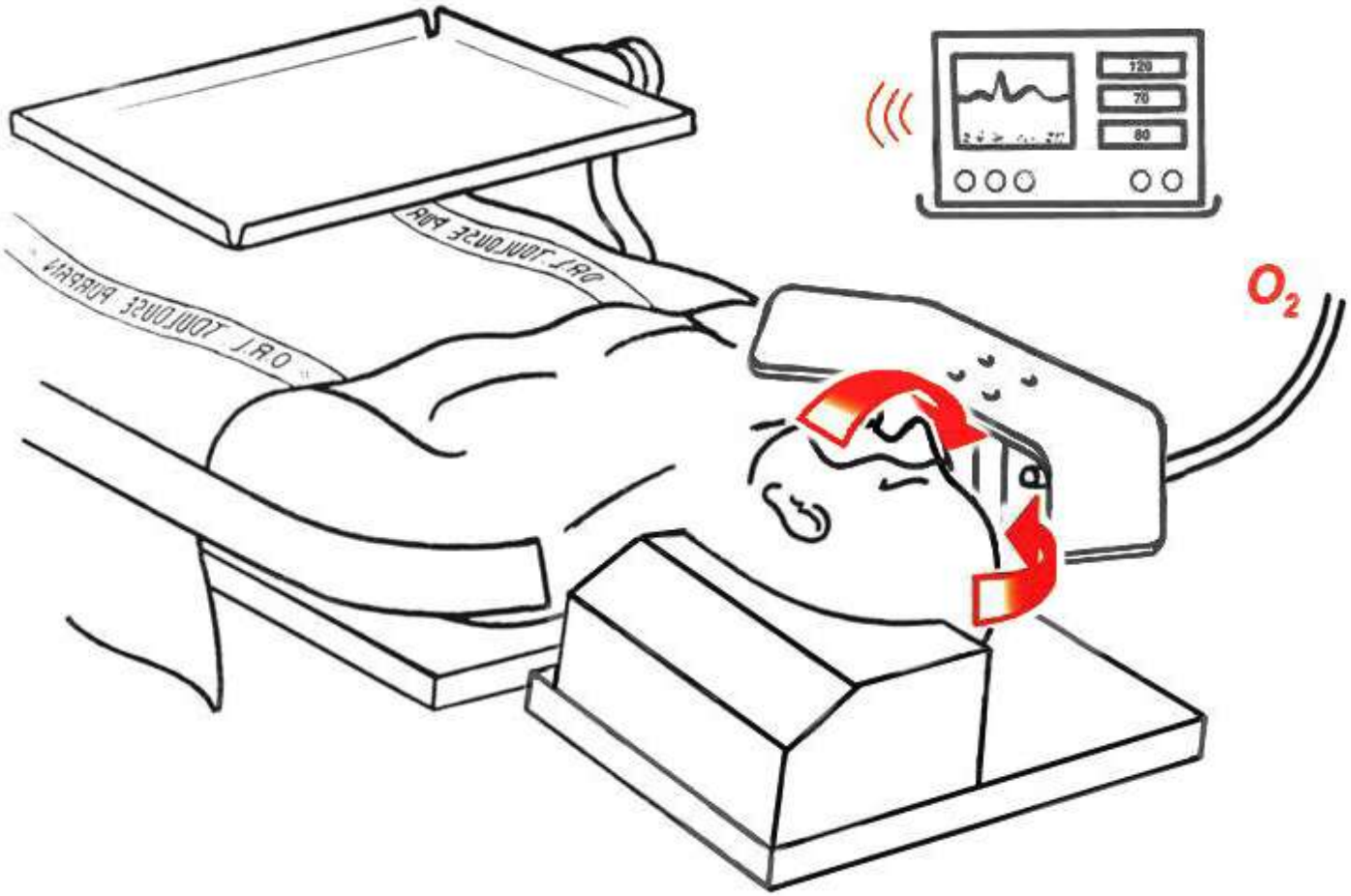


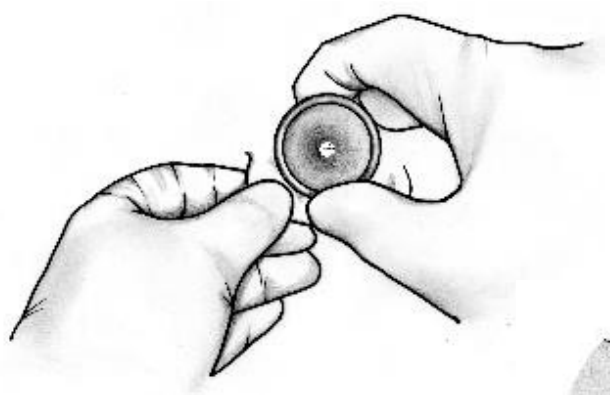
Fosamax® 70mg : 1p/WEEK (6 months)

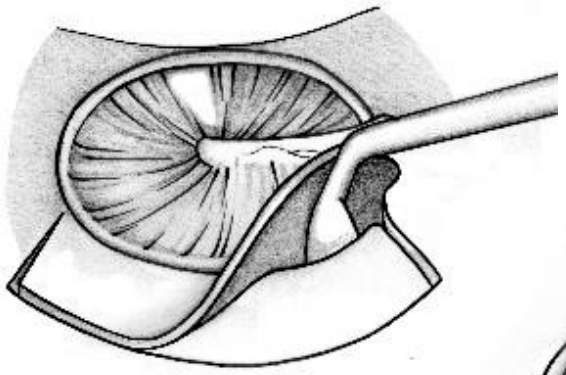
HEARING AID AMPLIFICATION IN CONDUCTIVE AND MIXED HEARING LOSS

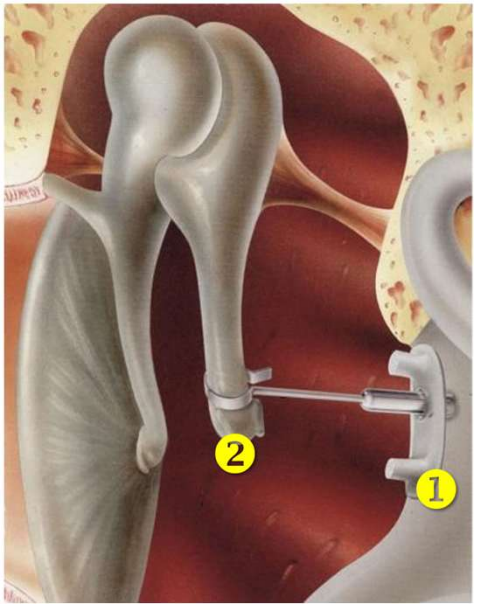
- The adaptation is easiest due to the good cochlear function
- The hearing aid amplification should
  - Compensate the sensorineural part of the loss
  - Additional gain at each frequency to correct the conductive loss
  - Due to the conductive component on low frequency an occluded ear mold may be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

SURGICAL TECHNIQUE





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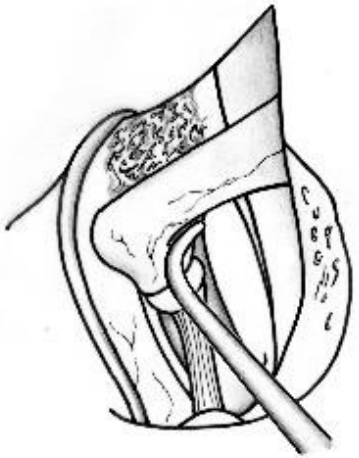
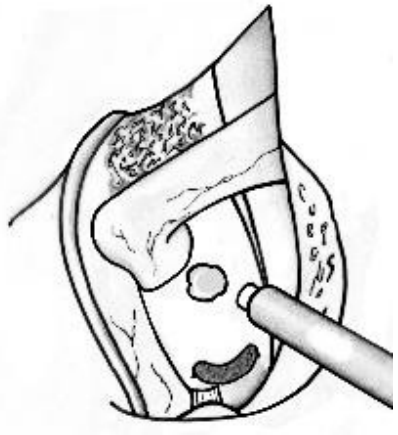
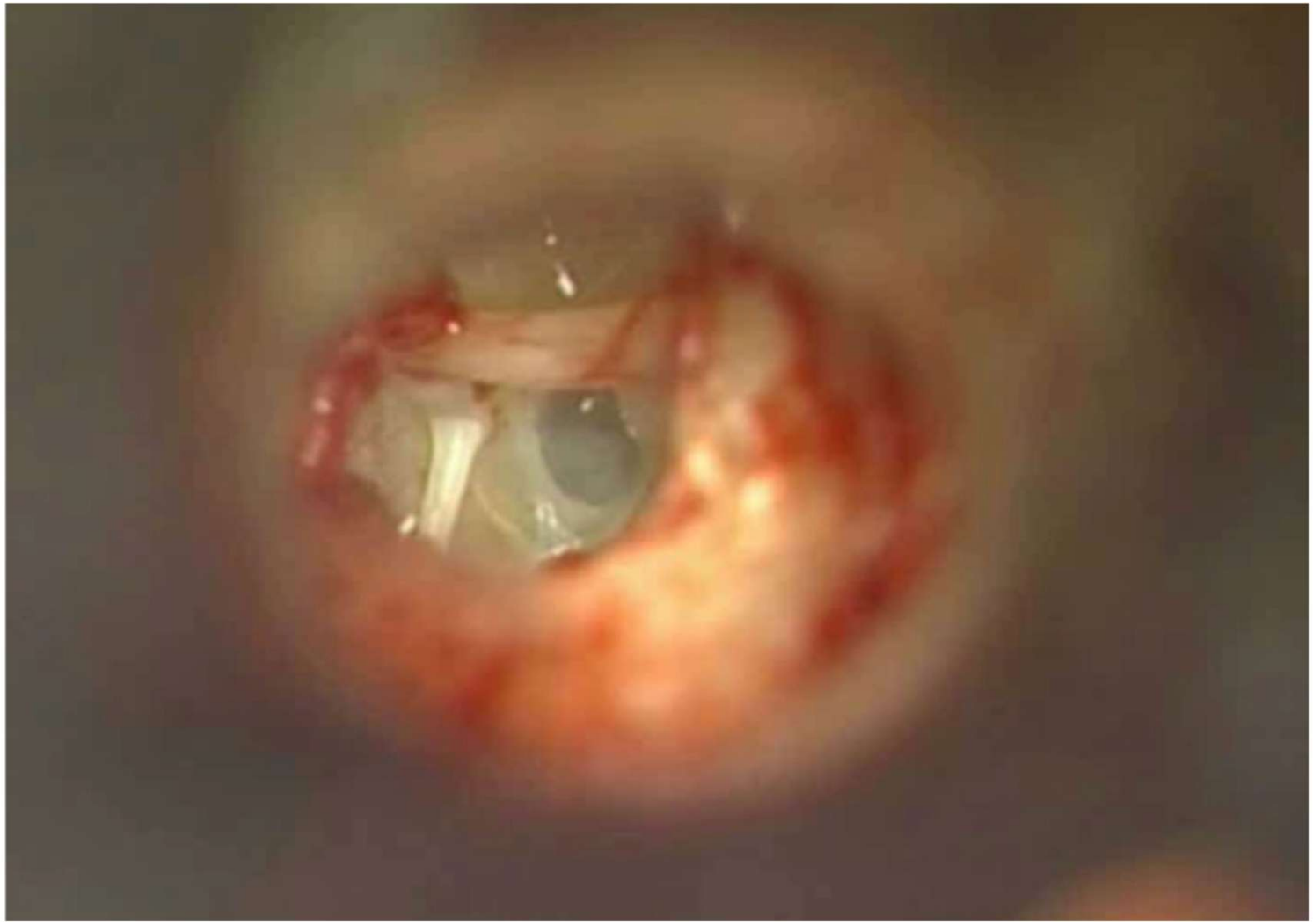
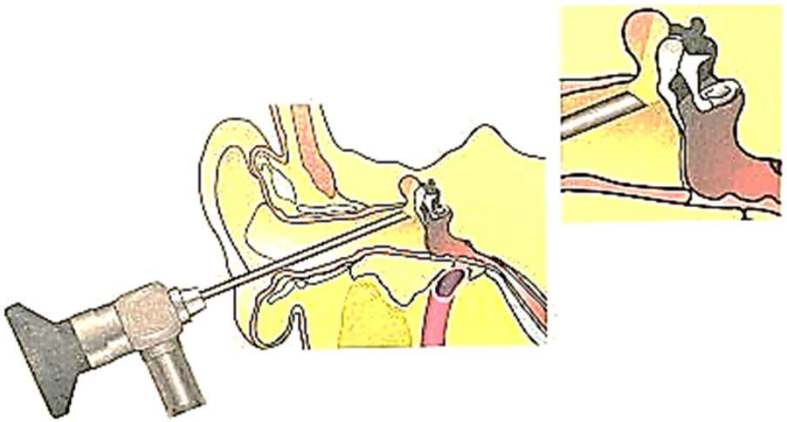
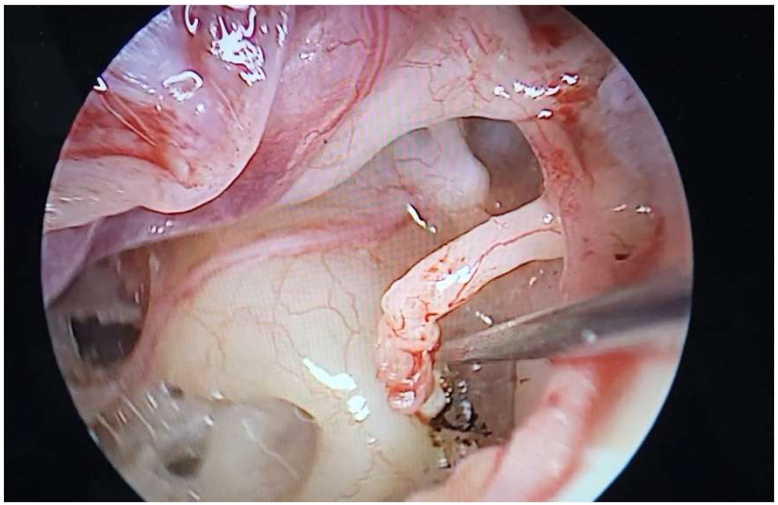






