A DEEP DIVE ON MASKING RESEARCH: IMPLICATIONS FOR PRACTICE?

SATURDAY, OCTOBER 17, 2026

CAA CONFERENCE

MONCTON, NEW BRUNSWICK

“MASKING REDUX I: AN OPTIMIZED METHOD OF MASKING”

Robert Turner; 2004

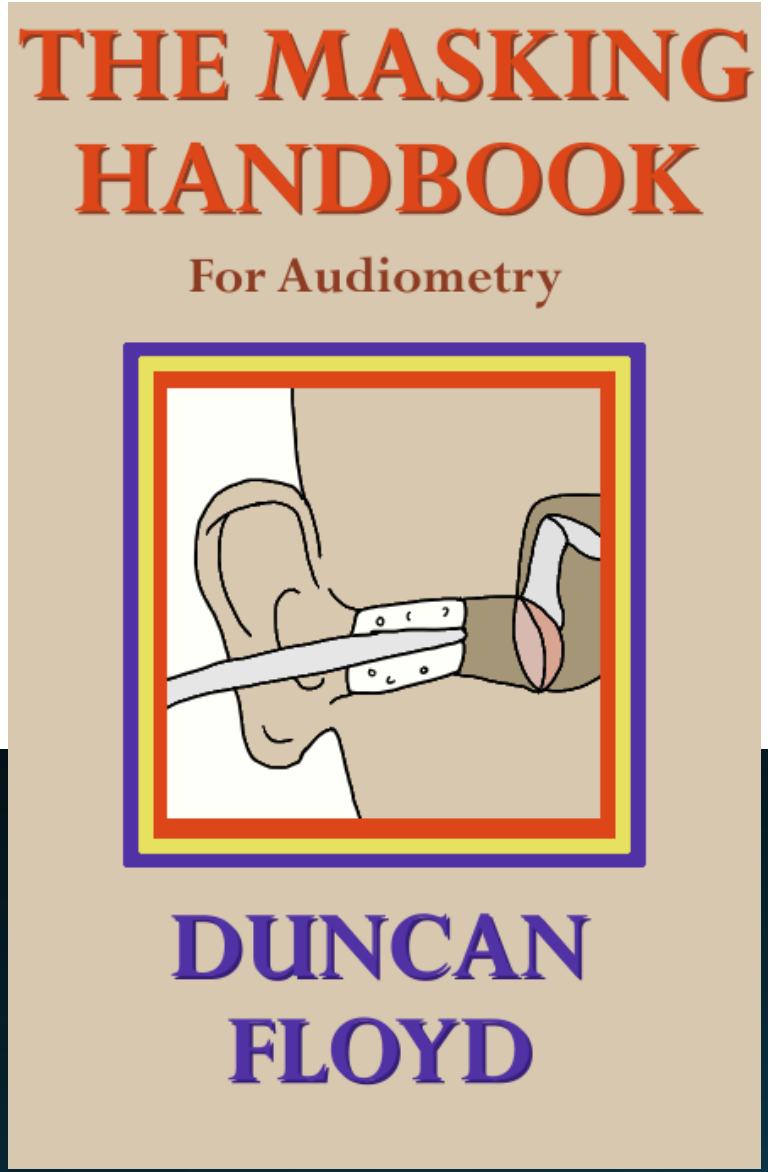
“Students rank **masking** with **immittance…**as the…most **tedious**, **confusing** subjects…what topic could be more **boring** than masking?”

WELCOME

- 30 years audiologist: Nova Scotia, Labrador, China, USA
- Dalhousie University, School of Communication Sciences and Disorders: **MASKING, ACOUSTIC IMMITTANCE**
- ENT
- Accessible Hearing Solutions Inc.

THE MASKING HANDBOOK (FOR AUDIOMETRY)

