1059

HOW TO IMPROVE COCHLEAR IMPLANT IN ADULT

Poor performances in adult CI patients and its remediation

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IFOS WORLD MASTER COURSE ON HEARING REHABILITATION

DUBAI
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INTRODUCTION

- A number of patients do not reach optimal performance according to their own pronostic factors

10 to 50% can be considered as poorer performer

GOAL OF THE STUDY

❶ To analyze CI auditory outcomes as a function of delay post activation and the various factors underlying the results

❷ To design a predictive model during counselling based on patient related factors and electrode insertion

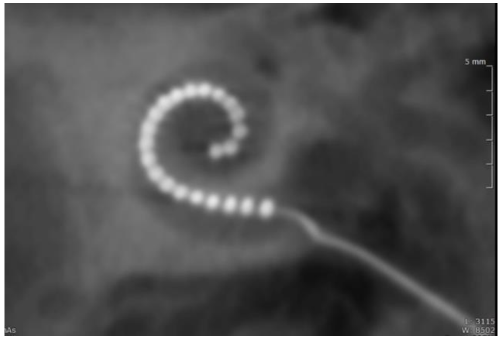
❸ To compare early auditory outcomes to the predictive mode and propose remediation

POPULATION

N : 118

Inclusion

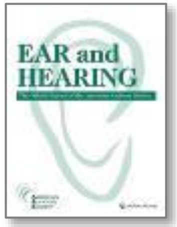
- All adults with unilateral CI and profound HL at least one year follow-up and receiving the same aural rehabilitation program



Cone Beam / CT-Scan

Study design

- The percentage of variance (22) expresses the impact of each factors



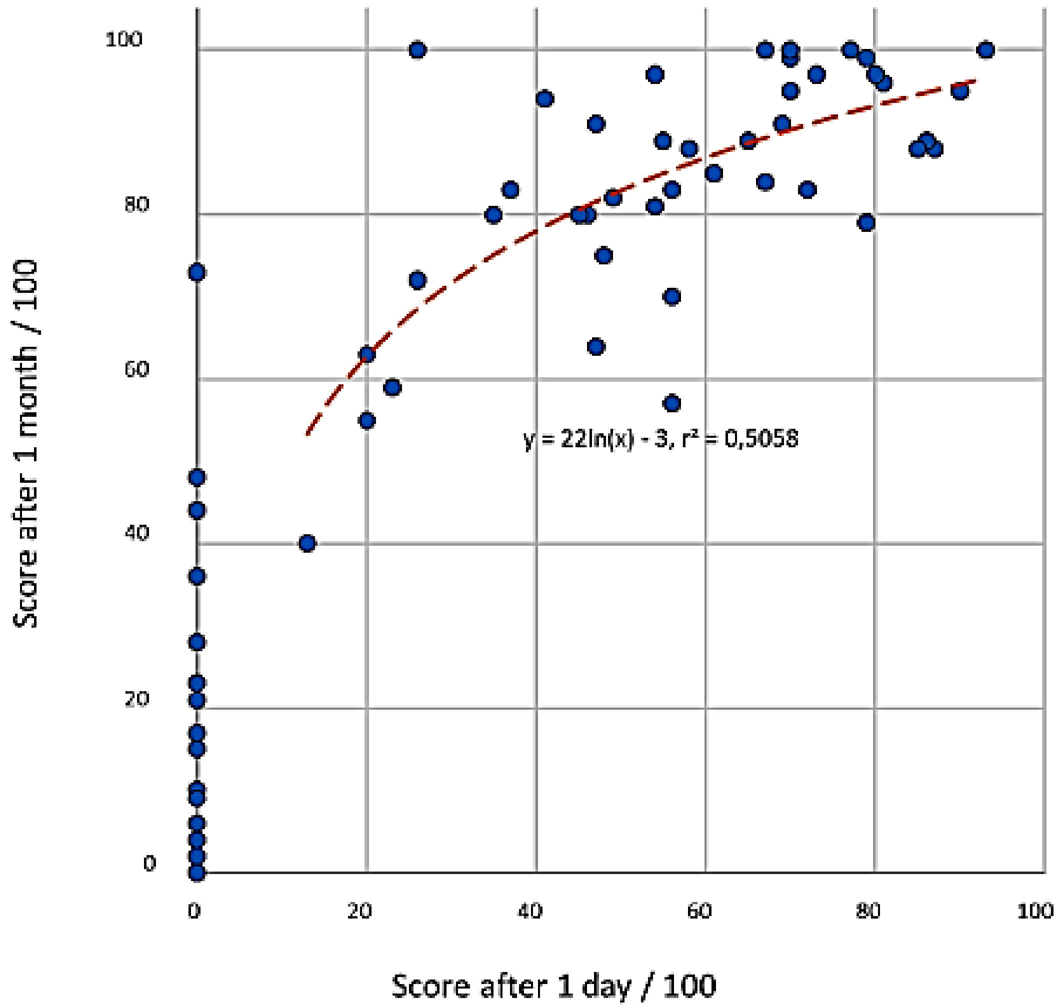
EARLY SENTENCE RECOGNITION IN ADULT COCHLEAR IMPLANT USERS

Chris James, Chadlia Karoui, Mathieu Marx, Marie-Laurence Laborde, Charles-Edouard Molinier, Benoit Lepage, Olivier Deguine, Bernard Escudé, Bernard Fraysse

Accepted for publication

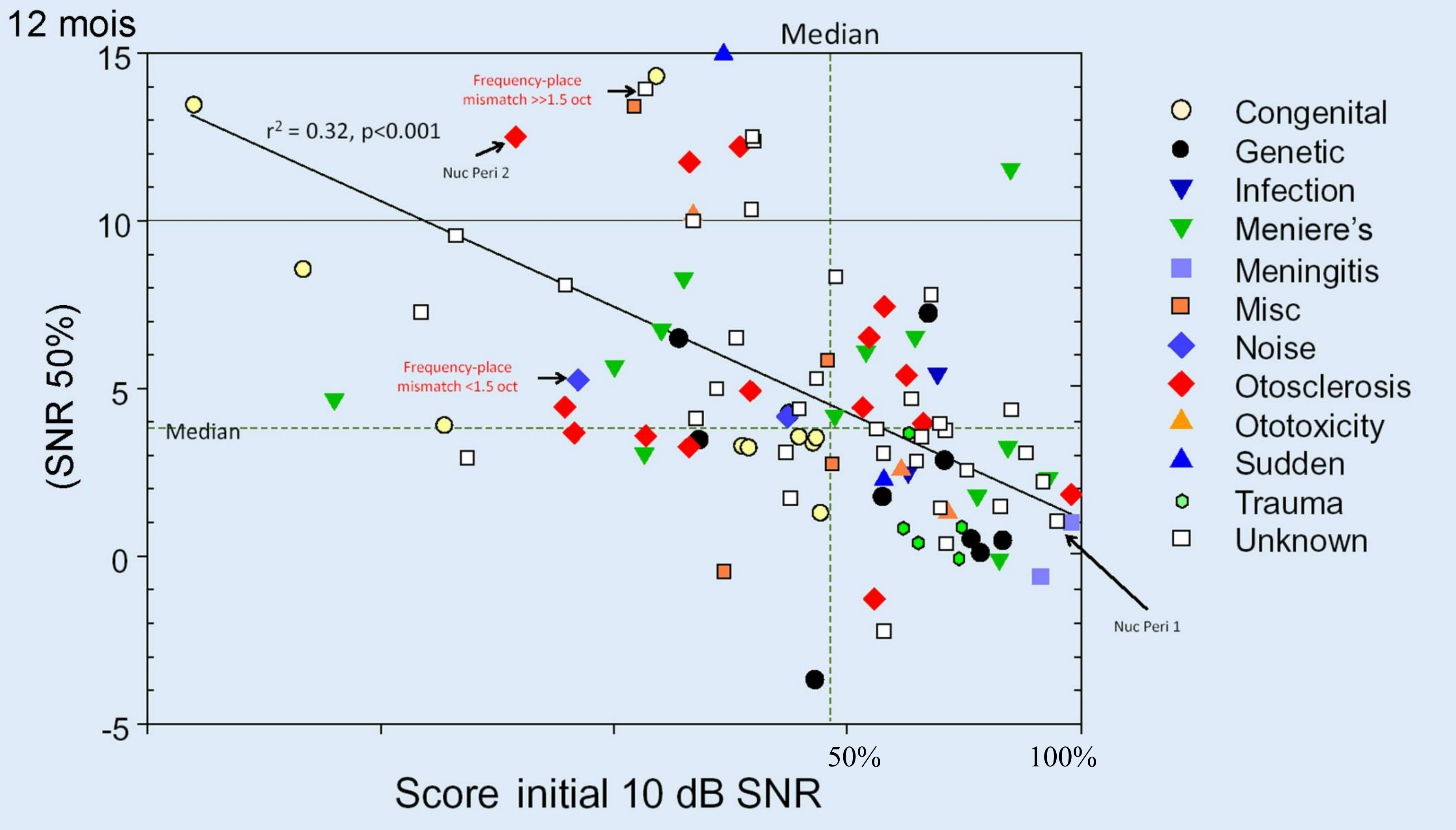
AUDITORY OUTCOMES / DELAY POSTACTIVATION