ENDOSCOPIC STAPEDOTOMY





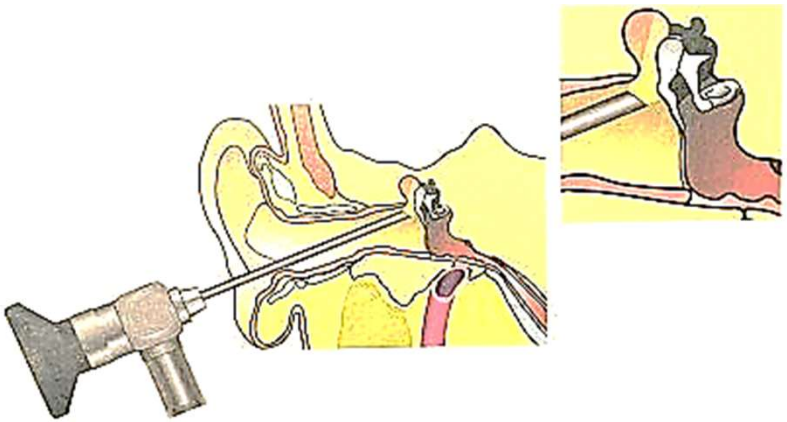
FOR

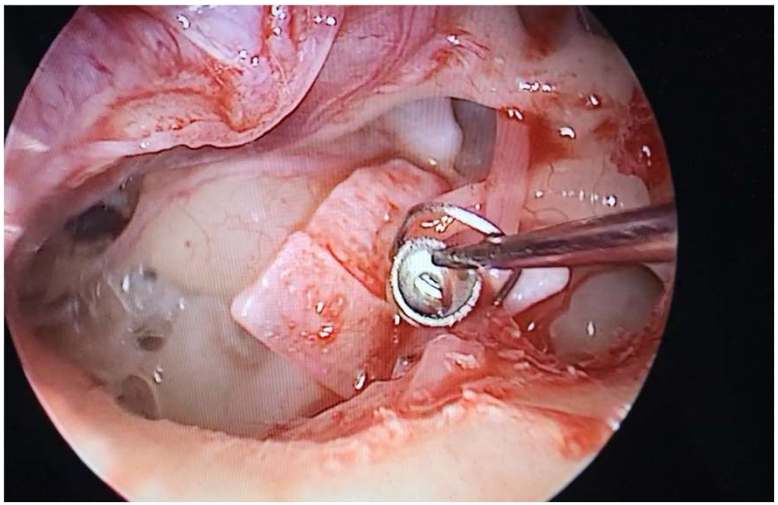
- Better visualisation of the footpalte
- Saffer on the corda tympani

AGAINST

- Manipulation of the footplate and piston more difficult training

COMPARAISON ENDOSCOPE vs MICROSCOPE DANS LA CHIRURGIE STAPÉDIENNE





FOR

- Better visualisation of the footplate
- Saffer on the corda tympani

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OTOLOGY & NEUROTOLOGY

Systematic review of 11 RCT studies - 532 patients

Meta-Analysis > Otol Neurotol. 2025 Oct 1;46(9):1022-1030.
doi: 10.1097/MAO.0000000000004606. Epub 2025 Aug 4.

Stapedotomy in Otosclerosis: A GRADE-Guided Systematic Review and Meta-analysis of Endoscopy vs. Microscopy

Mina Botros, Merna Raafat Roshdy, Abanoub Mokhles, George Karas, Samer Sameh Bedwany

No significant difference on

- Audiological results
- Surgical times
- Complications

Except

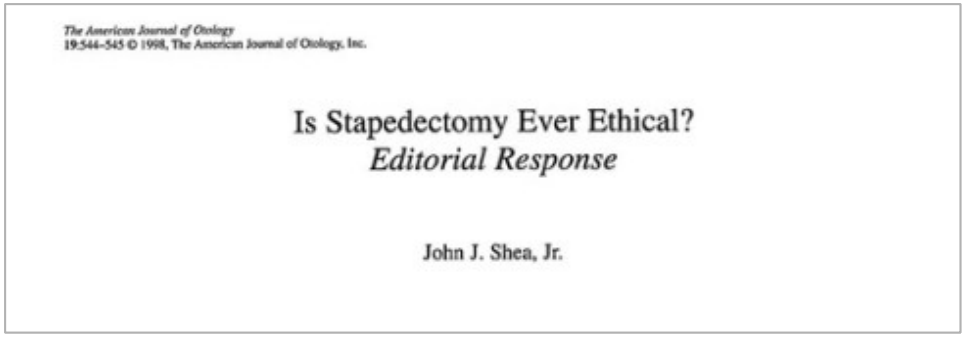
- Less dysgensia

DECISION IN COUNCELLING

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.

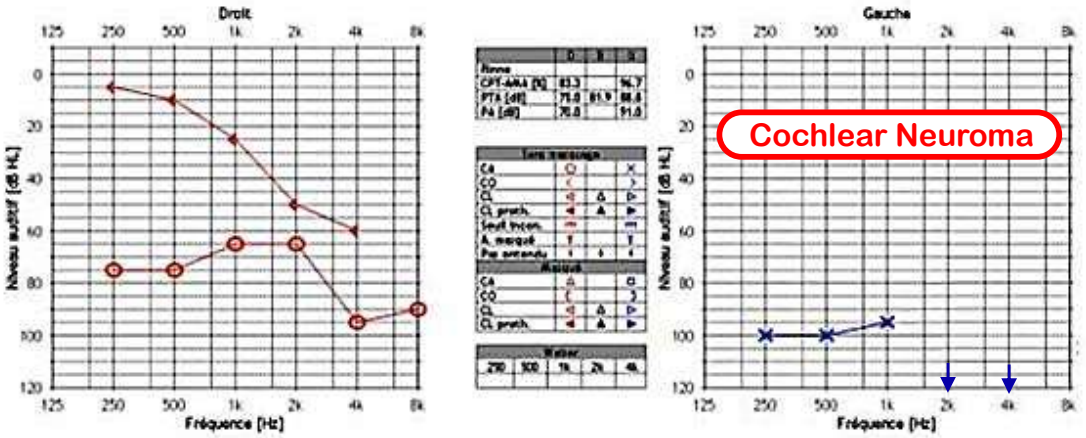
Is Stapedectomy Ever Ethical?
Editorial Response

John J. Shea, Jr.