DISCLOSURE



OUTLINE

Textbook recommendations: review on some topics

Lit data review: IA, OE

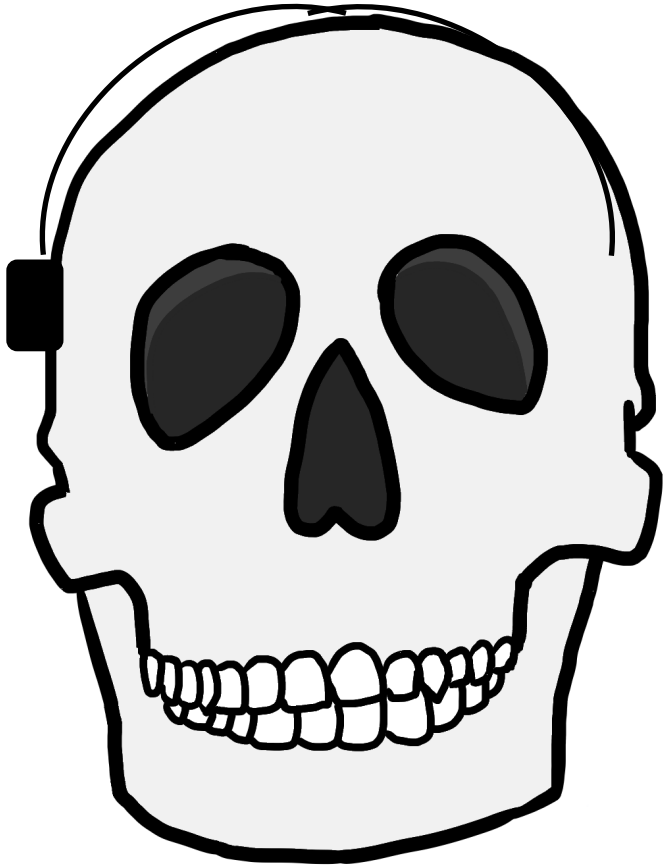
6 papers highlighted

- Interaural attenuation
- Optimized Method of masking

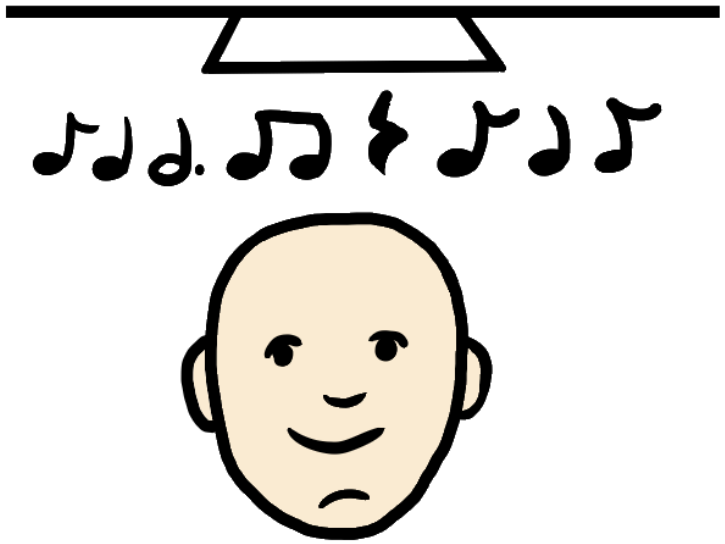


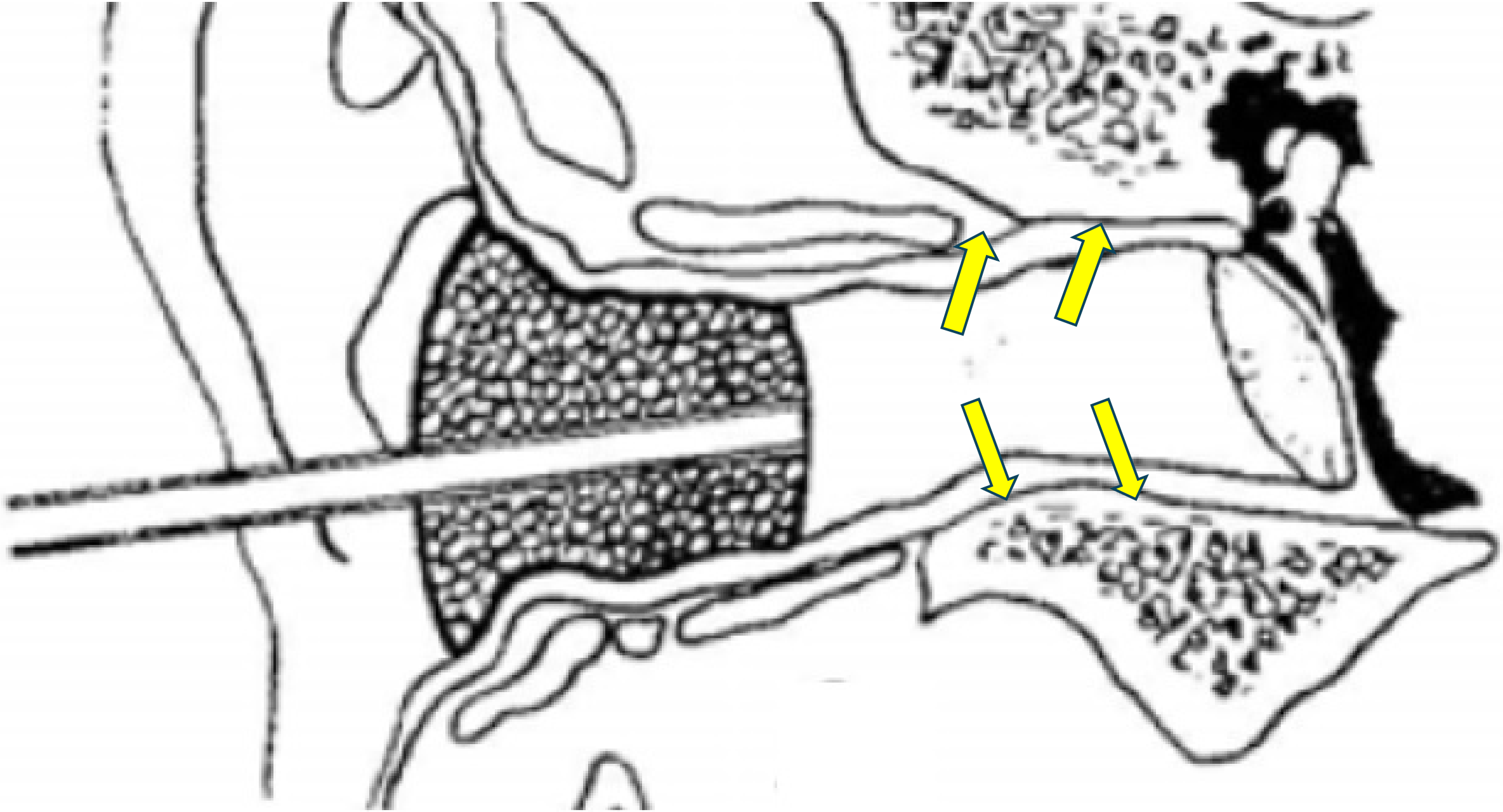
- Central masking
- Occlusion Effect

B/C signals are not ear specific



=





INTERAURAL ATTENUATION

INTERAURAL **ATTENUATION**: WHAT IS IT?

- Snyder, 1973: "The **reduction in auditory sensitivity** as it passes across the cranium…"
- Smith and Markides, 1981: "The **reduction in the intensity** of the test signal as it crosses the skull…"
- Sklare and Denenberg, 1987: "The **amount of 'acoustic isolation'** between the two auditory peripheries."

- **The Concise Oxford Dictionary, Fifth Edition**
  - *Inter: "between"*
  - *Aural: "pertaining to the organ of hearing"*
  - *Attenuation**: "reduction in force or value"***

INTERAURAL **ATTENUATION**: WHAT IS IT?

- Snyder, 1973: "The **reduction in auditory sensitivity** as it passes across the cranium…"
- Smith and Markides, 1981: "The **reduction in the intensity** of the test signal as it crosses the skull…"
- Sklare and Denenberg, 1987: "The **amount of 'acoustic isolation'** between the two auditory peripheries."

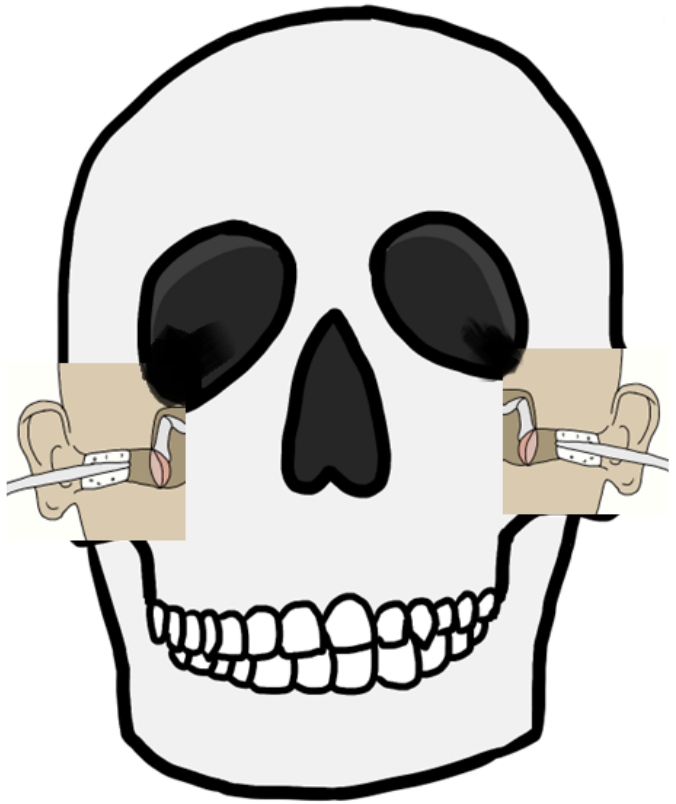
- **The Concise Oxford Dictionary, Fifth Edition**
  - *Inter: "between"*
  - *Aural: "pertaining to the organ of hearing"*
  - *Attenuation**: "reduction in force or value"***

Poor branding?