1 day / 1 month



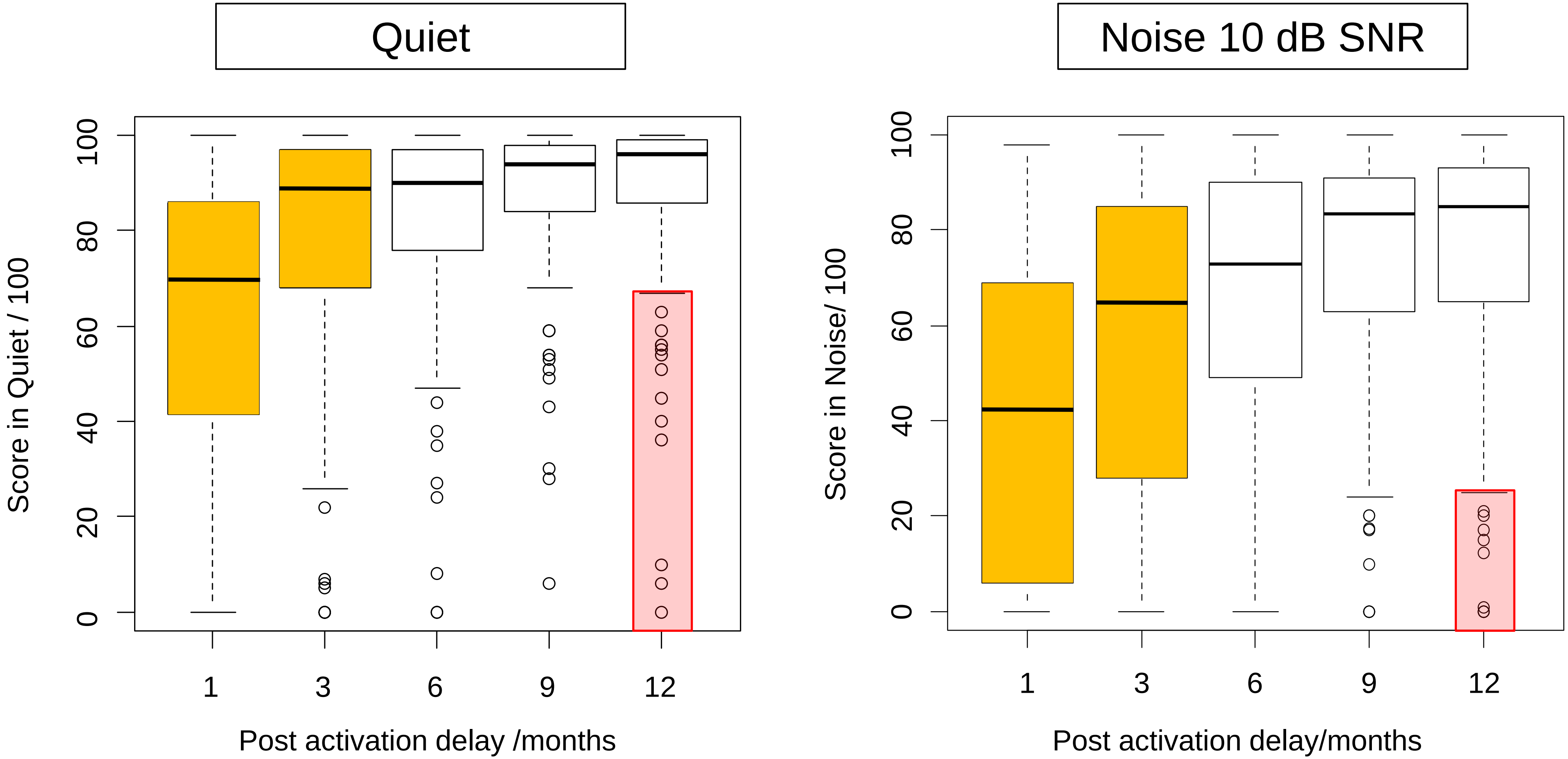
AUDITORY OUTCOMES / DELAY POSTACTIVATION