ONLY HEARING EAR IN THE ERA OF CI

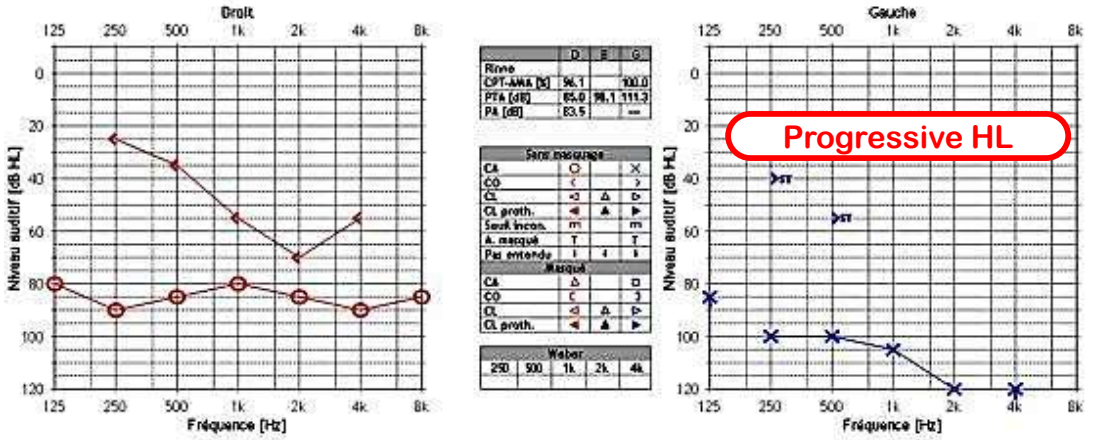
Case 1

- M – 49 years old



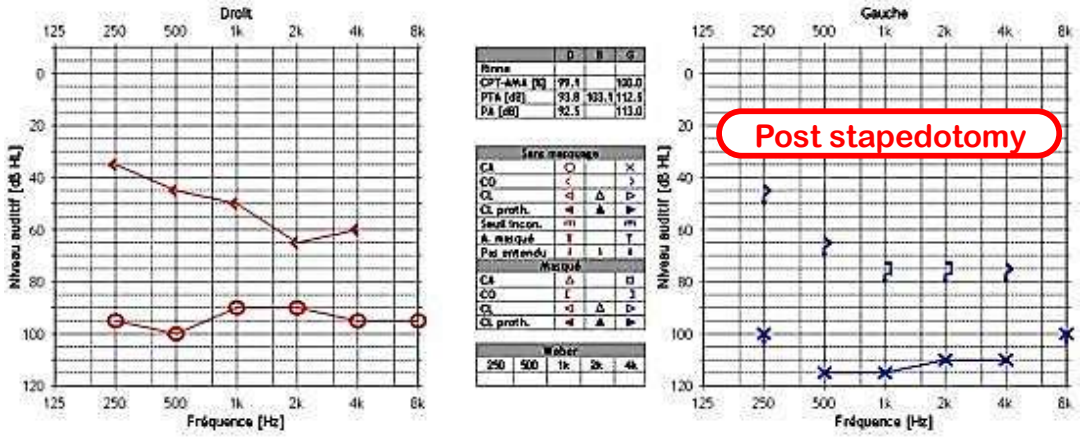
Case 2

- W – 55 years old



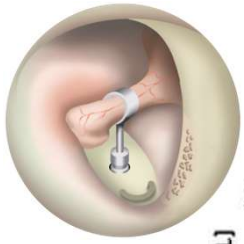
Case 3

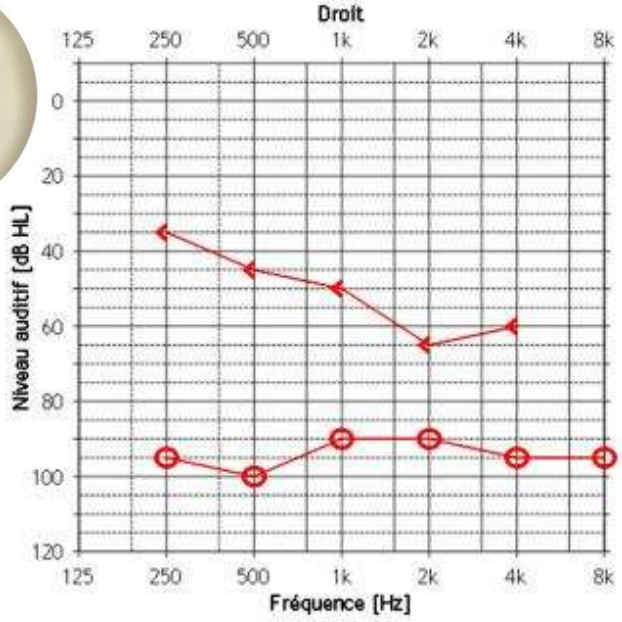
- W – 65 years old



SURGICAL DECISION

Second stage : Stapedotomy



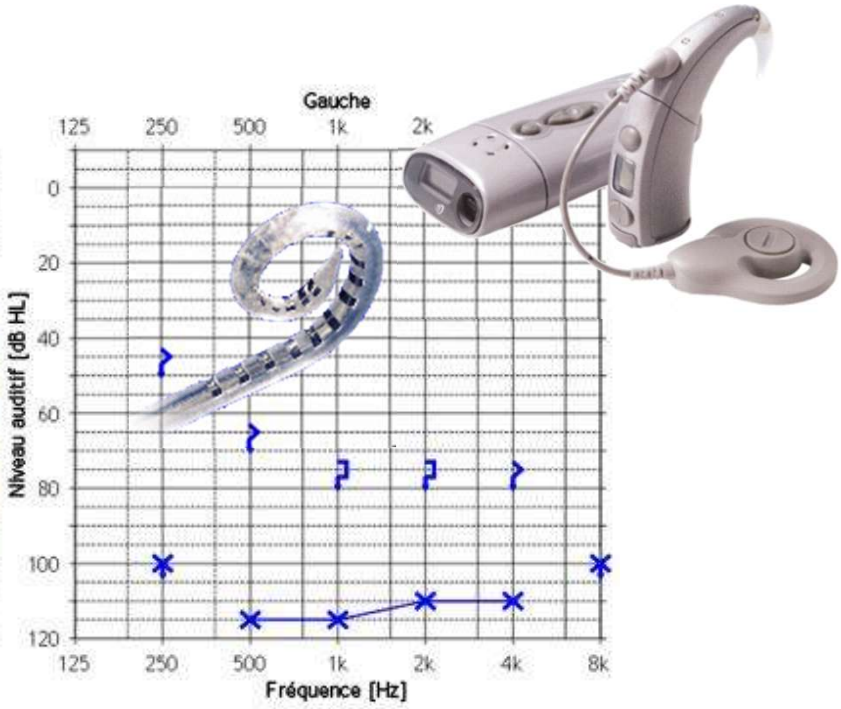


	D	B	G
Rinne			
CPT-AMA [%]	99.1		100.0
PTA [dB]	93.8	103.1	112.5
PA [dB]	92.5		113.0

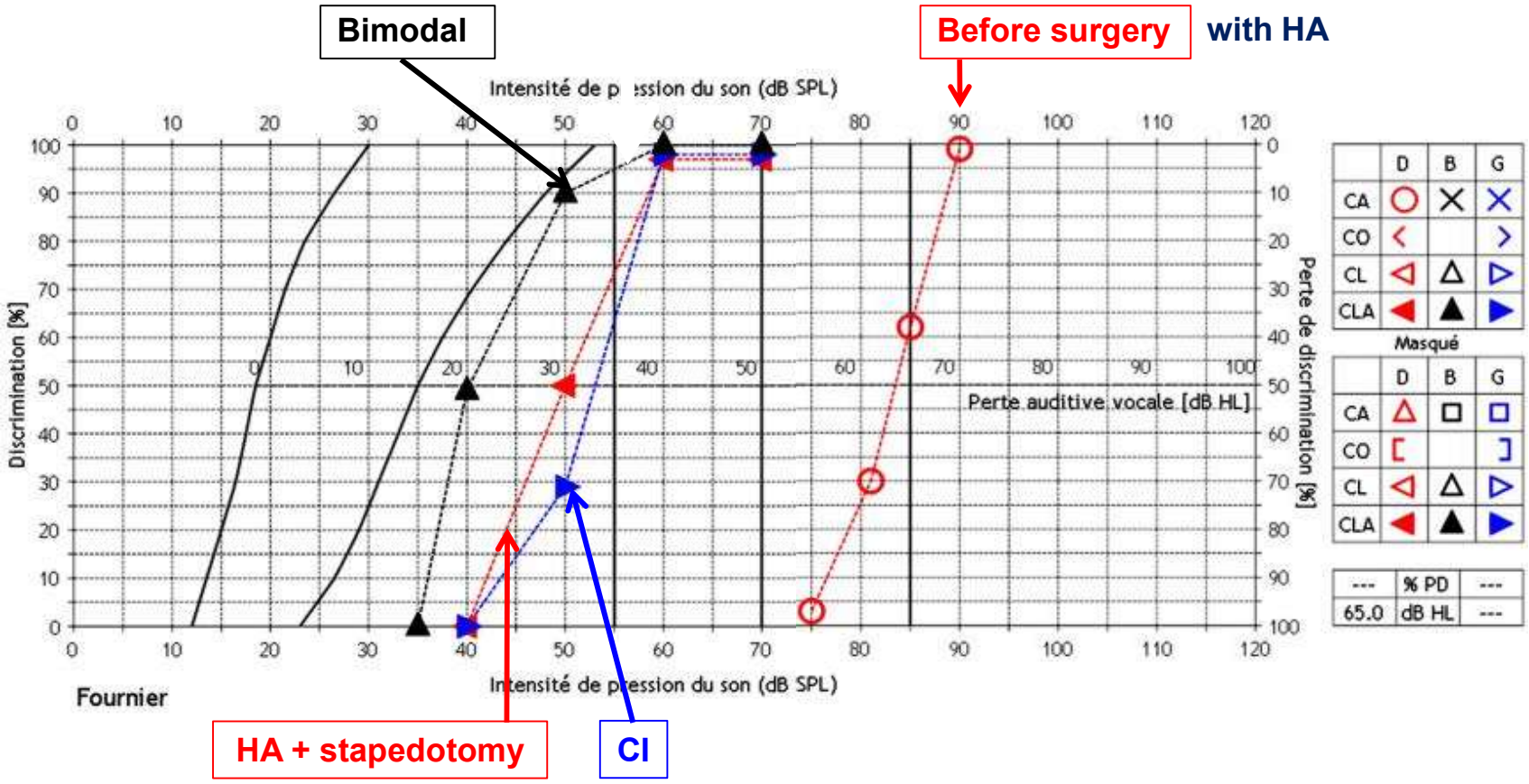
Sans masquage			
CA			
CO			
CL			
CL proth.			
Seuil incon.			
A. masqué			
Pas entendu			
Masqué			
CA			
CO			
CL			
CL proth.			

Weber				
250	500	1k	2k	4k

First stage : CI

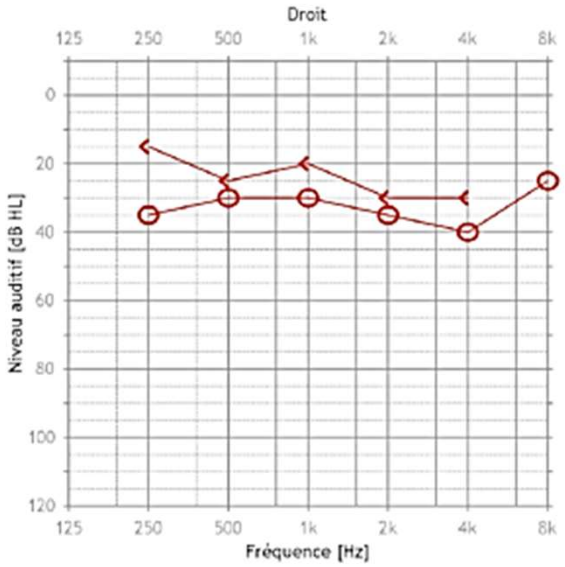


SPEECH DISCRIMINATION RESULTS



TWO OPTIONS ARE NEEDED

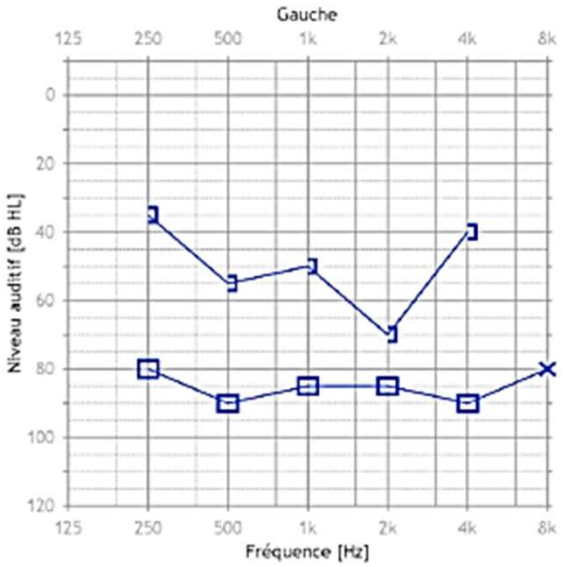
- 59 years old woman
  - The optimal gain provide undesirable audiometric effects
  - It is not possible to provide enough gain to compensate



	R	B	L
Rinne			
CPT-AMA [s]	22.8		97.2
PTA [dB]	34	61	88

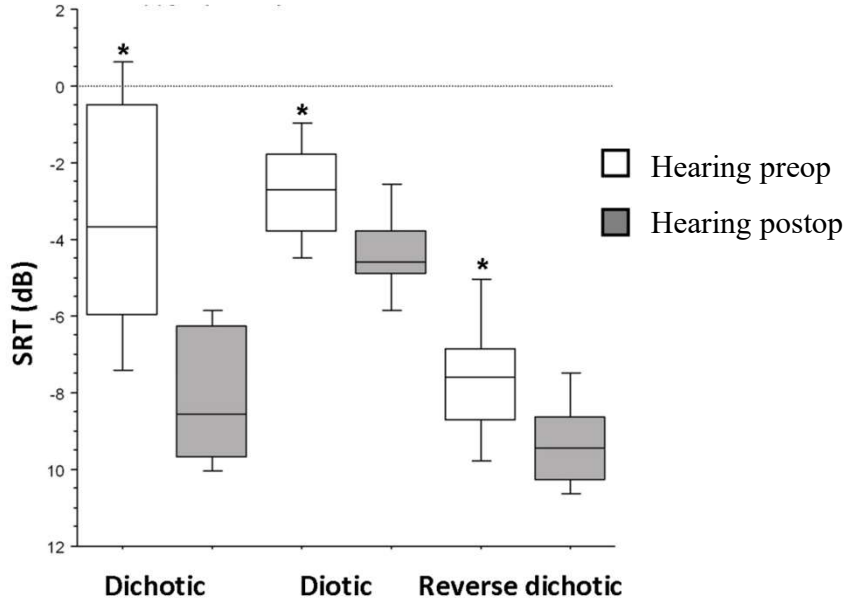
Sans masquage			
CA			
CO			
CL			
CL proth.			
Seuil incon.			
A. masqué			
Pas entendu			
Masqué			
CA			
CO			

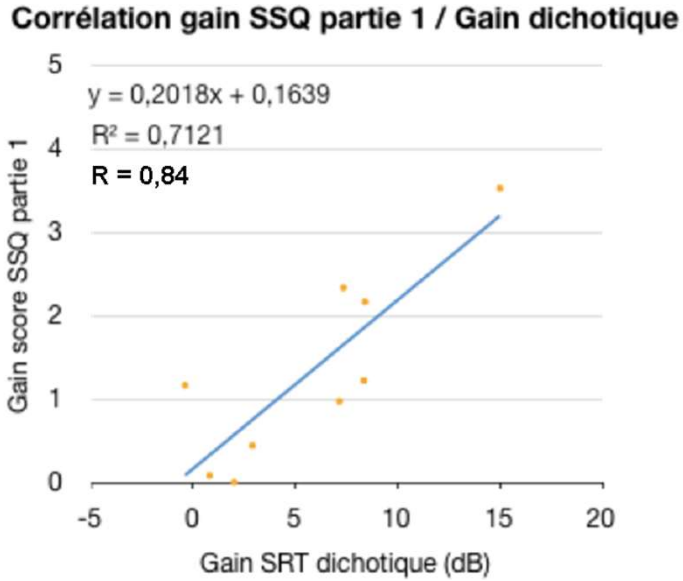
Weber				
250	500	1k	2k	4k



BINAURAL HEARING IN OTOSCLEROSIS

Thesis 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)

THE TWO OPTIONS ARE POSSIBLE BETWEEN HEARING AIDS AND STAPEDOTOMY

Are the audiological results the sames ?