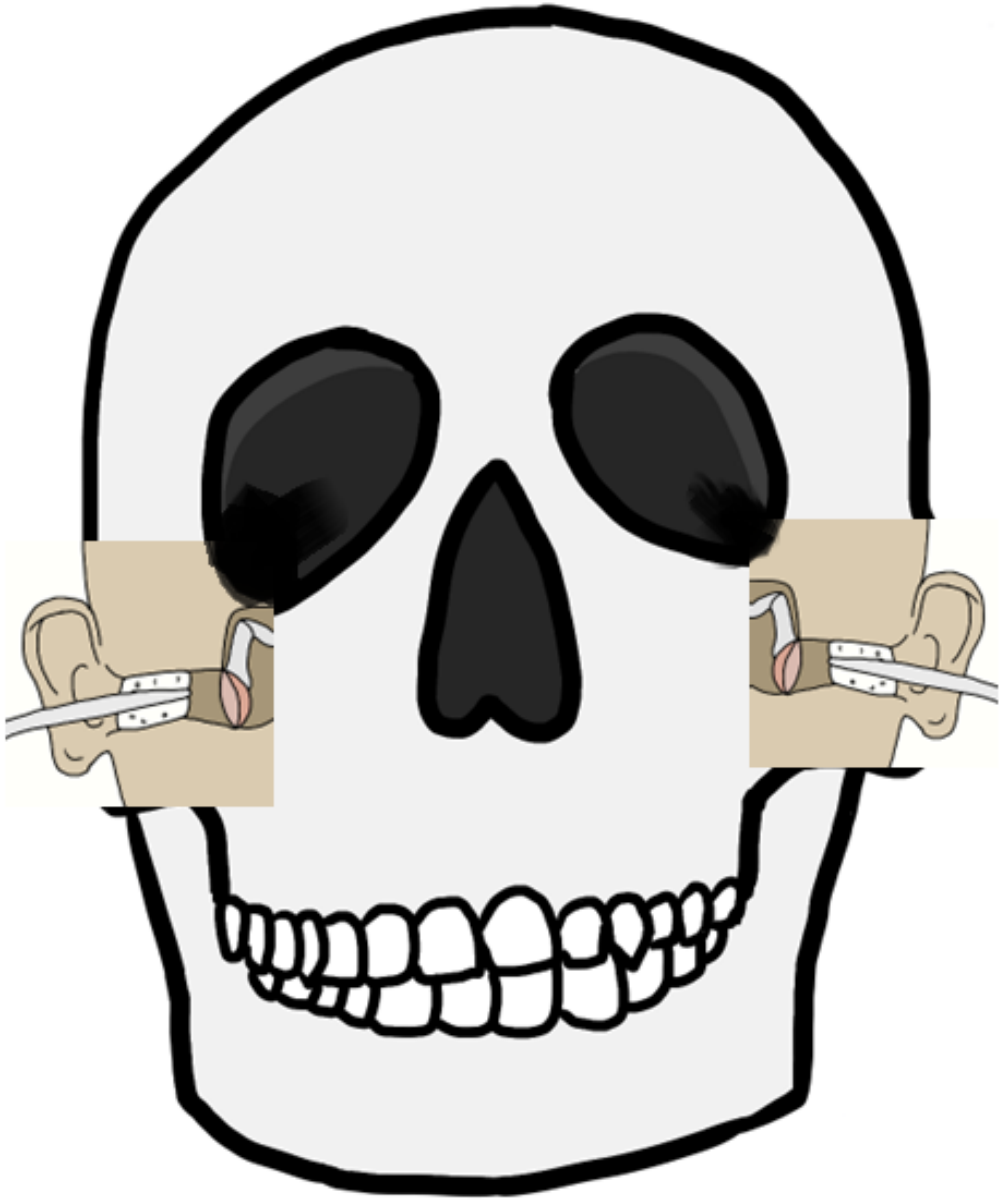
RESEARCH DESIGN FOR QUANTIFYYING IA

HOW...

- IS IA MEASURED?
- ARE IA VALUES DEFINED?



PROFOUND SNHL



WNLs

NORMAL MIDDLE EAR FUNCTION

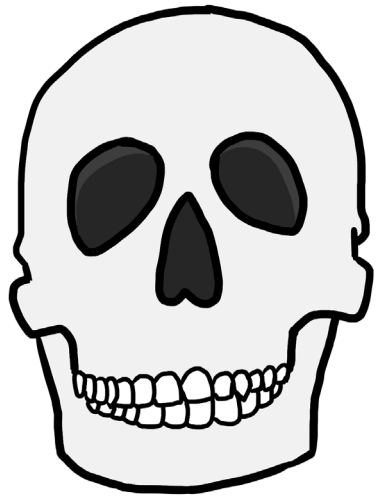
INTERAURAL ATTENUATION: REFLECTION

- The term “attenuation” **focuses attention** on the amount of **blockage** from one side to the other

- But IA values are defined by the intensity point at which the **sound radiates to, and can be heard by**, the opposite ear

IA = SNHL – HE

IA = 80 - 10



IA QUANTIFIED AT LEVEL OF CROSS-HEARING



IA CAN BE VIEWED THROUGH DIFFERENT LENSES

LENS #1: minIA

- The minimum-possible amount of attenuation that is known for a transducer

(And for a specific frequency?)

- Clinical values used for audiometric decision-making: when do we need to mask?

“IA” = minIA = potCH

- minIA as the **potential Cross-Hearing value (potCH)**
- Using an IA value of 50?
- If there’s a 50 dB minIA/potCH difference from one side to the other, then masking is required

TYPICAL minIA = potCH

- SUPRA-AURAL HEADPHONES (e.g., TDH) **40 dB**
- INSERT EARPHONES **50 dB**
- RADIOEAR BONE CONDUCTOR **0 dB**

minIA/potCH

INTERAURAL ATTENUATION: AUTHOR RECOMMENDATIONS

YEAR	AUTHORS	INSERTS [dB]	SUPRA-AURAL [dB]	BONE [dB]
1988	Larson-Donaldson	n/a	40	n/a
1991	Dennis and Neely	n/a	40	0
1991	Silman and Silverman	50	40	0 - 15
1992	Staab	n/a	35-50	0
1994	Goldstein and Newman (Katz ed.)	n/a	40 to 50	0
1997	Hall and Mueller	55 to 85	45 to 60	n/a
1998	Stach	50	40	0
2000	Roeser and Clark (Roeser et al ed.)	n/a	40	0
2000	Martin and Clark	n/a	40	0
2009	Valente	50	40	n/a
2015	Yacullo (Katz ed.)	75 to 50	40	0

minIA/potCH

INTERAURAL ATTENUATION: AUTHOR RECOMMENDATIONS

YEAR	AUTHORS	INSERTS [dB]	PRA-AURAL [d	BONE [dB]
1988	Larson-Donaldson	n/a	40	n/a
1991	Dennis and Neely	n/a	40	0
1991	Silman and Silverman	50	40	0 - 15
1992	Staab	n/a	35-50	0
1994	Goldstein and Newman (Katz ed.)	n/a	40 to 50	0
1997	Hall and Mueller	55 to 85	45 to 60	n/a
1998	Stach	50	40	0
2000	Roeser and Clark (Roeser et al ed.)	n/a	40	0
2000	Martin and Clark	n/a	40	0
2009	Valente	50	40	n/a
2015	Yacullo (Katz ed.)	75 to 50	40	0

TRANSDUCER	N TOTALS
SUPRA-AURAL HEADPHONES	314
RADIOEAR BONE CONDUCTION	174
INSERT EARPHONES	53***

LENS 2 & LENS 3

SUPRA-AURAL HEADPHONES



TDH-STYLE PHONES		250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	80
SNYDER; 1973	max	70	75	75	80		85		80
SMITH & MARKIDES; 1981	max	85	75	85	70		65		
KILLION ET AL; 1985	max	65	65	65	66	67	73		
MUNRO & AGNEW; 1999	max	71	71	72	71	82	82	82	80
BRANNSTROM/LANTZ; 2010	max	65	64	80	64	77	87	66	78