1 day / 1 month

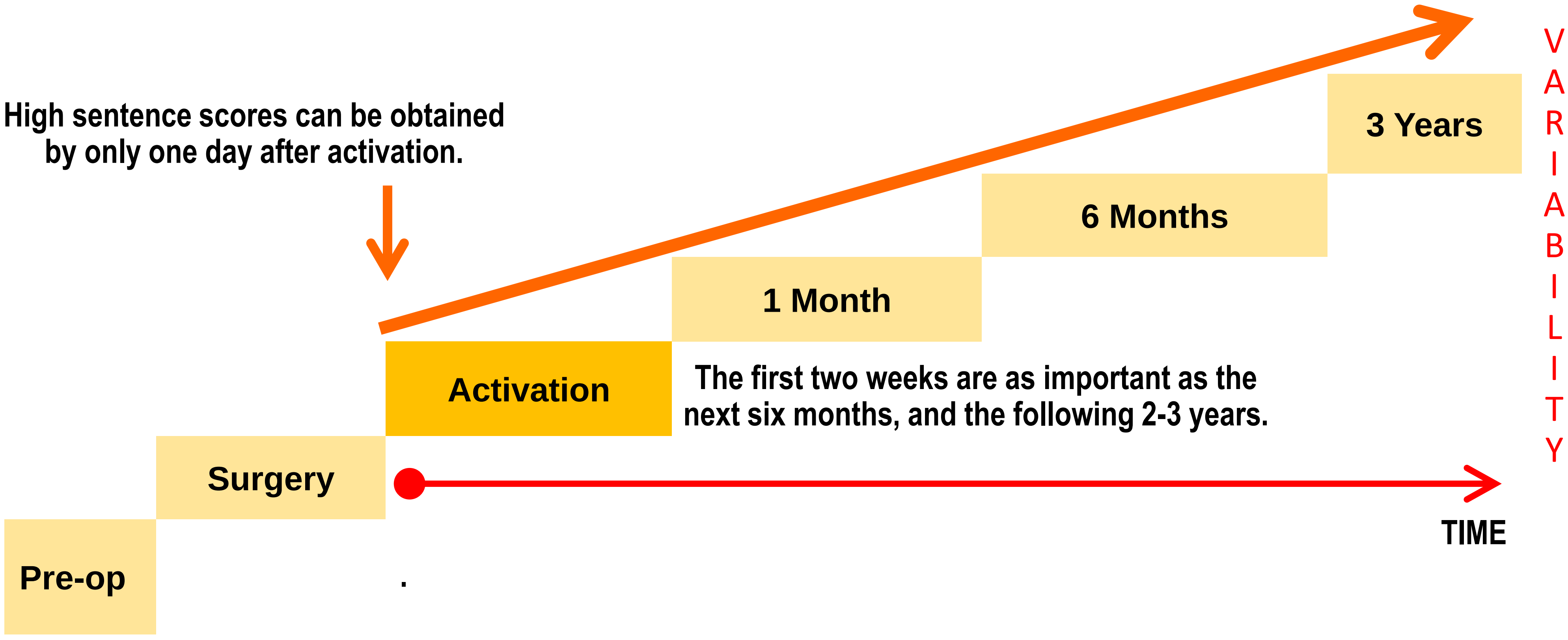


OVERAL RESULTS

N = 118



The development of speech understanding with CI does not follow a linear function with time



FACTORS TO BE CONSIDERED

- **Biographic and audiologic factors**
  - Age at implantation
  - Etiology
  - Duration of hearing loss

  Patient related

- **Anatomical and surgical factors**
  - Insertion depth of apical electrodes
  - Scala location

  Insertion technique

- **Linguistic and neurocognitive skills**

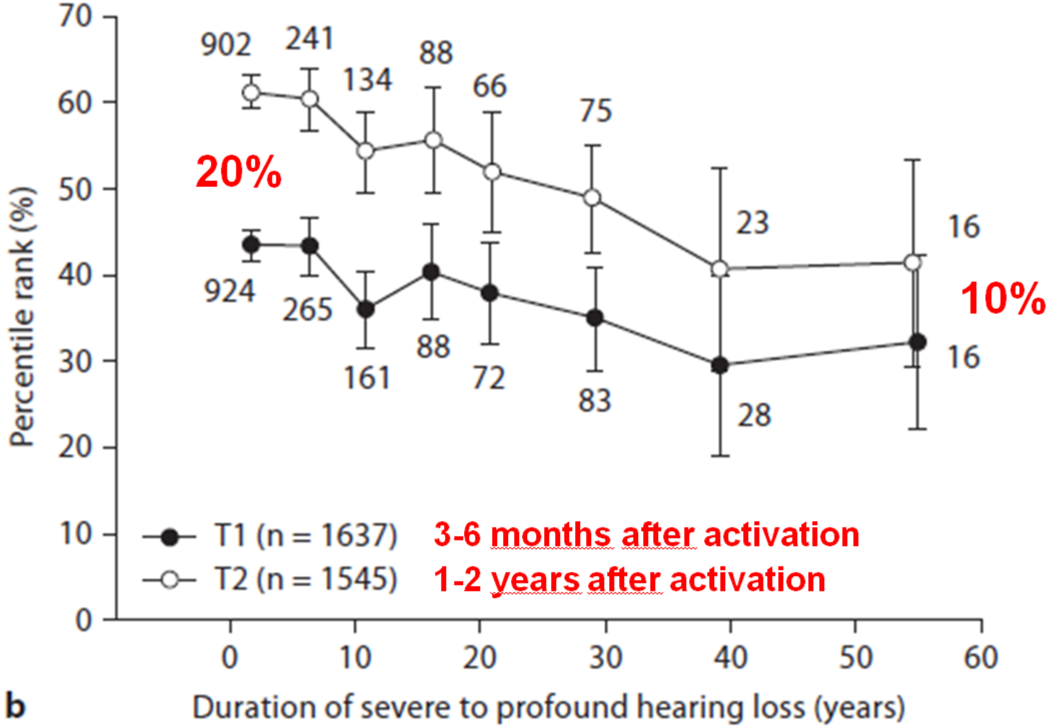
  Personalized auditory rehabilitation

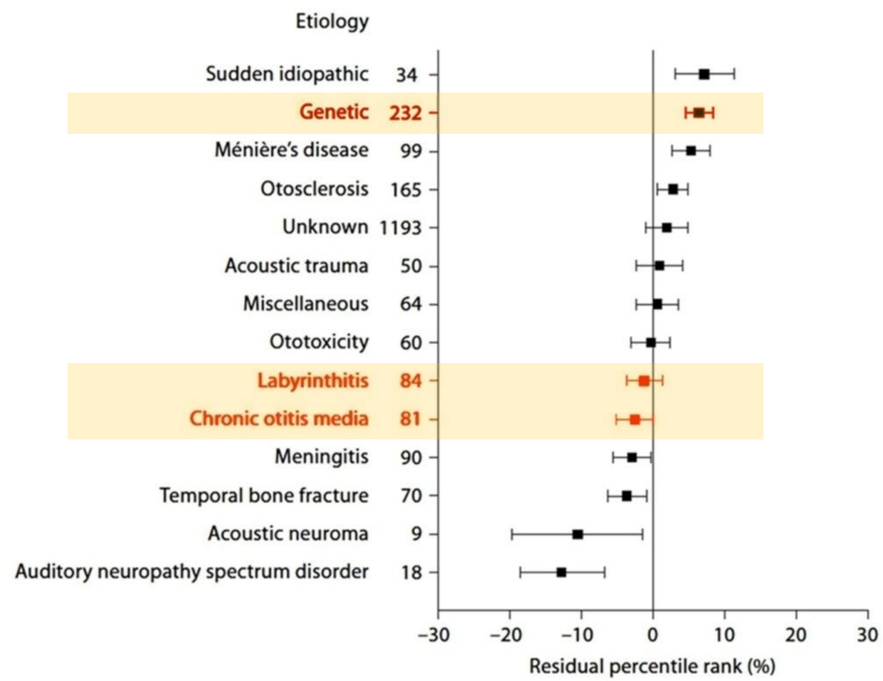
BIOGRAPHIC FACTORS

- Age at implantation : **NS**
- Duration of deafness : 9 to 12% total variance
  (*0.46 pts per year of profound HL)*
- Etiologies : 20 to 30% total variance
  (*Chronic otitis, Meniere diseases)*