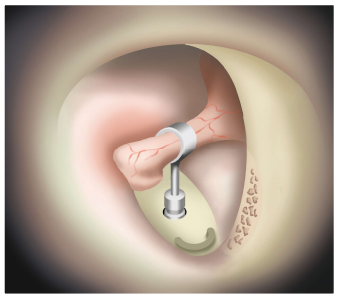
STUDY DESIGN

Otol Neurotol. 2022 Aug 1;43(7):773-780. doi: 10.1097/MAO.0000000000003585.

Stapedotomy Versus Hearing Aids in the Management of Conductive Hearing Loss Caused by Otosclerosis: A Prospective Comparative Study

Charles-Edouard Molinier [1], Yohan Gallois [1], Olivier Deguine [1], Gaetan Iversenc [1], Olivier Vales [2], Soumia Taoui [1], Benoit Lepage [3], Bernard Fraysse [1], Mathieu Marx [1]

- Prospective longitudinal cohort study of patients treated by hearing aid followed by stapedotomy



EVALUATION OF OUTCOMES

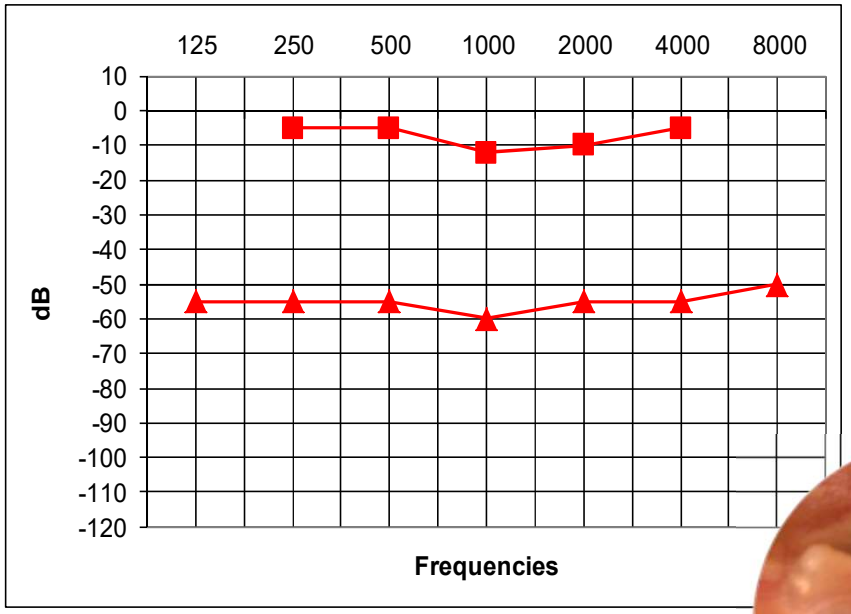
Audiometric assessment

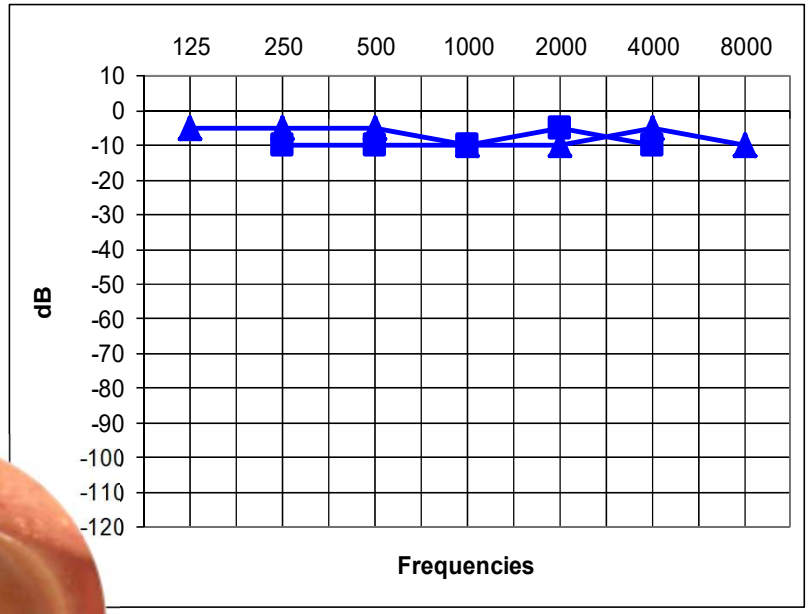
- PTA value of AC and BC at 0.5, 1, 2, 4 KHz
- Air bone GAP
- Speech discrimination in quiet (dissylabic words)
- Binaural hearing Fra-Matrix, sound localisation

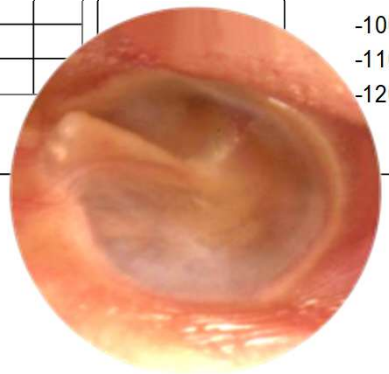
Quality of life

- GHSI (*Glasgow Heath Status Inventory*)
- SSQ focused on binaural systems
- Patient satisfaction, adverse effects complication
- Tinnitus : THI

POPULATION



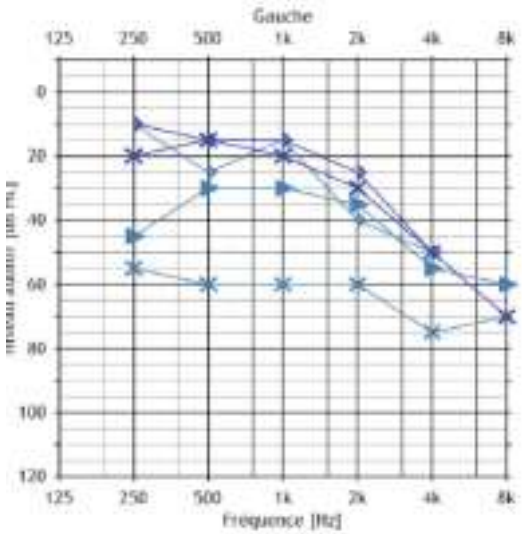


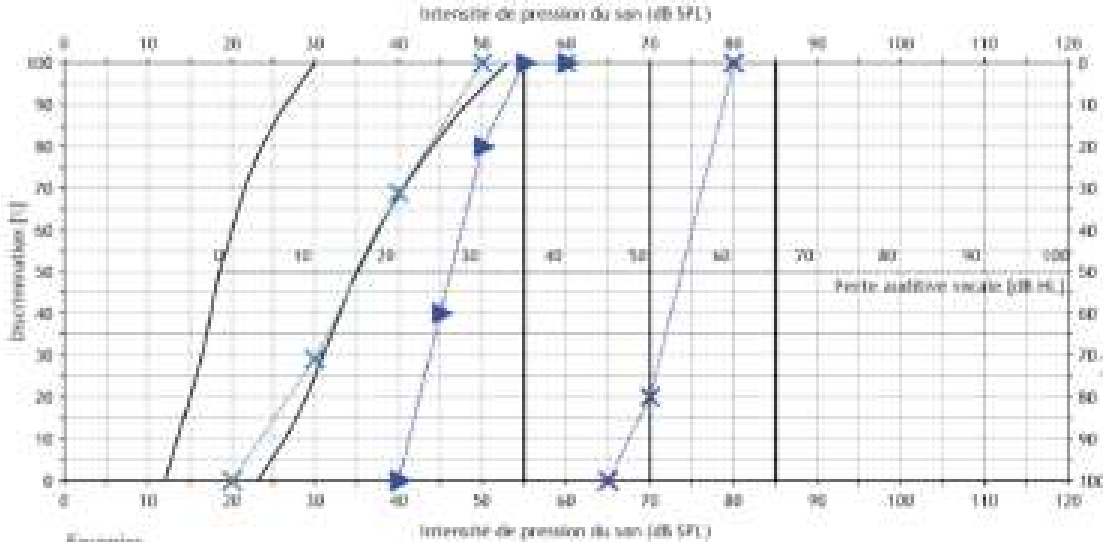


Mean PTA : 53dB

- The main symptoms associated were tinnitus (68%)

AUDIOMETRIC RESULTS

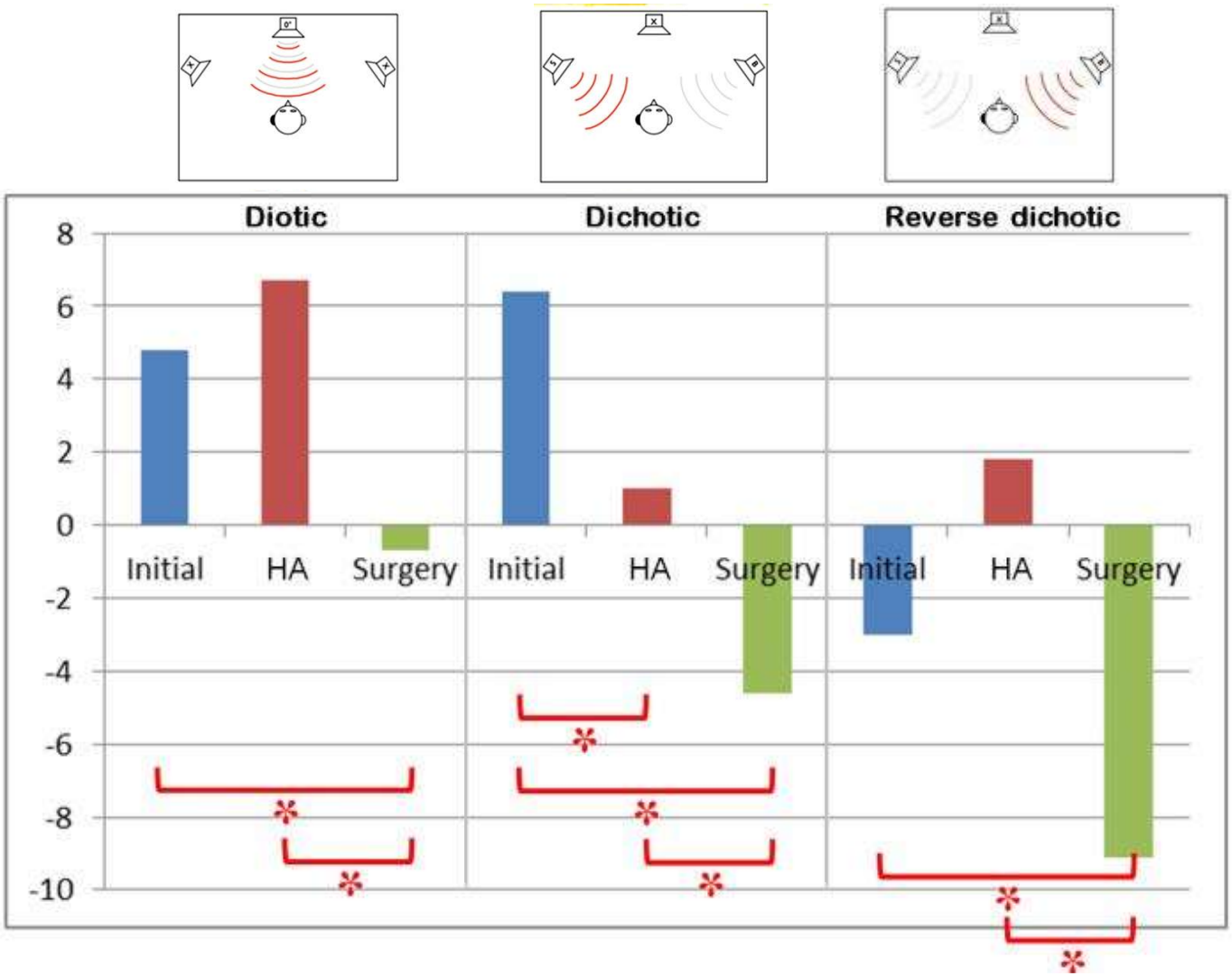




- **PTA**
- **Discrimination**

	Baseline	HA	p. Value	Surgery	p. Value
PTA	53dB	-13dB	0.0002	-24.9dB	0.0001
ABG	33dB	-13dB	0.0002	-24dB	0.0001
SD		15%	p. 0.02	+53%	p. 0.0004