75-85

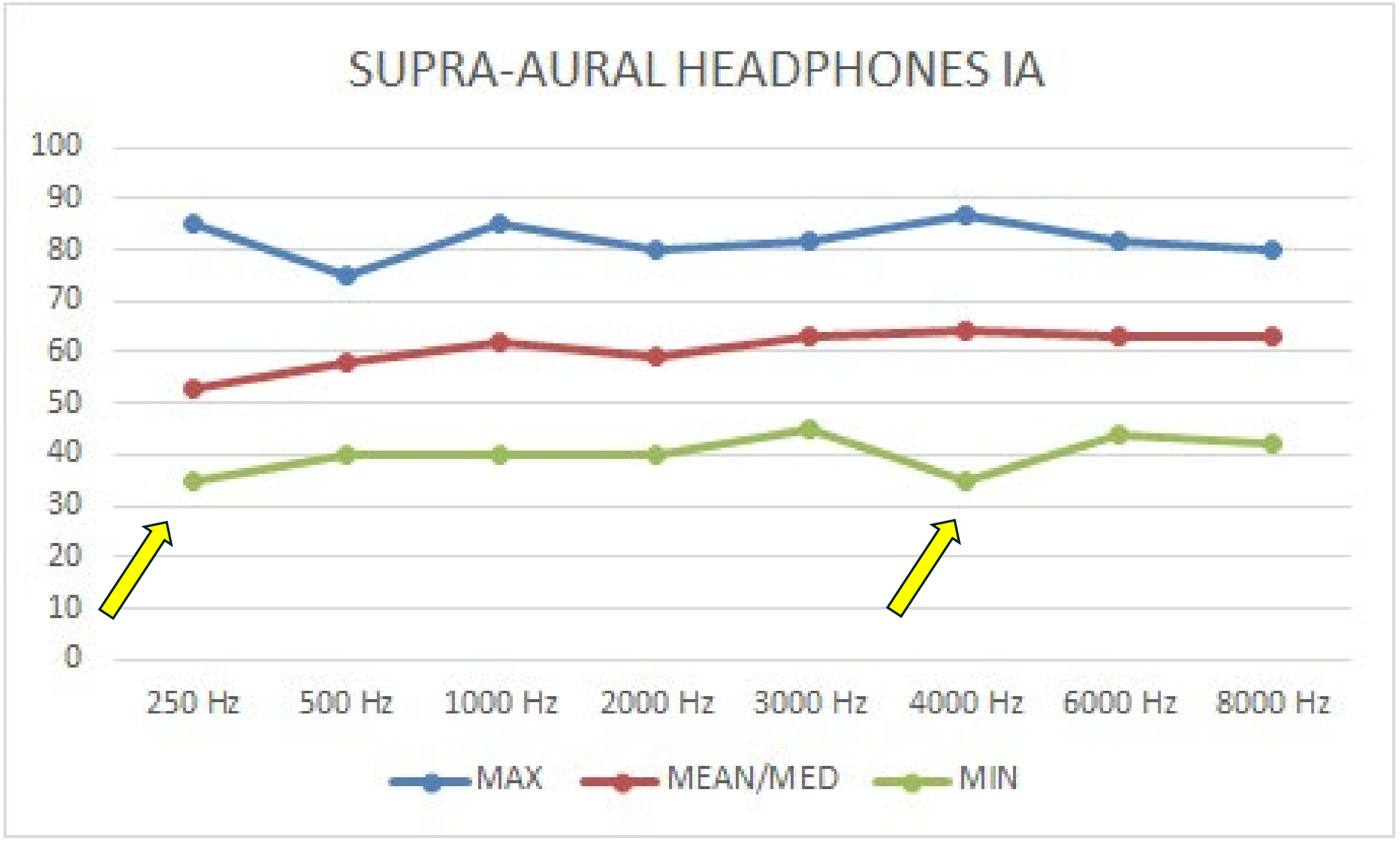
minIA

TDH		250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
FELDMAN; 1963	MEAN	48	51	58			60		
SNYDER; 1973	MEAN	51	58	60	60		63		58
SMITH & MARKIDES; 1981	MEAN	55	55.5	62.7	54.1		52.3		
KILLION ET AL; 1985	MEAN	50	60	60	59	60	62		
SKLARE & DENENBERG; 1987	MEAN	54	59	62	58	57	65	65	
BRANNSTROM/LANTZ; 2013	MEAN	54	58	65	55	63	64	59	69
PALVA AND PALVA; 1962	MEAN		58	53	50		52		
GYLLENCREUTZ AND LIDEN; 1967	MEAN	55	60	62	65		70		
COLES AND PRIEDE; 1970	MEAN	61	63	63	63		68		60
CHAIKLIN; 1967	MEAN	51	59	61	61		70		57
MUNRO & AGNEW; 1999	MEDIAN	59	55	60	58	68	67	67	65
RAMOS ET AL; 2	MEDIAN	48	60	76	67	69	71	61	68
		53.2727	**58.0417**	**61.8917**	**59.1**	**63.4**	**63.6917**	**63**	**62.8333**

55-65

TDH-STYLE PHONES		250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz	6000 Hz	8000 Hz
SNYDER; 1973	min	35	45	40	40		40		
SMITH & MARKIDES; 1981	min	35	40	45	40		35		
KILLION ET AL; 1985	min	45	52	52	50	50	52		
SKLARE & DENENBERG; 1987	min	45	45	60	45	45	60	50	
MUNRO & AGNEW; 1999	min	48	44	48	44	56	50	44	42
BRANNSTROM/LANTZ; 2010	min	46	51	51	44	54	55	49	59

35-45


SUPRA-AURAL HEADPHONES IA
100
90
80
70
60
50
40
30
20
10
0
250 Hz
500 Hz
1000 Hz
2000 Hz
3000 Hz
4000 Hz
6000 Hz
8000 Hz
MAX
MEAN/MED
MIN

INSERT EARPHONES

INSERT EARPHONES: INTERAURAL ATTENUATION DATA

		250 Hz	500 Hz	1000 Hz	2000 Hz	3000 Hz	4000 Hz
KILLION ET AL; 1985	max	100	110	88	86	90	95
SKLARE & DENENBERG; 1987	max	>100	105	90	90	80	85
MUNRO & AGNEW; 1999	max	103	96	86	82	96	98
MUNRO/CONTRACTOR; 2010	max	95	94	92	72	84	88
FELDMAN; 1963	MEAN	73	73	75			71
KILLION ET AL; 1985	MEAN	90	98	82	70	79	80
SKLARE & DENENBERG; 1987	MEAN	>94	89	81	71	69	77
MUNRO & AGNEW; 1999	MEDIAN	89	83	76	68	77	82
MUNRO/CONTRACTOR; 2010	MEDIAN	84	81	73	68	77	76
RAMOS ET AL; 2009	MEDIAN	85	85	76	67	69	71
GUMUS ET AL; 2016	MEAN	94	89	81	74		71
KILLION ET AL; 1985	MIN	85	90	79	60	68	72
SKLARE & DENENBERG; 1987	MIN	>75	85	75	55	50	60
MUNRO & AGNEW; 1999	MIN	72	64	58	56	58	72
MUNRO/CONTRACTOR; 2010	MIN	64	50	56	54	60	64
RAMOS ET AL; 2009	MIN	45	70	60	45	60	60
GUMUS ET AL; 2016	MIN	85	80	75	65		55

minIA

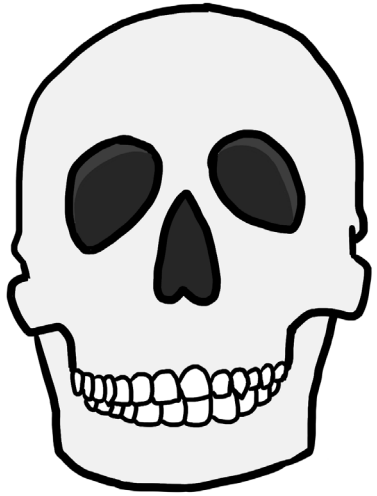
85-105

70-80

50-60

BONE-CONDUCATION IA

(HEH HEH)



B/C **IA [potCH]**

- Recommended value for audiometry = 0 dB
- We use 0 dB because that's the **minIA/potCH** value for bone-conduction
- Right?