BIOGRAPHIC FACTORS DATA

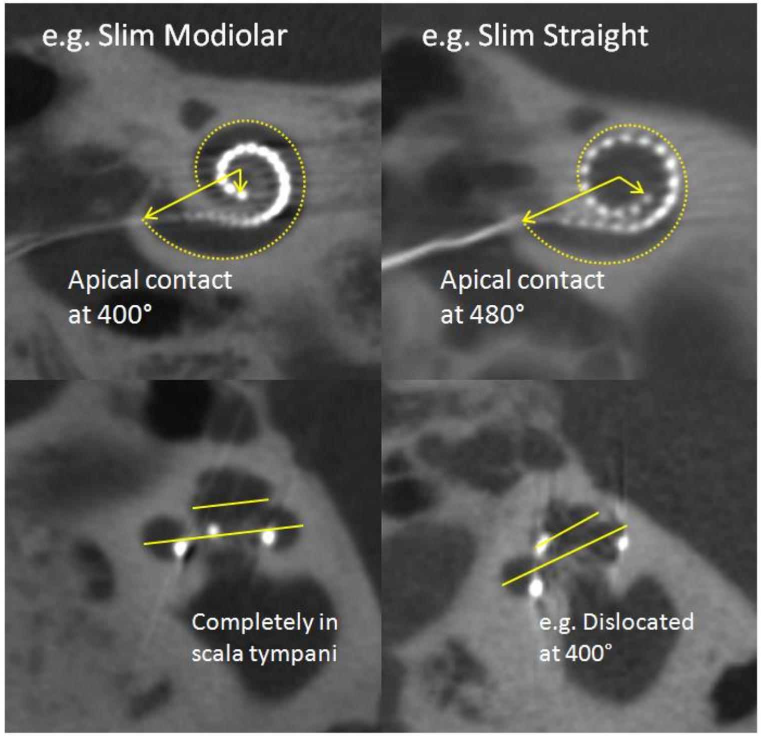
Blamey, P. J., Artières, F., Başkent, D., Bergeron, F., Beynon, A., Burke, E., ... Lazard, D. S. (2012).
Factors Affecting Auditory Performance of Postlinguistically Deaf Adults Using Cochlear Implants: An Update with 2251 Patients.
Audiology & Neuro-Otology, 2013;18(1): 36–47.





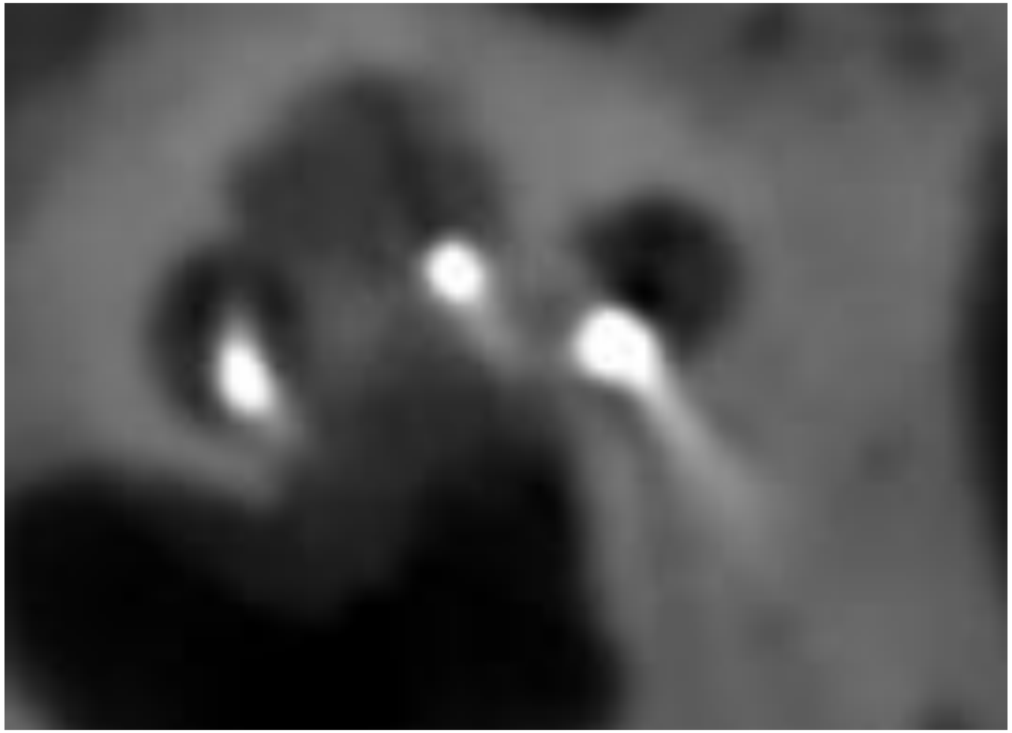
ANATOMICAL AND SURGICAL FACTORS BASED ON POSTOPERATIVE CONE BEAM

1 Insertion depth



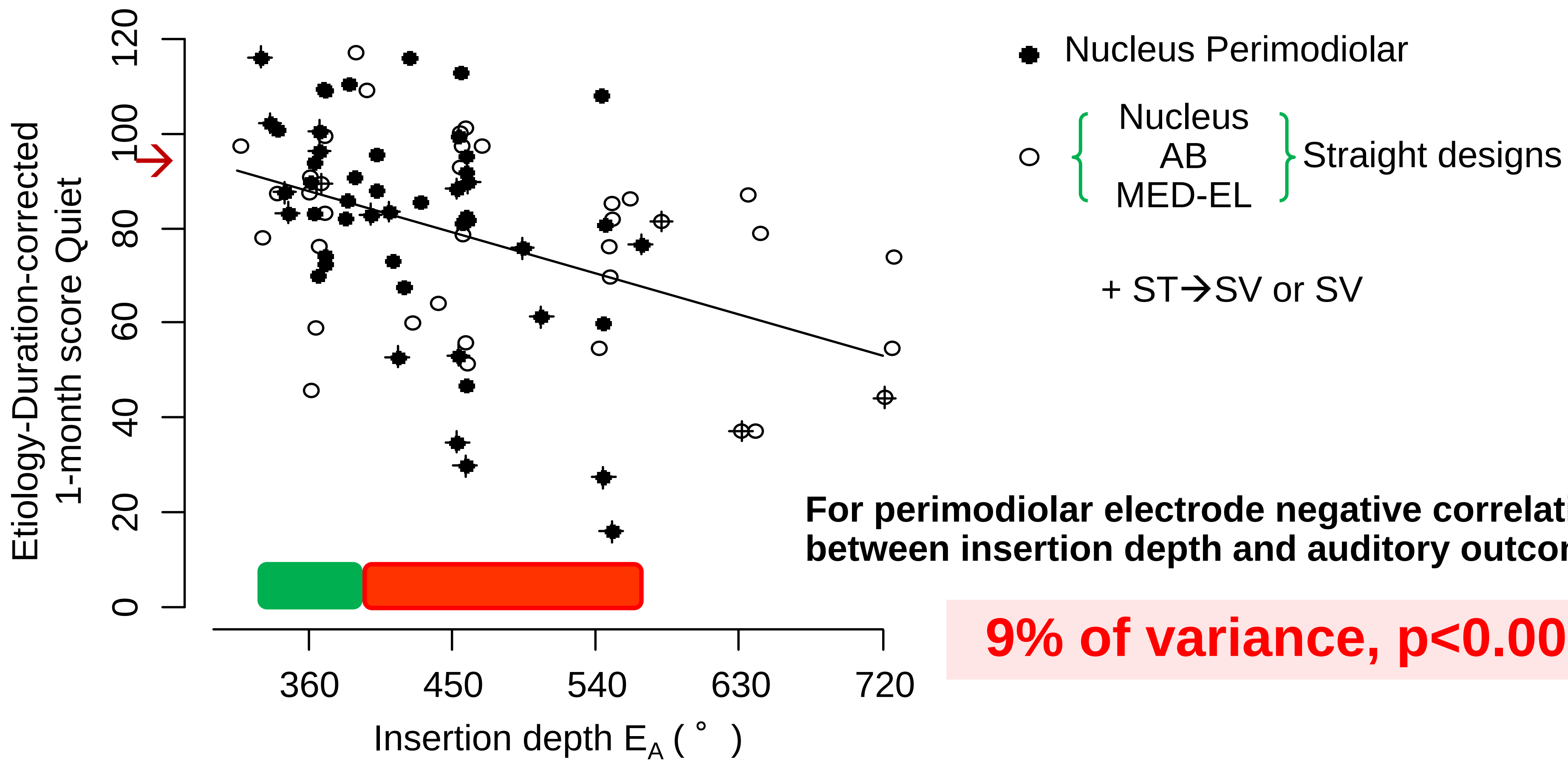
In vivo CT images: Professor Tobias Struffert, University of Erlangen.