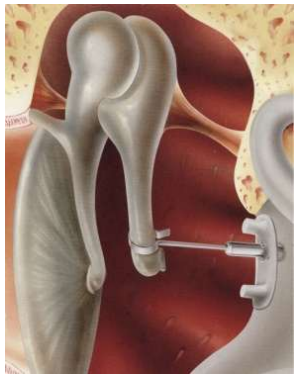
BINAURAL HEARING / MATRIX



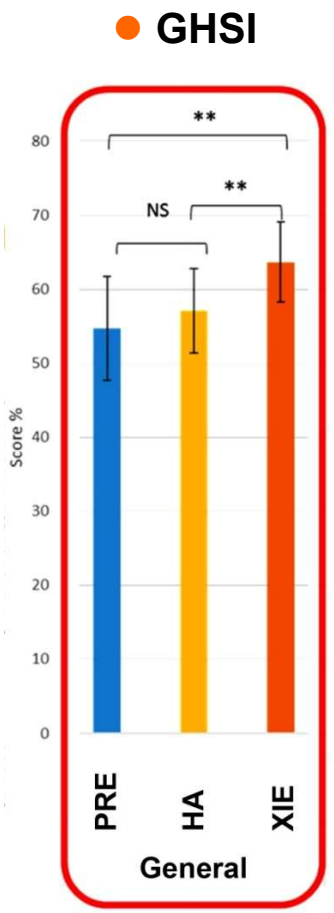
OVERALL RESULTS

Hearing aid

VS



Stapes surgery



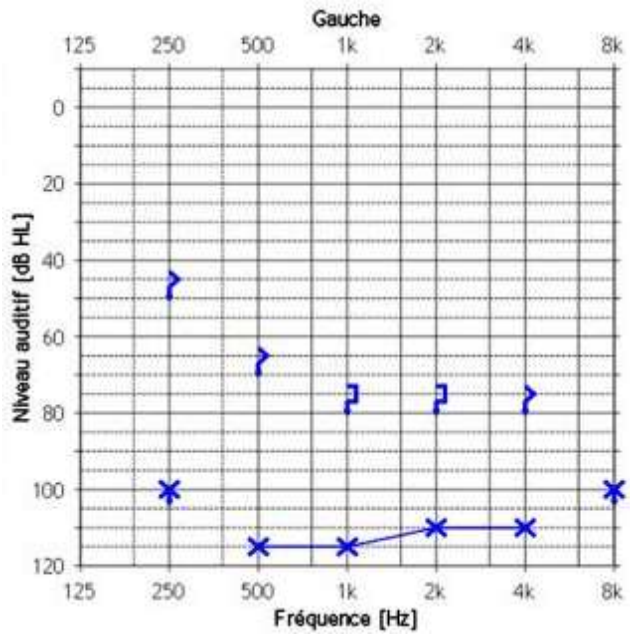
- Despite more adverse effect, stapedotomy versus HA showed greater improvement in :
  - QoL Tinnitus
  - Audiometric performance
  - Binaural hearing

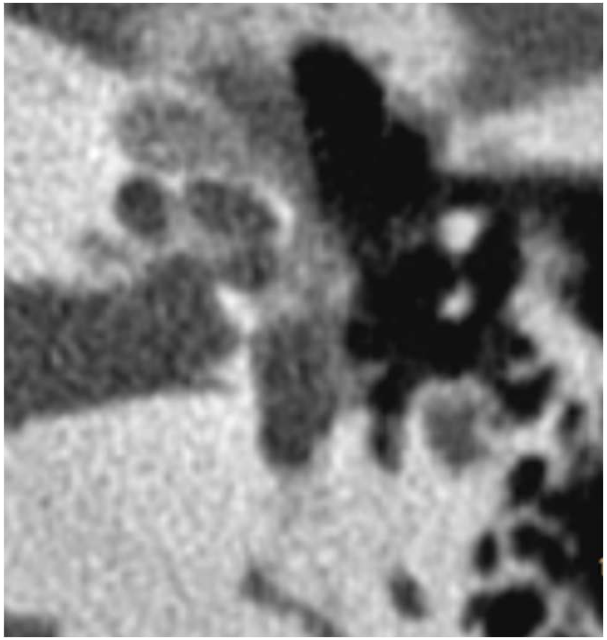
OTOSCLEROSIS IN SEVERE HEARING LOSS

Far advance otosclerosis

1 - Black audiogram no response

- CT Scan evidence of otosclerosis focus





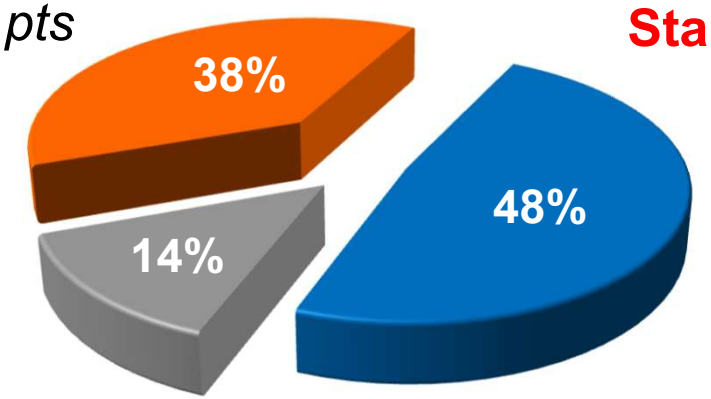
POPULATION

Otol Neurotol. 2015 Mar;36(3):e73-8. doi: 10.1097/MAO.0000000000000692.

Decisive criteria between stapedotomy and cochlear implantation in patients with far advanced otosclerosis

Bilal Kabbara [1], Clement Gauche, Marie-Noelle Calmels, Benoit Lepage, Bernard Escude, Olivier Deguine, Bernard Fraysse, Mathieu Marx

Stapedotomy + CI
25 pts



Stapedotomy alone
32 pts

CI alone
9 pts

N : 660

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

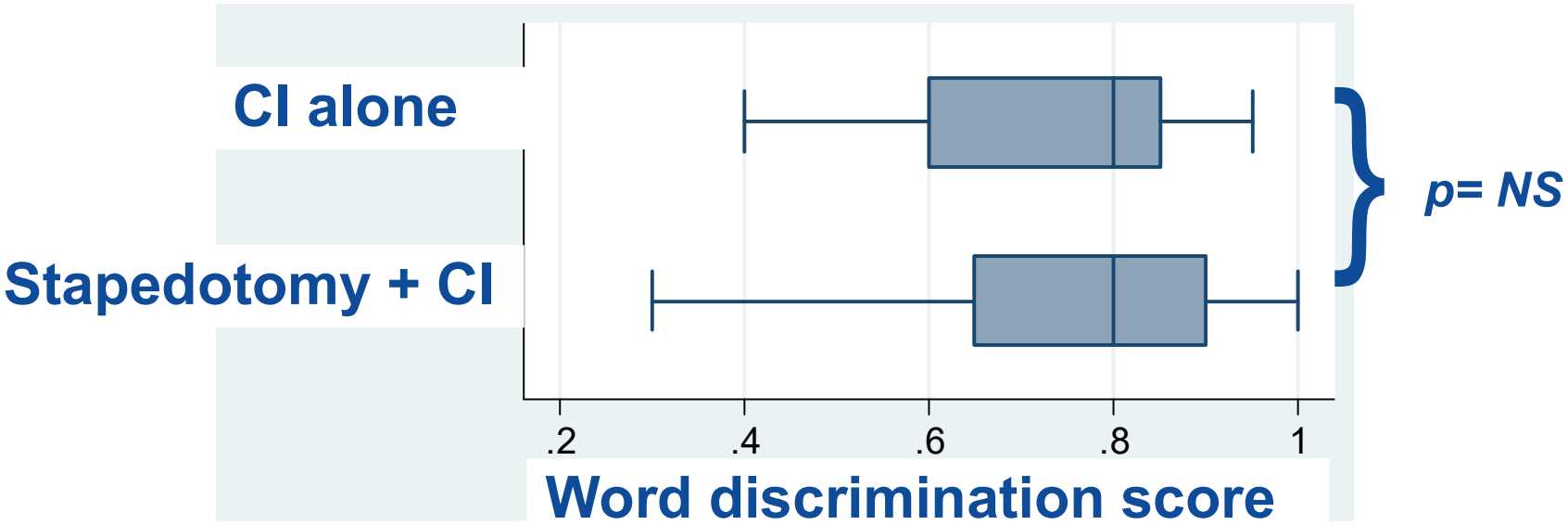
	Mean Word Discrimination Score	% Patients scoring ≥ 50%
Group A : Stapedotomy	**50,6%**	60%
Group B + C CI alone / CI + S	**72.8%**	89%