PROFOUND SNHL

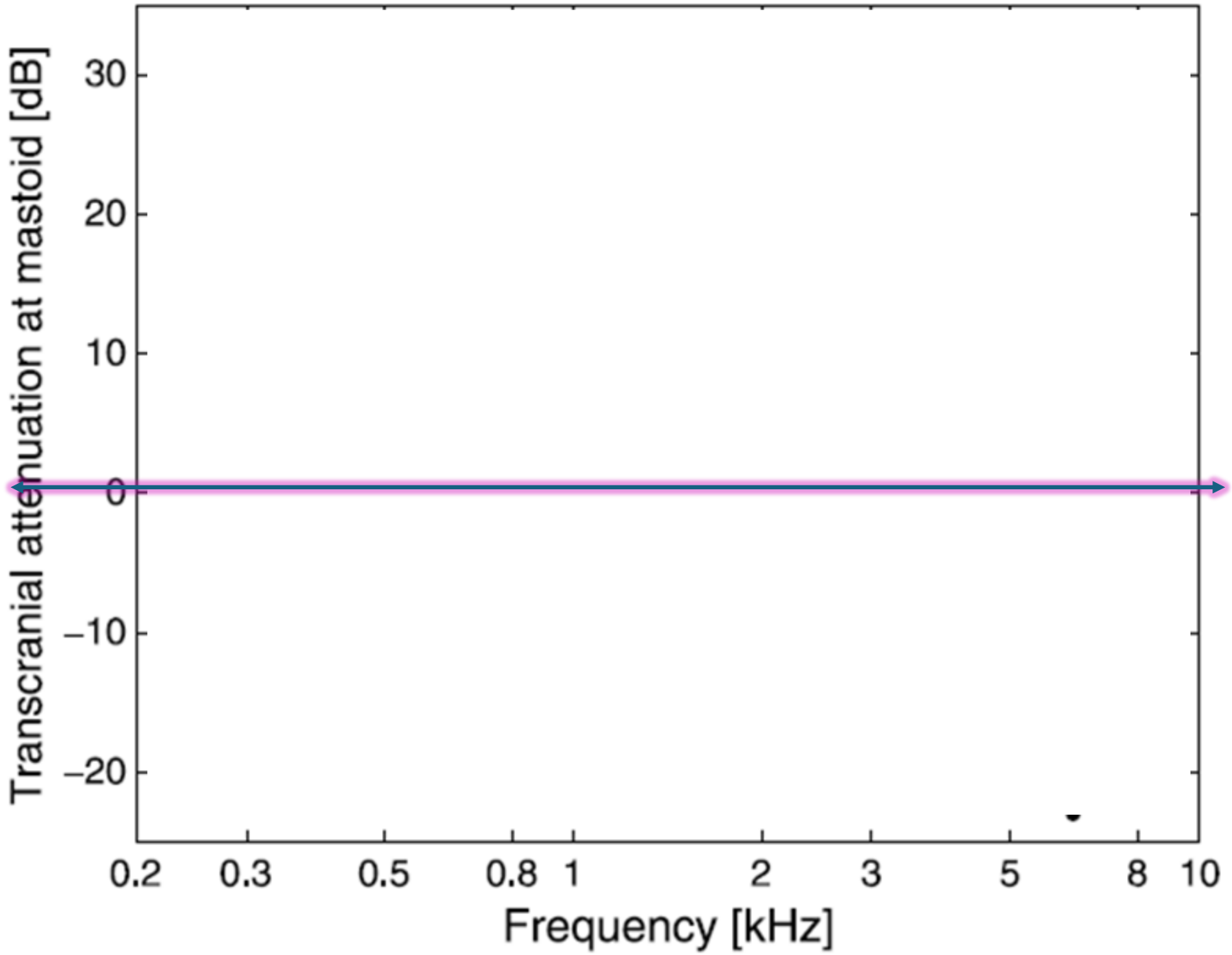
WNLs



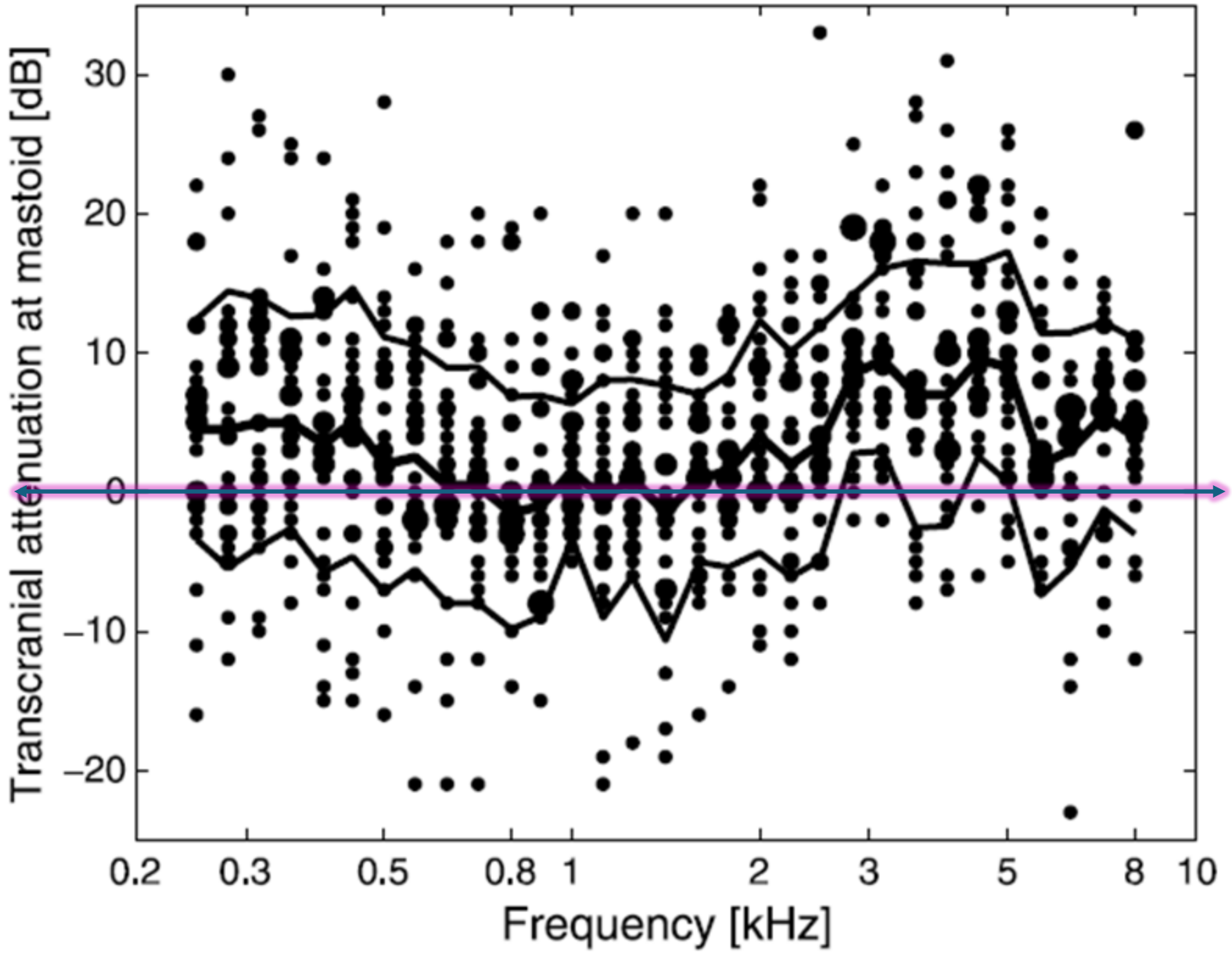
ALL LEFT MASTOID B/C THRESHOLDS = 5 dB

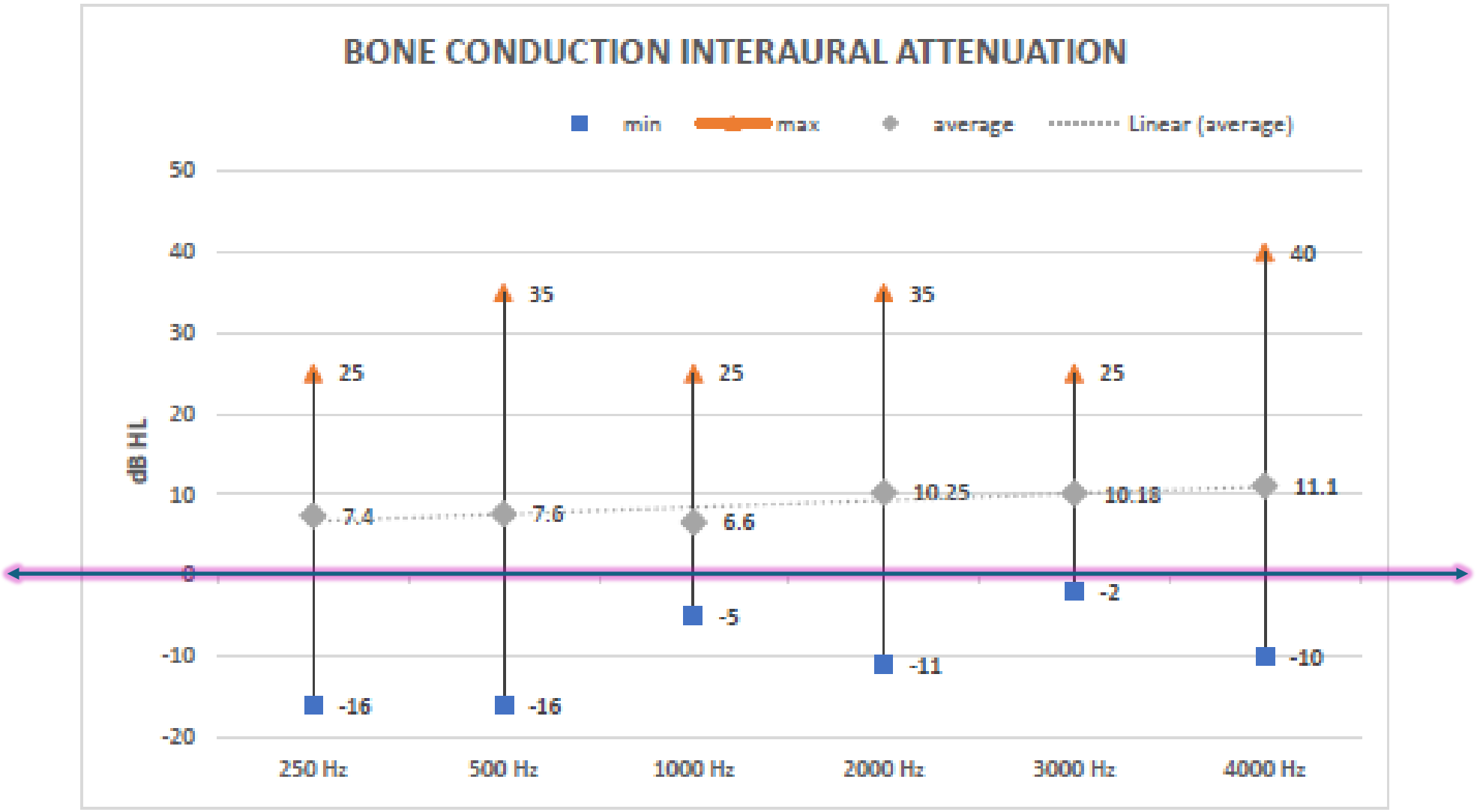
B/C IA = 0 dB

STENFELDT; 2012
"TRANSCRANIAL ATTENUATION OF B/C SOUND"



STENFELDT; 2012 "TRANSCRANIAL ATTENUATION OF B/C SOUND"