2 Scalar location



THE EFFECT OF INSERTION DEPTH ON AUDITORY OUTCOMES

1

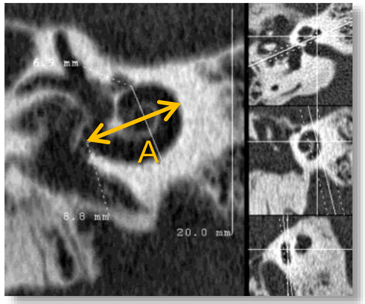


For perimodiolar electrode negative correlation between insertion depth and auditory outcomes

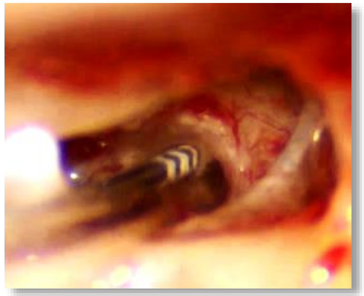
9% of variance, p<0.001

FREQUENCY ALLOCATION AND TONOTOPIC ORGANZATION

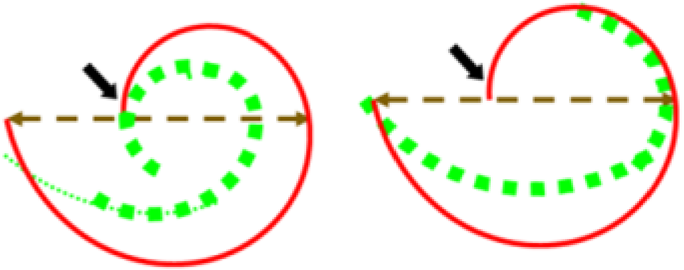
- Size of the cochlea



- Type of electrode array

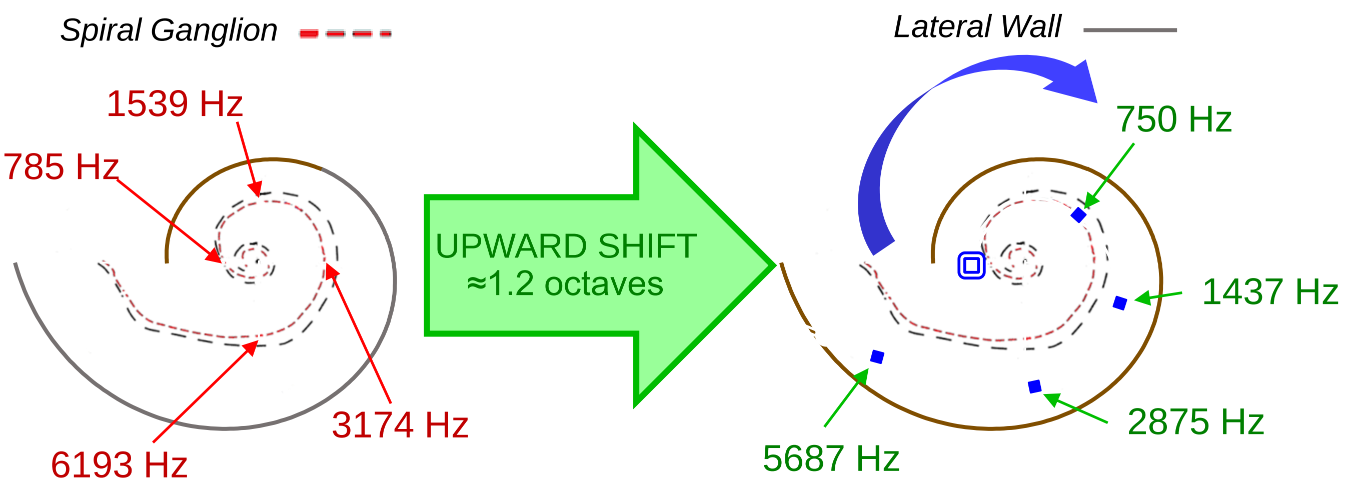


- Spacing between electrodes



FREQUENCY ALLOCATION INSERTION DEPTH

- Moderate shifts may be easily accomodated but larger shifts > 1,5 octave may affect auditory performance and the adaptation process take more time *(e.g. Li et al., 2009)*



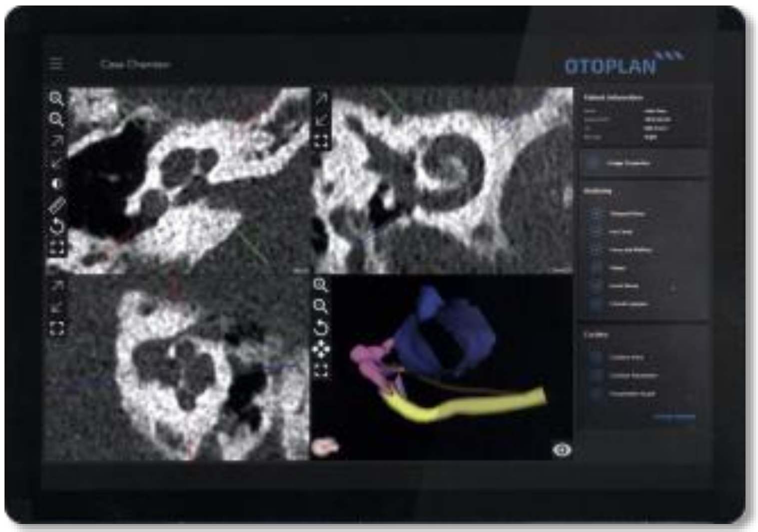
Mean spiral ganglion frequencies (Stakhovskaya et al, 2007)

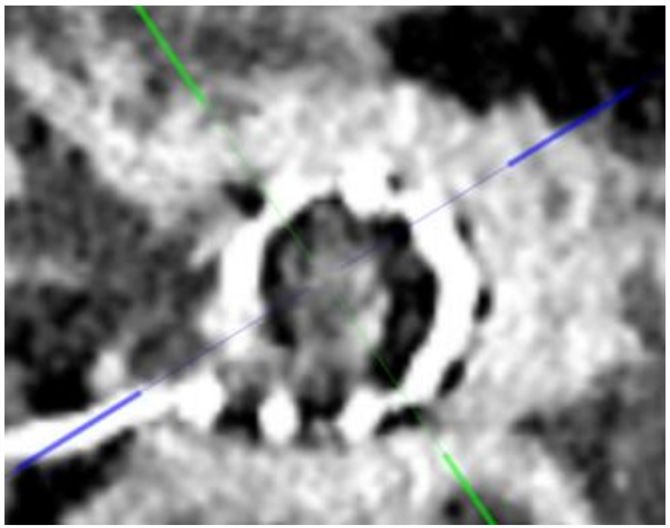
Matched sound-processor frequency to electrode allocation

HOW CAN WE OPTIMIZE FREQUENCY ALLOCATION ?

Pre op.