p = 0.002

p= 0.027

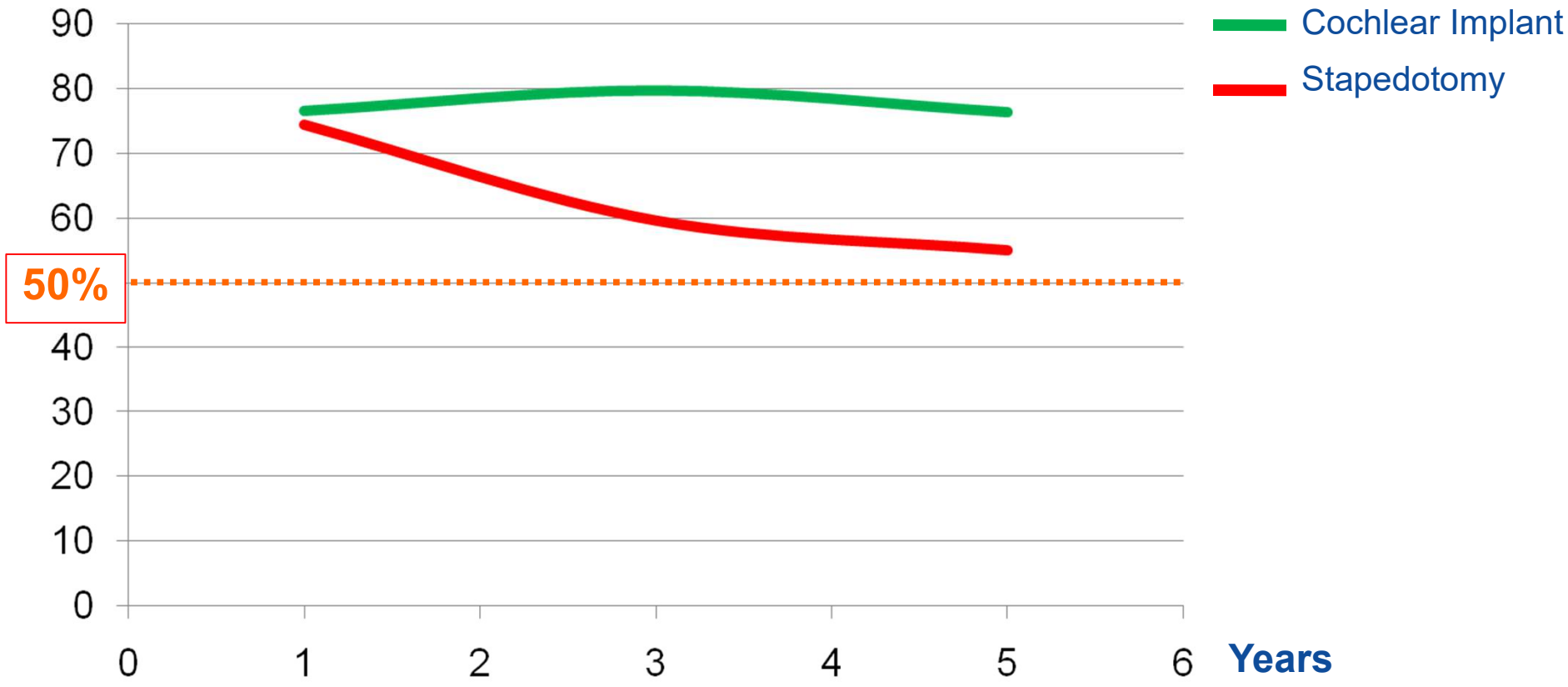
PREDICTIVE FACTORS OF CI OUTCOMES

Cochlear Implant group



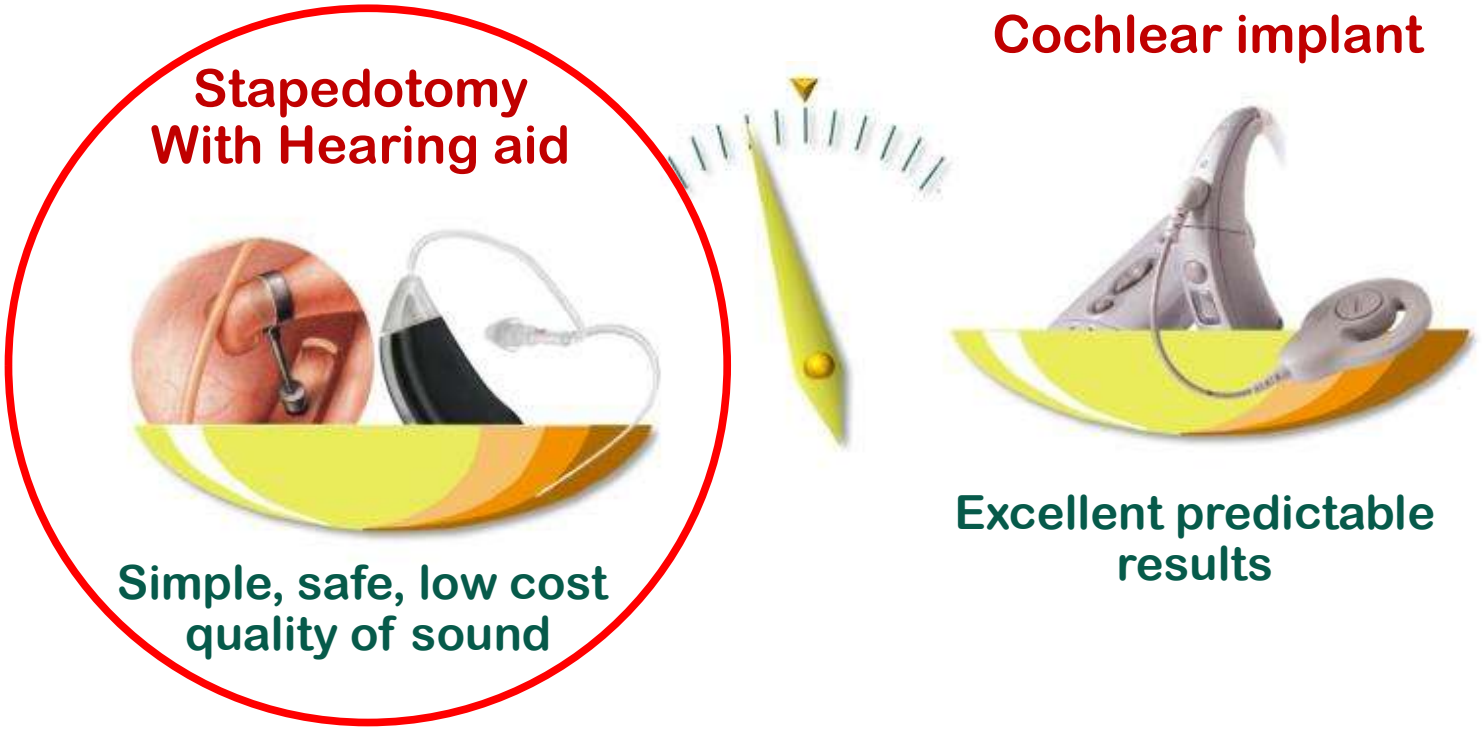
➔ Previous stapedotomy has No impact on Cochlear implant outcome

LONG TERM RESULTS



ALGORITHM FOR MANAGEMENT

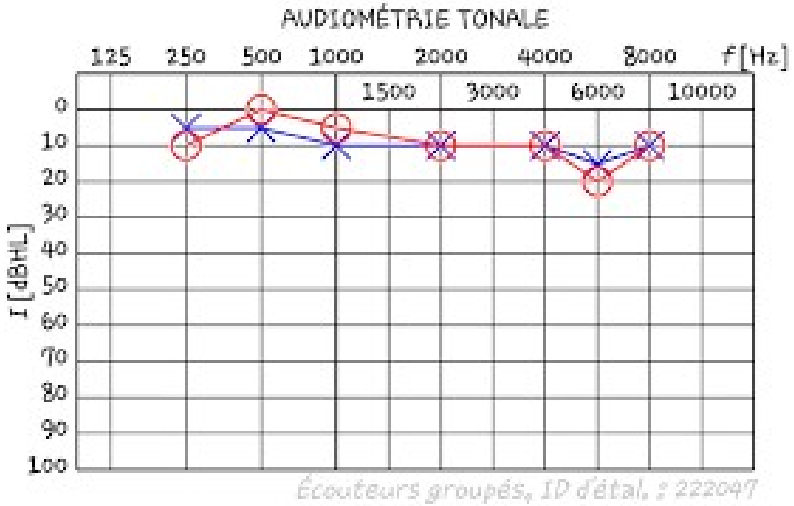
- Success of stapedotomy cannot be predicted pre-operatively
- Previous stapedotomy has no impact on cochlear implant results



PATIENT WITH NORMAL HEARING AND SEVERE PULSATIL TINNITUS THI>56

Mr G. 31 years old

- Pulsatil tinnitus
- Severity THI 52/100
- Not modified by vascular compression
- 70% show a significant improuvement on THI



Audiology and Neurotology

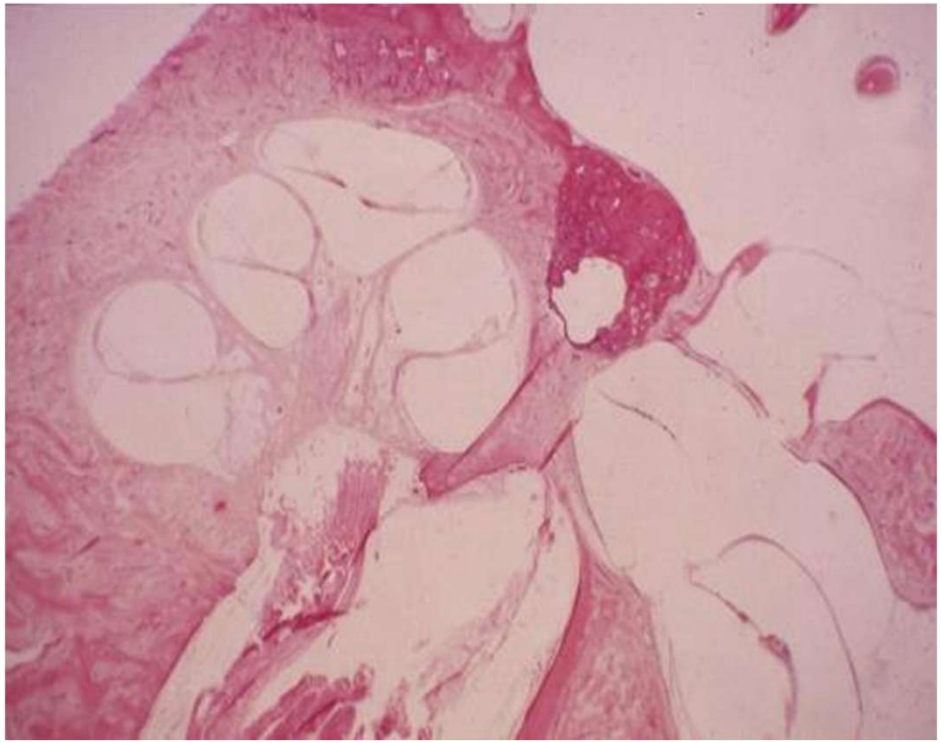
Research Article

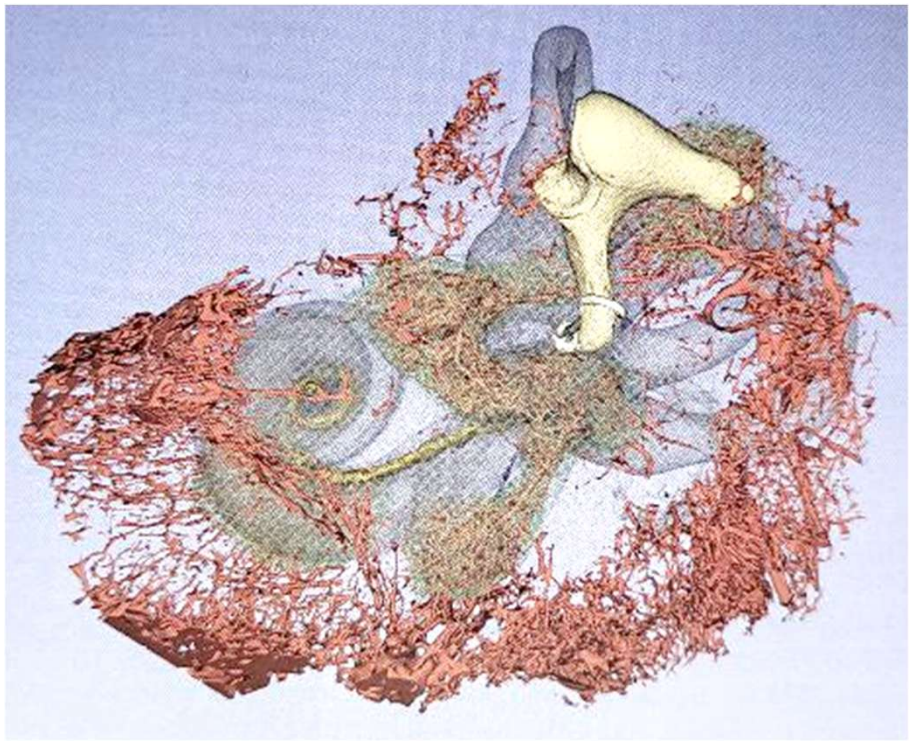
Audiol Neurotol 2024;29:487–499
DOI: 10.1159/000539422