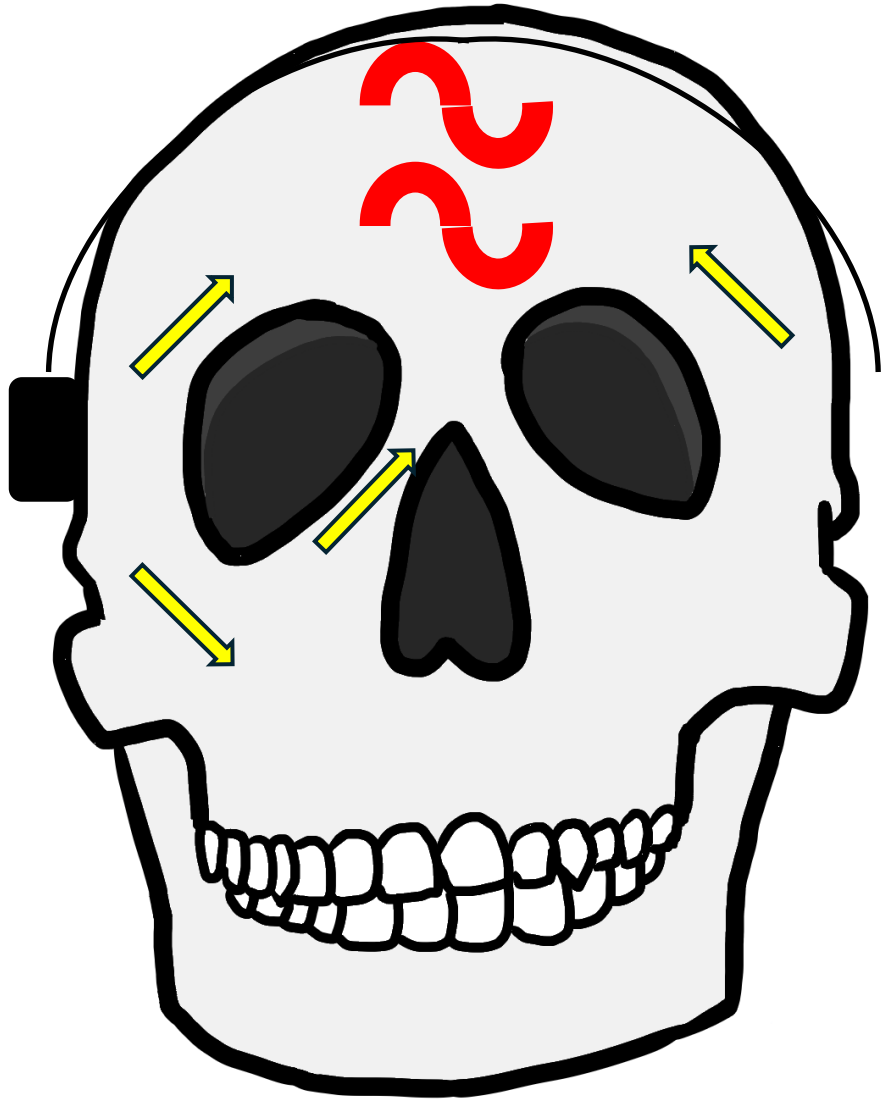


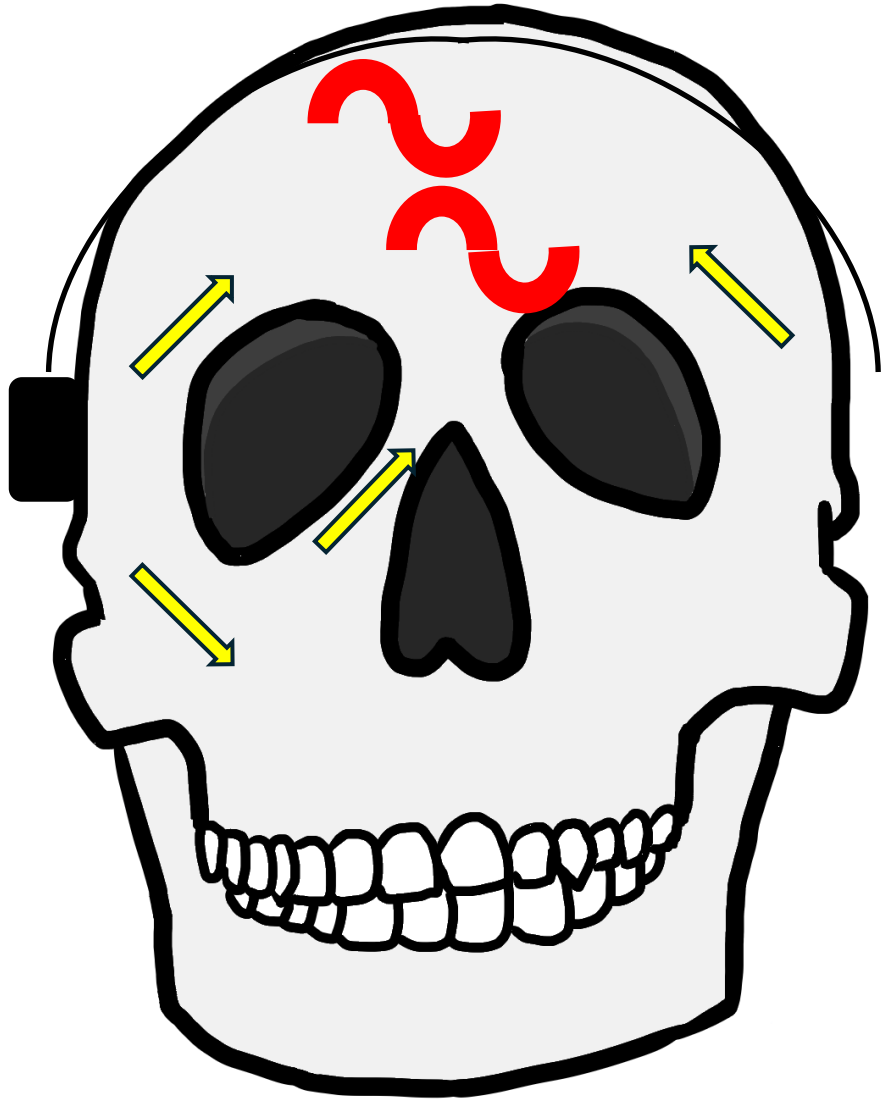

BONE CONDUCTION INTERAURAL ATTENUATION
min
max
average
Linear (average)
dB HL
50
40
30
20
10
0
-10
-20
25
35
25
35
25
40
7.4
7.6
6.6
10.25
10.18
11.1
-16
-16
-5
-11
-2
-10
250 Hz
500 Hz
1000 Hz
2000 Hz
3000 Hz
4000 Hz

WHAT'S GOING ON?

- Some **positive** attenuation on average [distance, bony tissue]
- Placement effects
- Phase differences: multiple pathways through the bony tissues "can add constructively or destructively due to their relative phases"







WHERE DOES IT LEAVE US?

AIR CONDUCTION

- minIA/potCH values

BONE CONDUCTION

CLINICAL minIA/potCH VALUES