- By a better surgical planning based on radiological data and electrode type



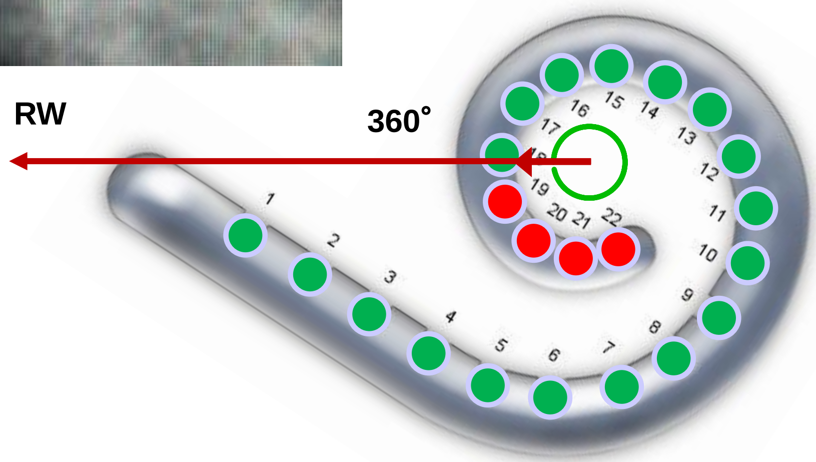


HOW CAN WE OPTIMIZE THE ELECTRODE INSERTION ?

Cochlear™

Pre op.

- By reprogramming the electrodes based on post operative insertion angle



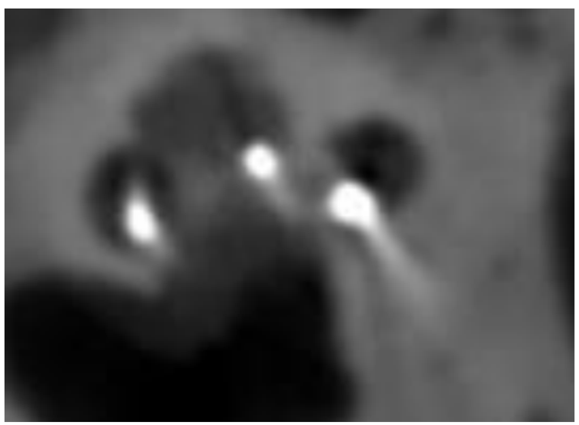
El	Angle	SG Freq	Filtre Freq	Shift Oct
1	535	335,4	149	1,17
2	460	498,3	261	0,93
3	390	724,3	408	0,83
4	325	1047,5	601	0,80
5	270	1471,4	854	0,78
6	225	1993,7	1191	0,74
7	185	2674,6	1638	0,71
8	145	3680,3	2233	0,72
9	110	4974,1	3028	0,72
10	70	7192,2	4090	0,81
11	35	10159,1	5510	0,88
12	10	13327,4	7175	0,89

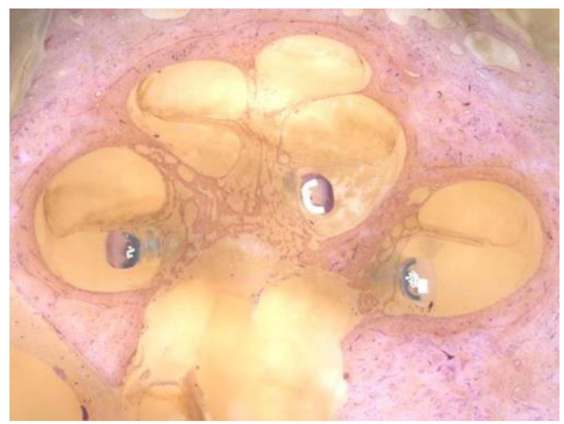
Decalage Moyen 0,83

Calcul Chris James, based on Stakhovskaya

SCALAR LOCATION

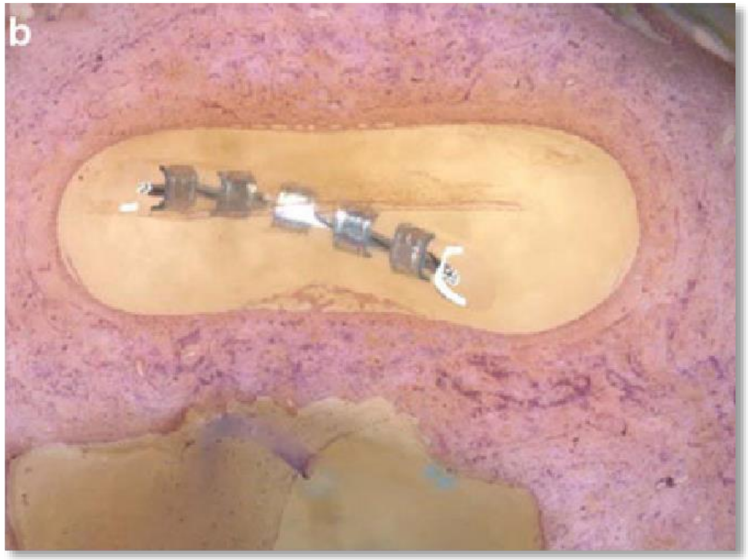
	Scala tympani	Scala vestibuli or Dislocation	
Type of electrode			
• Straight *(N : 43*)*	38 *(88%)*	5 *(12%)*	
• Perimodiolar *(N : 53**)*	33 *(62%)*	20 *(38%)*	$p < 0.01$
Depth of insertion	432°	403°	*NS*

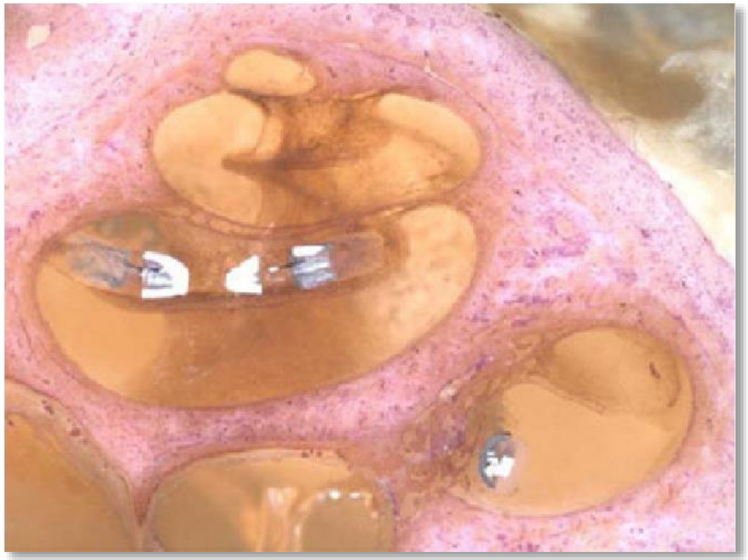




SCALAR DISLOCATION IMPACT AUDITORY OUTCOMES

- In our study the scala dislocation reduced scores by 12 - 25 pts at one year *($p<0.01$), $r^2=14\%$*





So why use a perimodiolar electrode ?

PREDICTIVE MODEL

Based on :

- Duration of deafness
- Etiologies
- Electrode insertion

PREDICTIVE MODEL OF AUDITORY PERFORMANCE

- Based on our biographic data, we may develop a mathematical model during councelling based on biographic factors
  - 90 – 0.5/yr HL – (X étiologies)

Otology & Neurotology
30:449–454 © 2009, Otology & Neurotology, Inc.