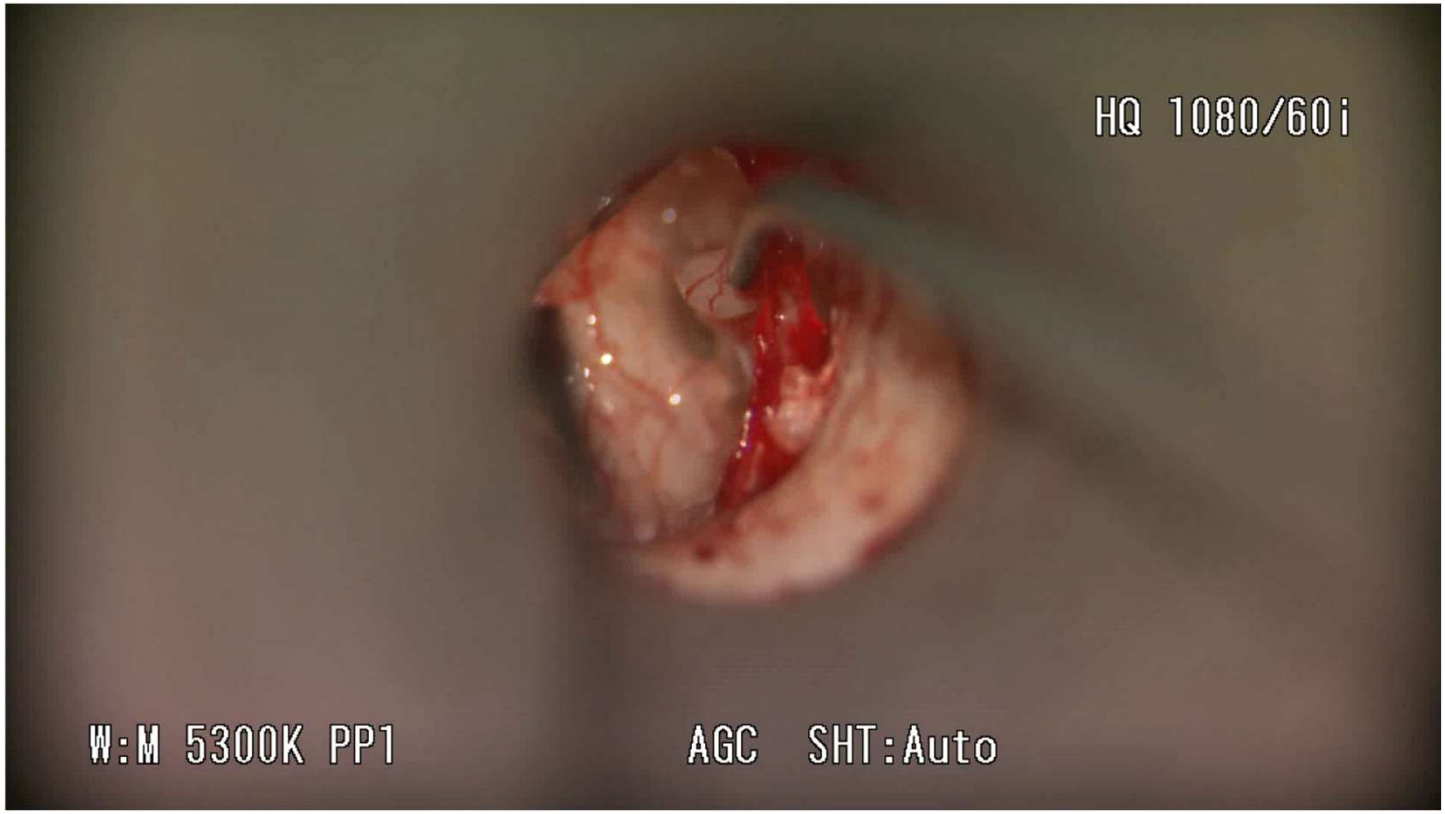
Received: December 6, 2023
Accepted: April 15, 2024
Published online: May 22, 2024

Synchrotron Phase-Contrast Imaging and Cochlear Otosclerosis: A Case Report

Dina Giese[a] Helge Rask-Andersen[a] Hanif M. Ladak[b, c, d]
Sumit Agrawal[b, c, d] Hao Li[a]





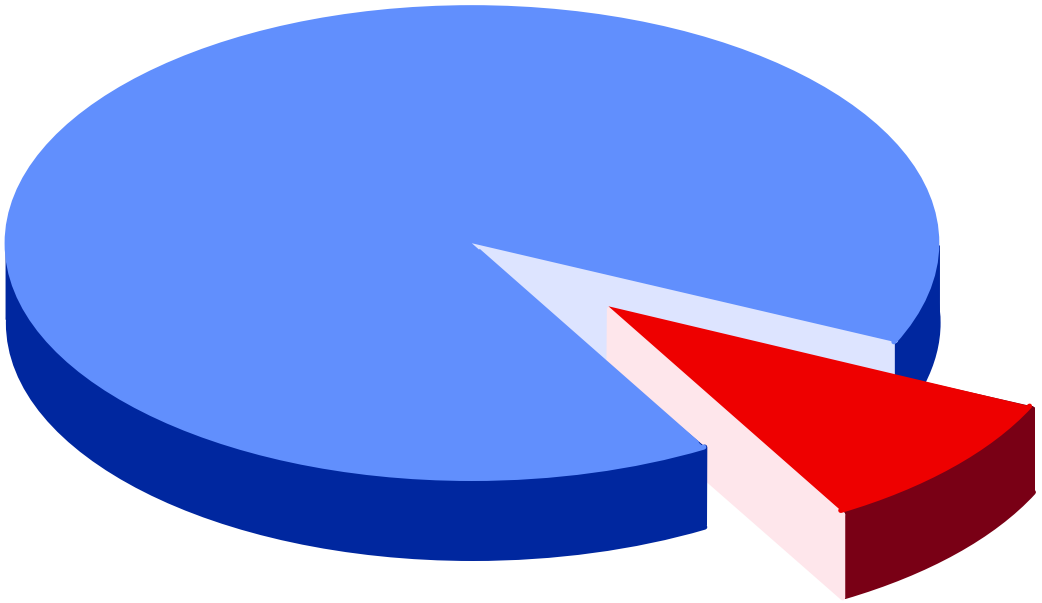

HQ 1080/60i
W:M 5300K PP1
AGC SHT:Auto

CONCLUSION

Thank you for your attention

REVISION SURGERY

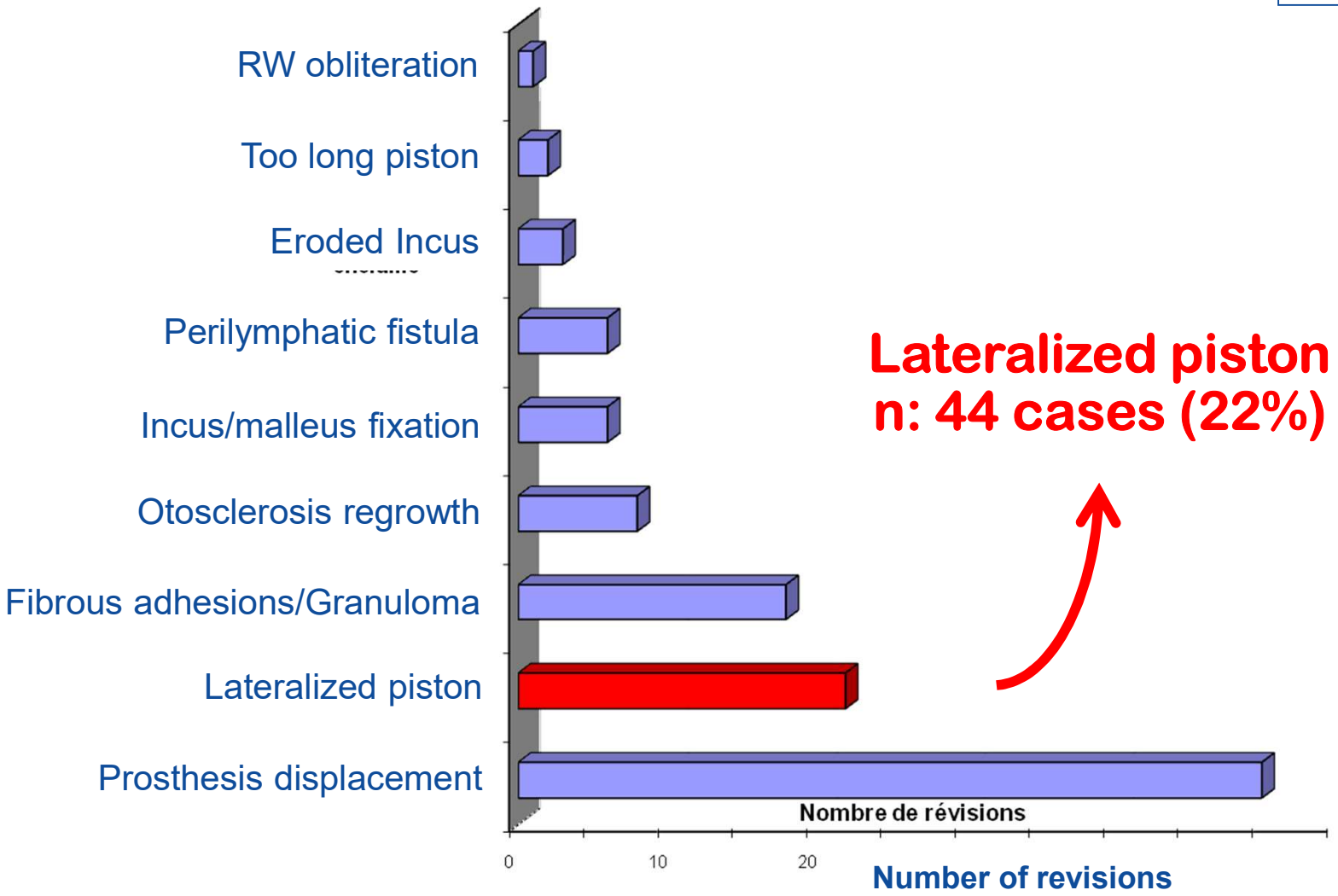
2180 surgeries
1993 - 2013



202 Revisions
9%

REVISION SURGERY

202 cases



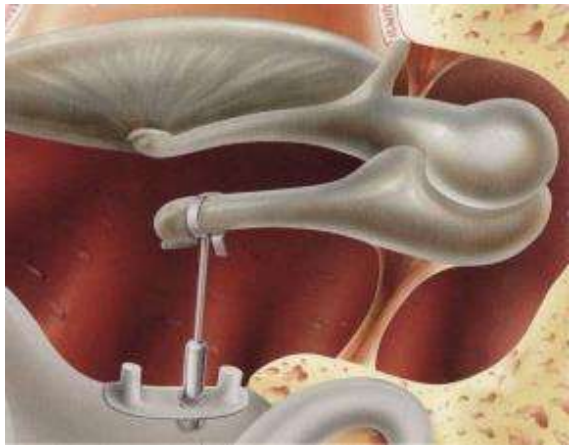
Lateralized piston
n: 44 cases (22%)

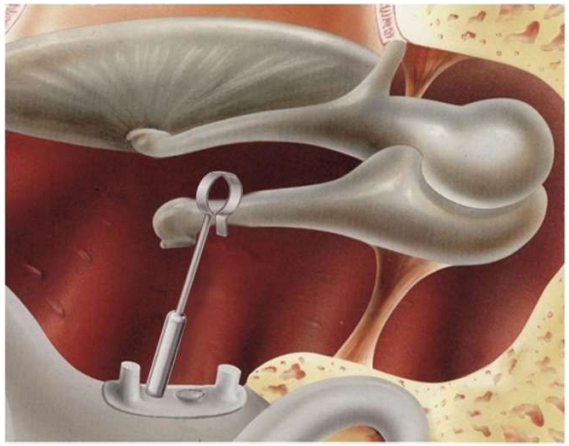
DEFINITION

Otology & Neurotology
30:1138–1144 © 2009, Otology & Neurotology, Inc.

Revision Stapes Surgery: The "Lateralized Piston Syndrome"

*Sebastien Lagleyre, *Marie-Noelle Calmels, †Bernard Escudé, *Olivier Deguine, and *Bernard Fraysse