FREQ	TDH	INSERTS	B/C THEORETICAL	BONE CONDUCTION
250 Hz	35	60	0	-20
500 Hz	45	50	0	-20
1000 Hz	40	55	0	-5
2000 Hz	40	50	0	-15
3000 Hz	50	50	0	-5
4000 Hz	35	60	0	-10
6000 Hz	40	50		-25
8000 Hz	40	50		

CLINICAL ~~minIA/potCH~~ VALUES

FREQ	TDH	INSERT	B/C THEORETICAL	E	CONDUCTION
250 Hz	35	60	0		-20
500 Hz	45	50	0		-20
1000 Hz	40	55	0		-5
2000 Hz	40	50	0		-15
3000 Hz	50	50	0		-5
4000 Hz	35	60	0		-10
6000 Hz	40	50			-25
8000 Hz	40	50			

LENS 4

sitIA
&
THE OPTIMIZED METHOD

J Am Acad Audiol 15:17–28 (2004)

Masking Redux I: An Optimized Masking Method

Robert G. Turner*

J Am Acad Audiol 15:29–46 (2004)

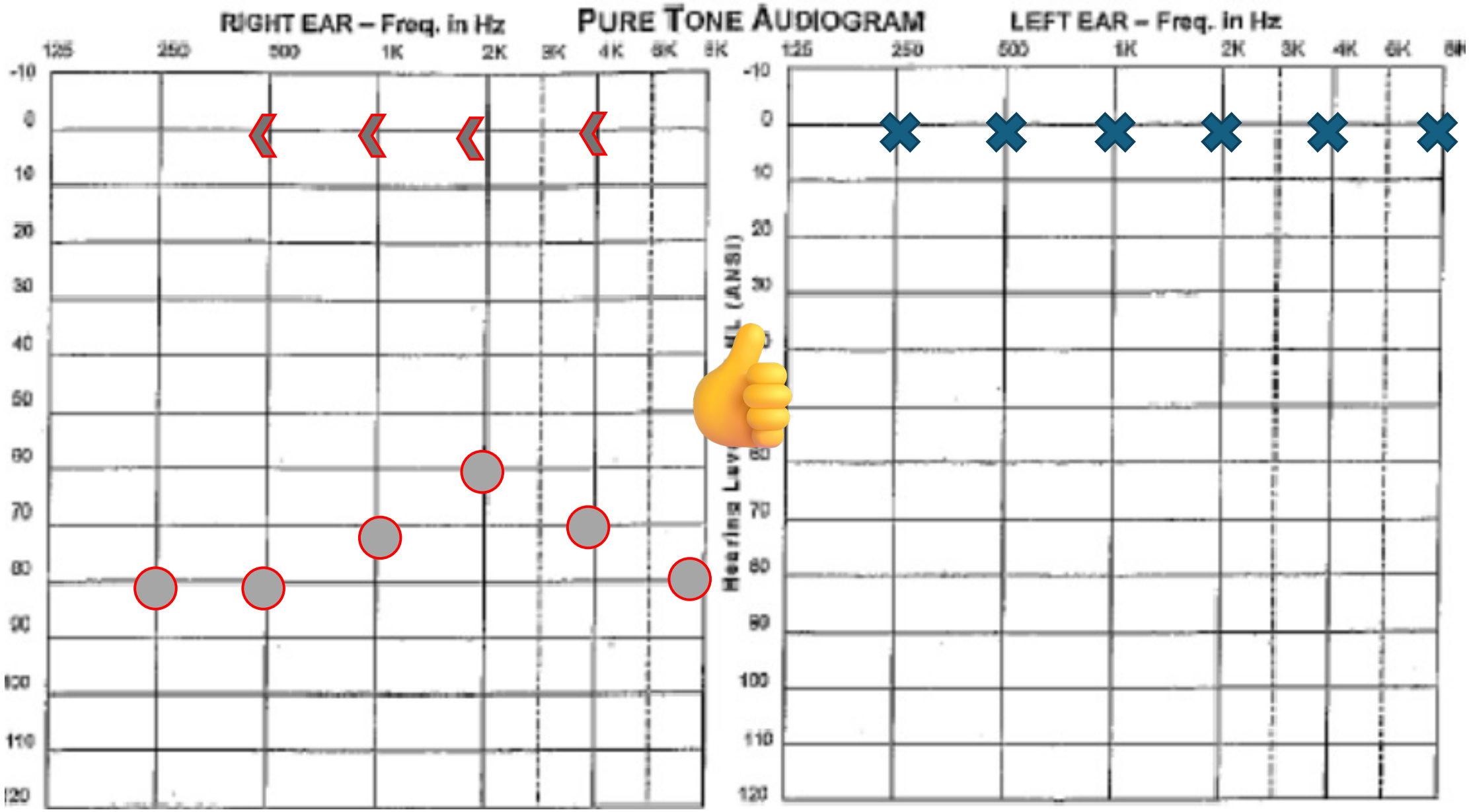
Masking Redux II: A Recommended Masking Protocol