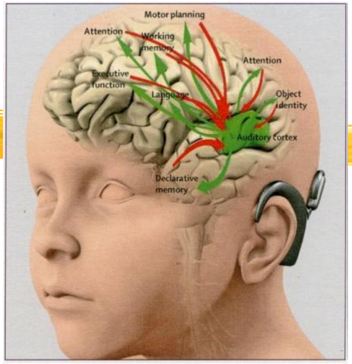
A Predictive Model of Cochlear Implant Performance in Postlingually Deafened Adults

*†Rachel E. Roditi, *‡§Sarah F. Poissant, §Eva M. Bero, and ||¶Daniel J. Lee

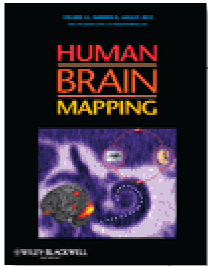
VARIANCE OF PERIPHERAL FACTORS ON OUTCOMES

	In noise	In quiet
Etiology	0.34***	0.25**
Duration of deafness per year	0.06* per year	0.08* per year
Insertion length per degree	0.09***	0.08**
Proportion of electrodes in the scala tympani	0.14**	0.13**
Total impact of peripheral factors	**41%**	**49%**

NEUROCOGNITIVE AND LINGUISTIC SKILLS



- In our study, 50 % of the variance at 1 month cannot be explained by auditory peripherical factors
- Speech discrimination in degraded condition (CI or HA to some limit) may be compensated by neurocognitive and linguistic skills
- The evolution of crossmodal plasticity is one of the underlying processes of compensatory mechanisms

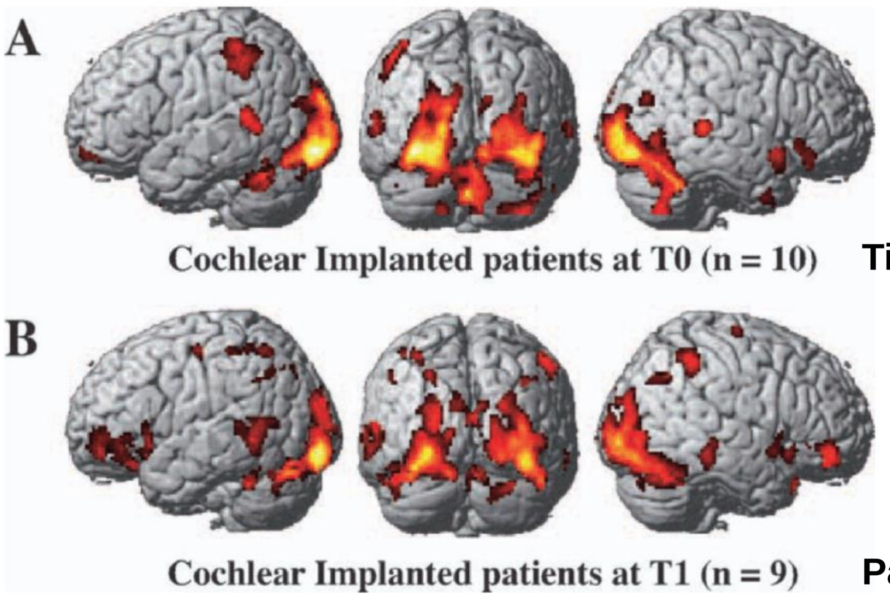


◆ Human Brain Mapping 33:1929–1940 (2012) ◆

Evolution of Crossmodal Reorganization of the Voice Area in Cochlear-Implanted Deaf Patients

Julien Rouger,[1] Sébastien Lagleyre,[2] Jean-François Démonet,[3] Bernard Fraysse,[2] Olivier Deguine,[1,2] and Pascal Barone[1]*

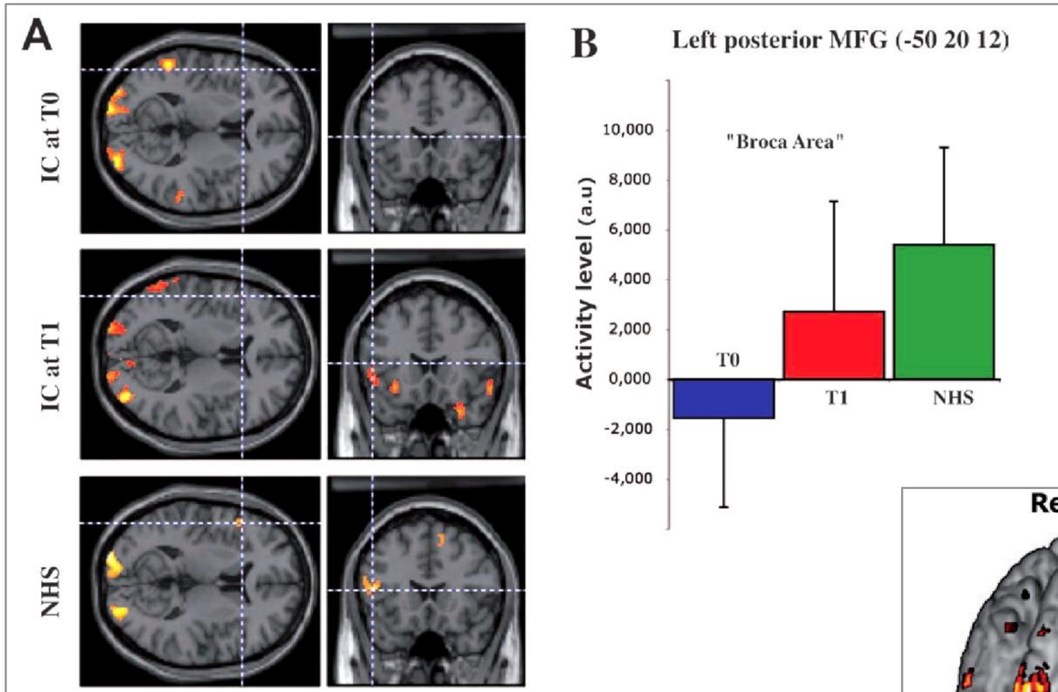
- We studied the dynamics of reversed crossmodal plasticity by TEP Brain imaging during auditory speech tracking



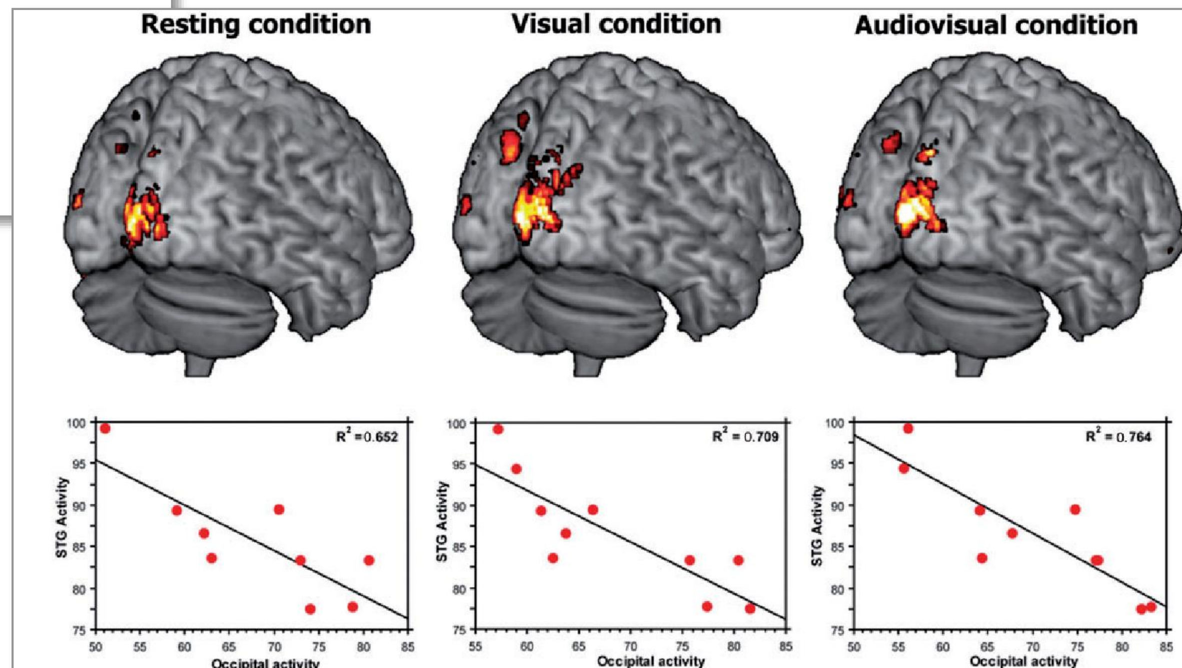
Time of activation

Patient reached 60% correct speech recognition

● Auditory stimulation determined a reactivation of auditory cortical areas but also a crossmodal reorganization of the cortical visual network