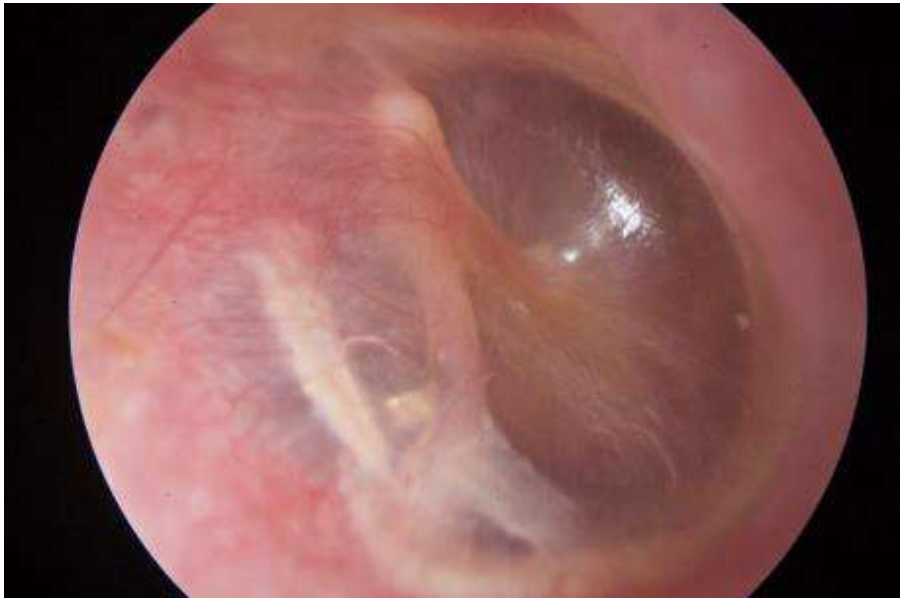




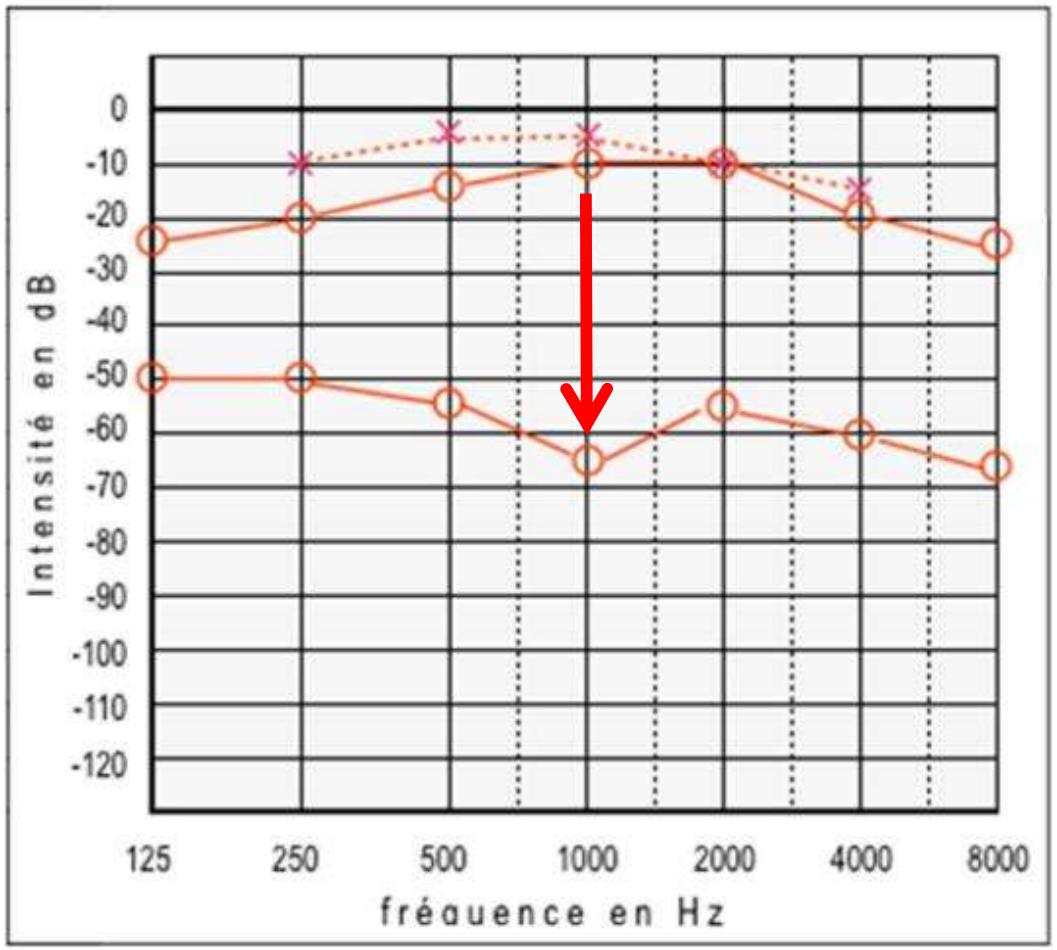
- Lateral displacement of the piston, with partial erosion of the incus and closing of the stapedotomy hole

CLINICAL SYMPTOMS

- Delayed post operative conductive hearing loss
- Hearing fluctuation improved after Valsalva
- Otoscopy : prosthesis loop against the tympanic membrane



PURE TONE AUDIOGRAM



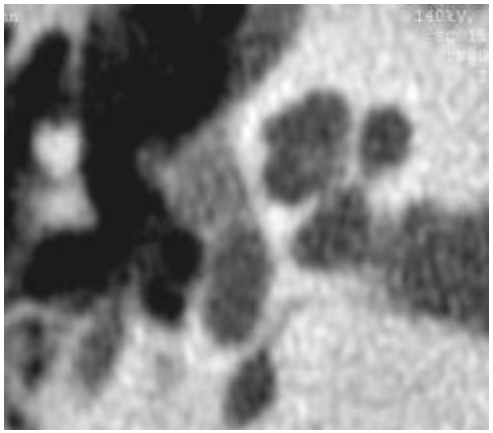
◀ Postoperative audiogram

◀ Secondary conductive hearing loss

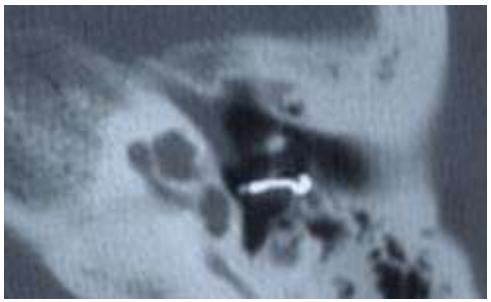
Mean Air Conductive : 60 dB

RADIOLOGICAL FINDINGS

- Positive focus in *94%*



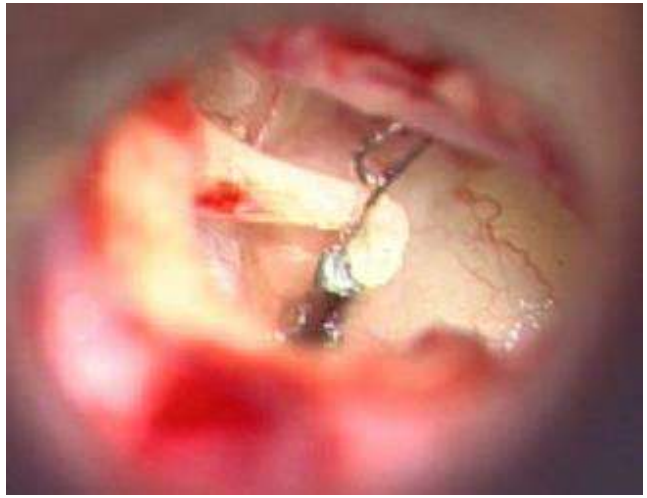
- Position of the piston nearby the tympanic membrane



- Piston out of the stapedotomy hole

SURGICAL FINDINGS

- Lateral displacement of the piston in the axis of the stapes. No or partial erosion of the incus



- Closing of the stapedotomy hole

OVERALL RESULTS – TYPE OF PISTON

	Conventional piston	Curved piston	TORP
N	31	9	6
Rinne ≤ 10 dB	48%	55%	0
Rinne ≤ 20 dB	93%	85%	50%

NS

Significant $p < 0.05$

IA / OTOSCLEROSIS

IA AS A DIGITAL HEALTH ADVISOR

Chat GPT-4

Front Surg. 2024 Jun 5:11:1373843. doi: 10.3389/fsurg.2024.1373843. eCollection 2024.

Evaluating ChatGPT-4's performance as a digital health advisor for otosclerosis surgery

Samil Sahin [1], Burak Erkmen [1], Yaşar Kemal Duymaz [2], Furkan Bayram [2], Ahmet Mahmut Tekin [3], Vedat Topsakal [3]

- 15 questions regarding indications, surgical technique and follow-up were submitted to Chat GPT-4.
- His answers were analyzed by three experts

	Expert 1	Expert 2	Expert 3	Moyenne
Pertinence score de discernement	49	50	52	**50,7**

UTILITY OF DEEP LEARNING IN THE DIAGNOSIS OF OTOSCLEROSIS BY CT

Automated detection of otosclerosis with interpretable deep learning using temporal bone computed tomography images

Heliyon (IF 3.6 Submission Guide >) **Pub Date: 2024-04-15** , DOI:10.1016/j.heliyon.2024.e29670

Zheng Wang, Jian Song, Kaibin Lin, Wei Hong, Shuang Mao, Xuewen Wu, Jianglin Zhang

Automatic detection
N: 175 patients

- The algorithm uses NetB4 with a specificity of 98%, analyzing only pre-stapedial forms

> J Imaging Inform Med. 2024 Dec;37(6):2931-2939. doi: 10.1007/s10278-024-01079-w. Epub 2024 Jun 26.

Artificial Intelligence for Otosclerosis Detection: A Pilot Study

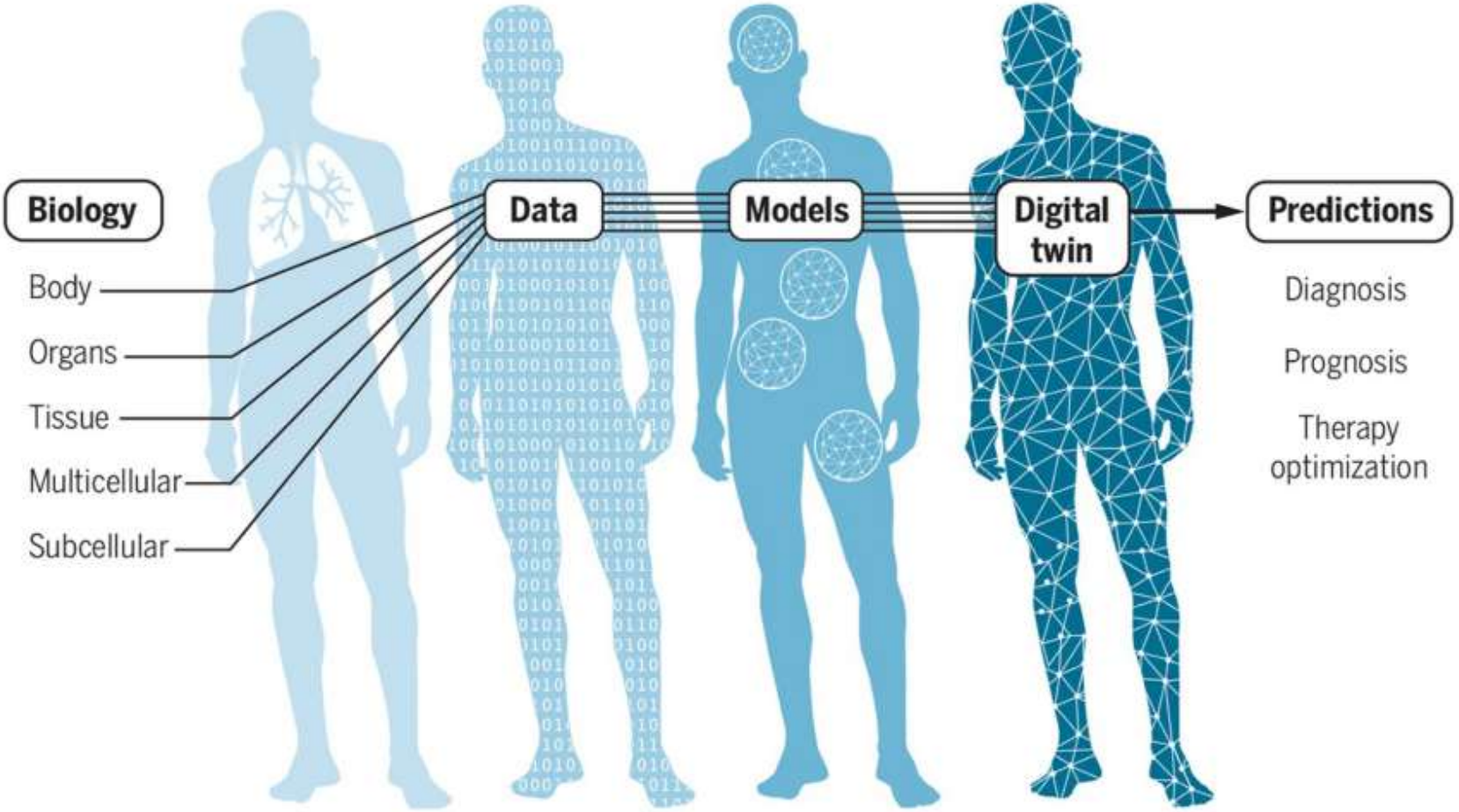
Antoine Emin [1], Sophie Daubié [1], Loïc Gaillandre [2], Arthur Aouad [3], Jean Baptiste Pialat [1 3], Valentin Favier [4], Florent Carsuzaa [5], Stéphane Tringali [3 6 7], Maxime Fieux [8 9 10]

N: 382 patients

- The authors found the same specificity of 98% on the pre-stapedial and retro-cochlear forms, but the reliability decreases considerably in the early forms, to 35%

HAS

FDA


Biology
Body
Organs
Tissue
Multicellular
Subcellular
Data
Models
Digital twin
Predictions
Diagnosis
Prognosis
Therapy optimization