● Clear correlation between individual visual and auditory brain activity and auditory outcomes



THE IMPORTANCE OF AUDITORY AND COGNITIVE REHABILITATION STRATEGIES

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Postoperative Rehabilitation Strategies Used by Adults With Cochlear Implants: A Pilot Study

Michael S. Harris, MD; Natalie R. Capretta, BS; Shirley C. Henning, MS, CCC-SLP; Laura Feeney, AuD; Mark A. Pitt, PhD; Aaron C. Moberly, MD

- This article confirm the interest to develop specific rehabilitation strategies according to early outcomes in auditory and audiovisual conditions

ON WHICH BASIS DEVELOP PERSONALIZED REHABILITATION STRATEGIES?

JSLHR

Research Article

Speech Recognition in Adults With Cochlear Implants: The Effects of Working Memory, Phonological Sensitivity, and Aging

Aaron C. Moberly,[a] Michael S. Harris,[a] Lauren Boyce,[a] and Susan Nittrouer[b]

- Optimization of the rehabilitation must take into account the level of :

❶ Phonemic sensitivity and lexical knowledge

❷ Cognitive factors

- → Speed of processing
- → Working memory and attention
- → Executive function

} Depend

One month results → Normal performer → Conventional rehabilitation

One month results → Poor performer

Poor performer → Auditory evaluation on objective method

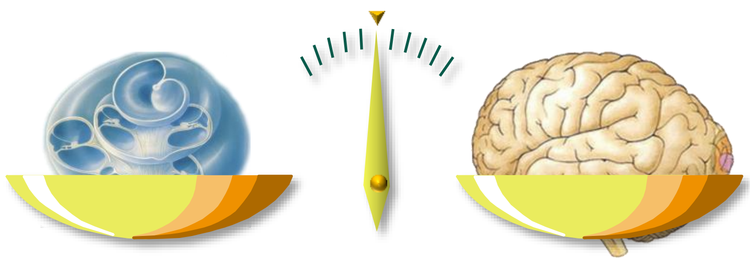
- Frequency allocation
- Scalar location

} X-Ray

- Speed of stimulation refractory period
- Channel selectivity spread of excitation

Poor performer → Working memory and phonological sensitivity evaluation

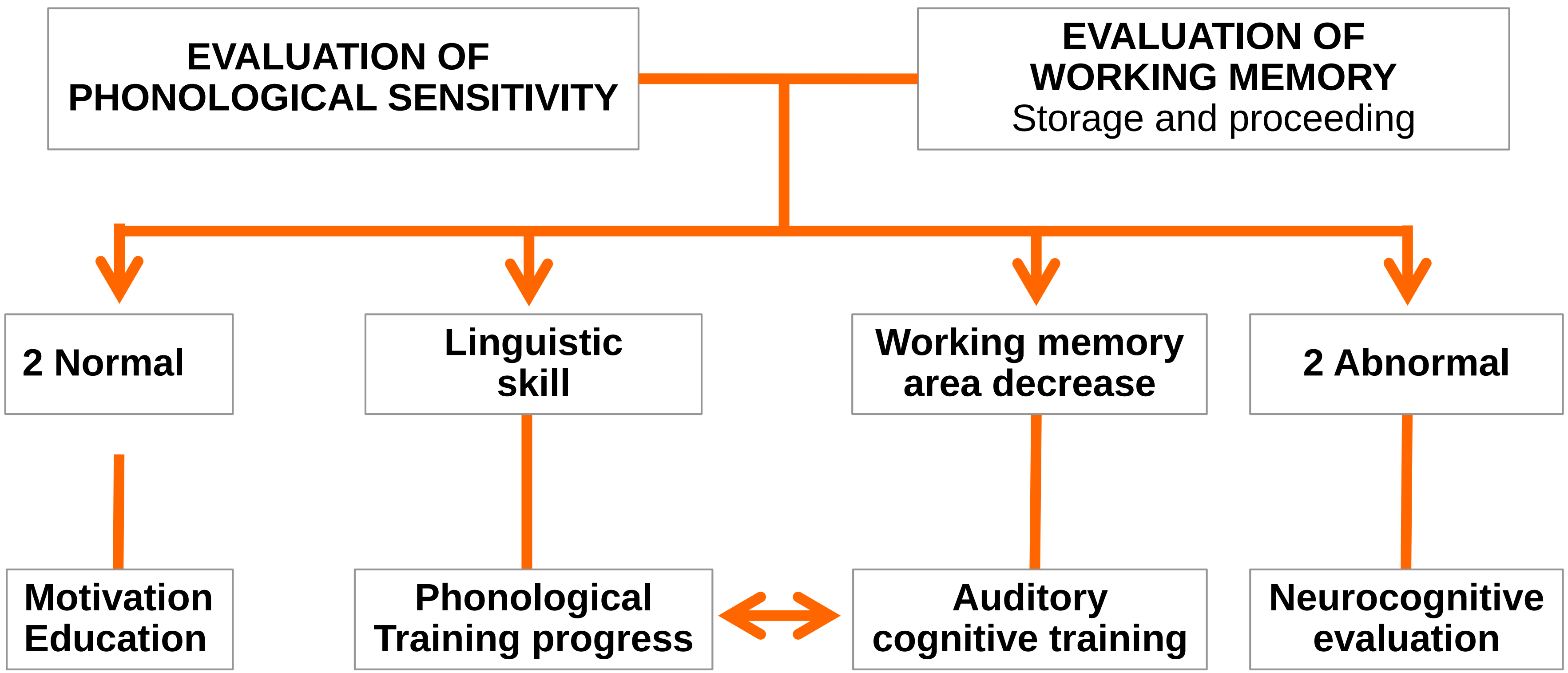
Personalized auditory rehabilitation



« Bottom up » approach

« Top down » approach

PERSONALIZED REHABILITATION PROGRAM



TIMING OF INTERVENTION

Predictive Model Councelling patient	Electrode insertion Surgical planning	Optimized Fitting	Sentence recognition score Compare to predictive model	SNR50 as expected ?
Hearing story	Size of cochlea	X-Ray electrophysiological	❶ Data log	Data log
Etiology	Type of electrode	Frequency allocation	❷ Lexical knowledge	Loudness growth
			❸ Spread of excitation Recovery period	**6 MONTHS**
		→ Evaluate 2 programs	**1 MONTH**	
		ACTIVATION		→ MAP rehabilitation refinement
	SURGERY		Cognitive or auditory } Training	
PRE OP				

CONCLUSION

- Counseling patients with realistic expectations and take into account the patient's goals (GAS)
- Electrode insertion should avoid dislocation and be adapted to the tonotopic organization
- Develop personalized rehabilitation programs and material based on early outcomes and targeted on specific weaknesses

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Thank you for your attention