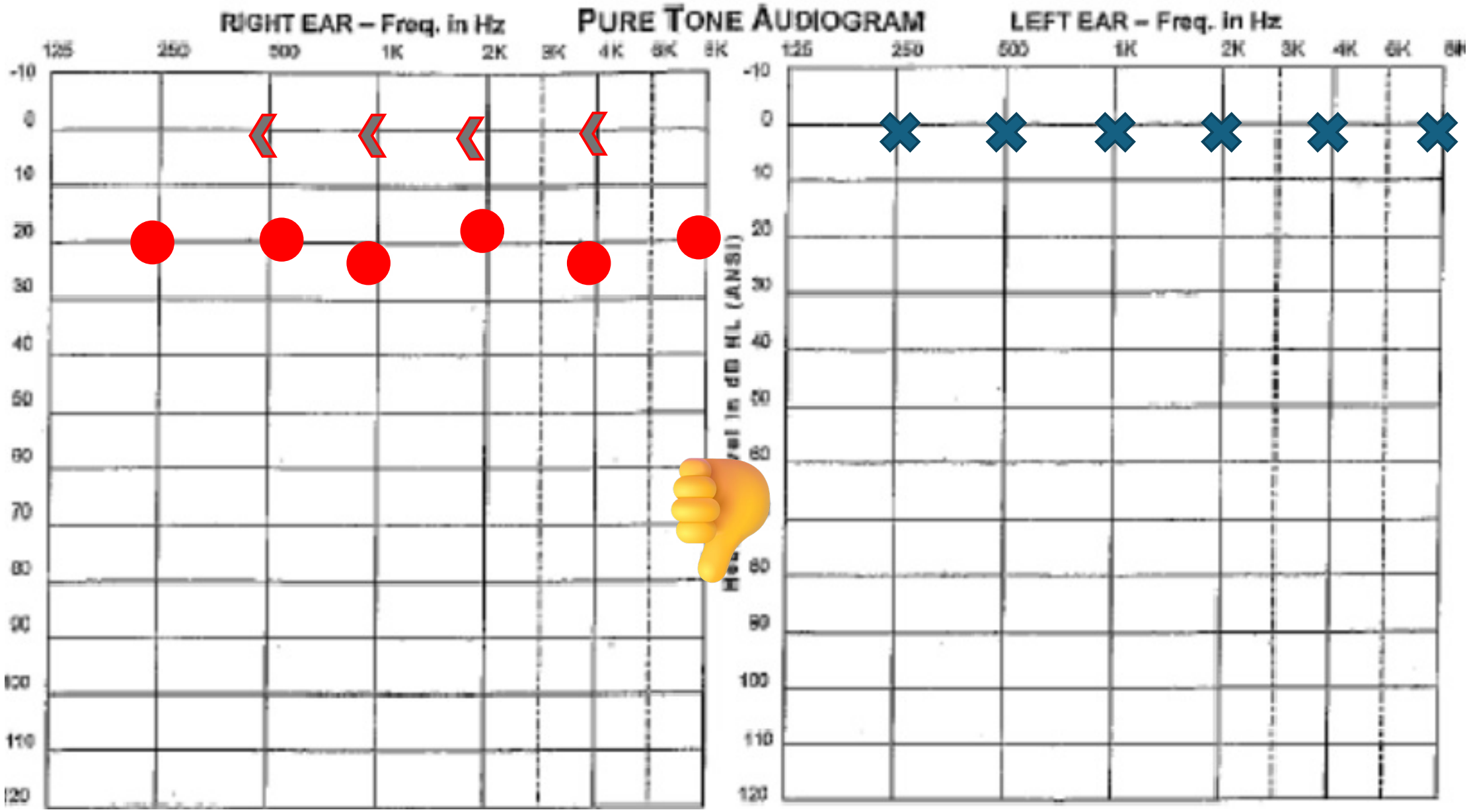
Robert G. Turner*



THE OPTIMIZED METHOD OF MASKING

- Appropriate when testing **only the poorer ear** during **asymmetrical hearing situation**; masking noise delivered to the **better-hearing ear**
    - For threshold testing only: tones, speech
    - Method works for air and bone-conduction testing
- Not an appropriate masking approach when the hearing is symmetrical or for supra-threshold testing such as WRS


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level (ANSI)


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120

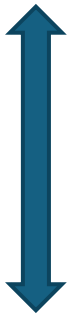
CONCEPT #1

“Masking Redux I: An Optimized Masking Method”

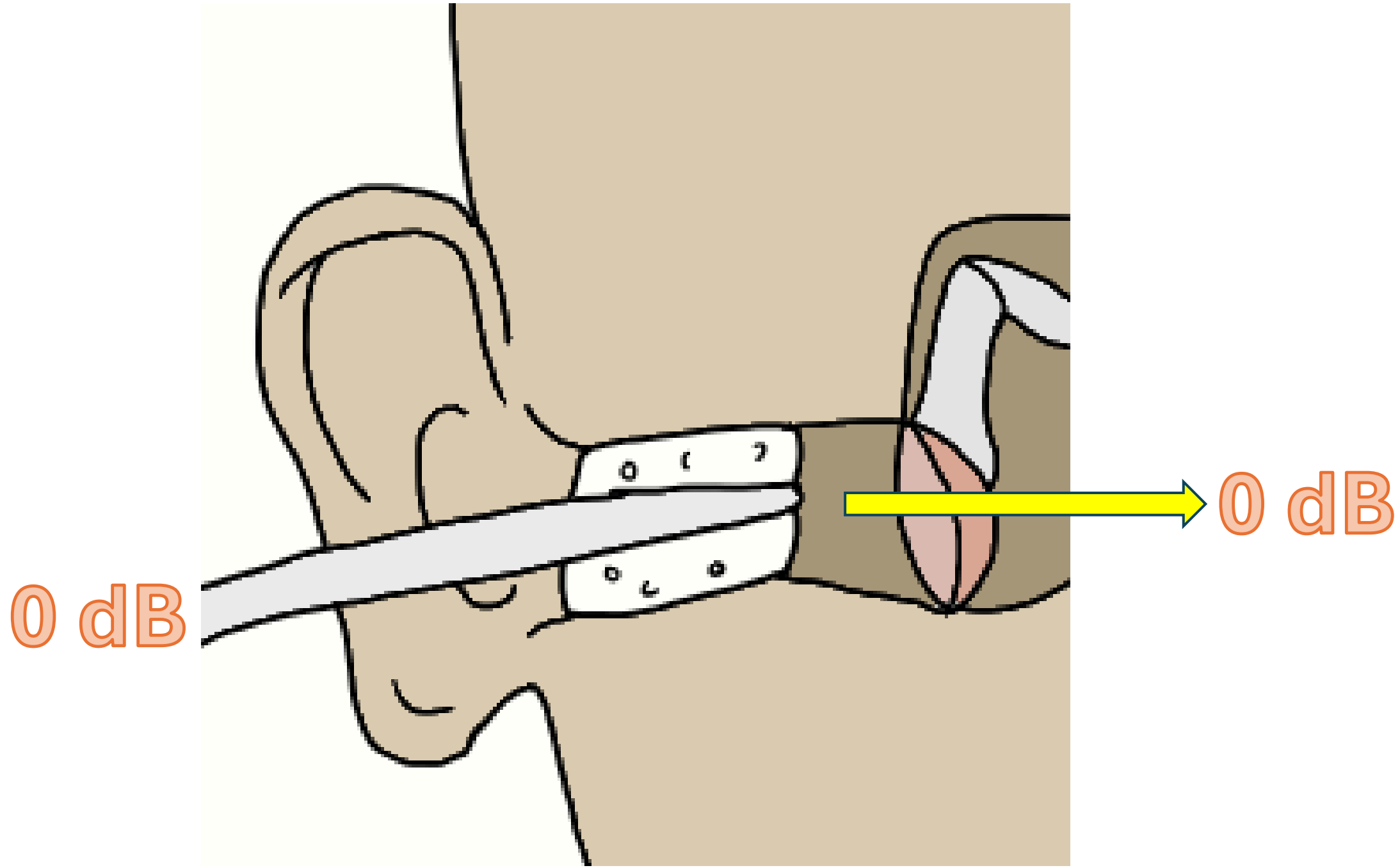
An air-bone gap can be less that a person’s IA…BUT

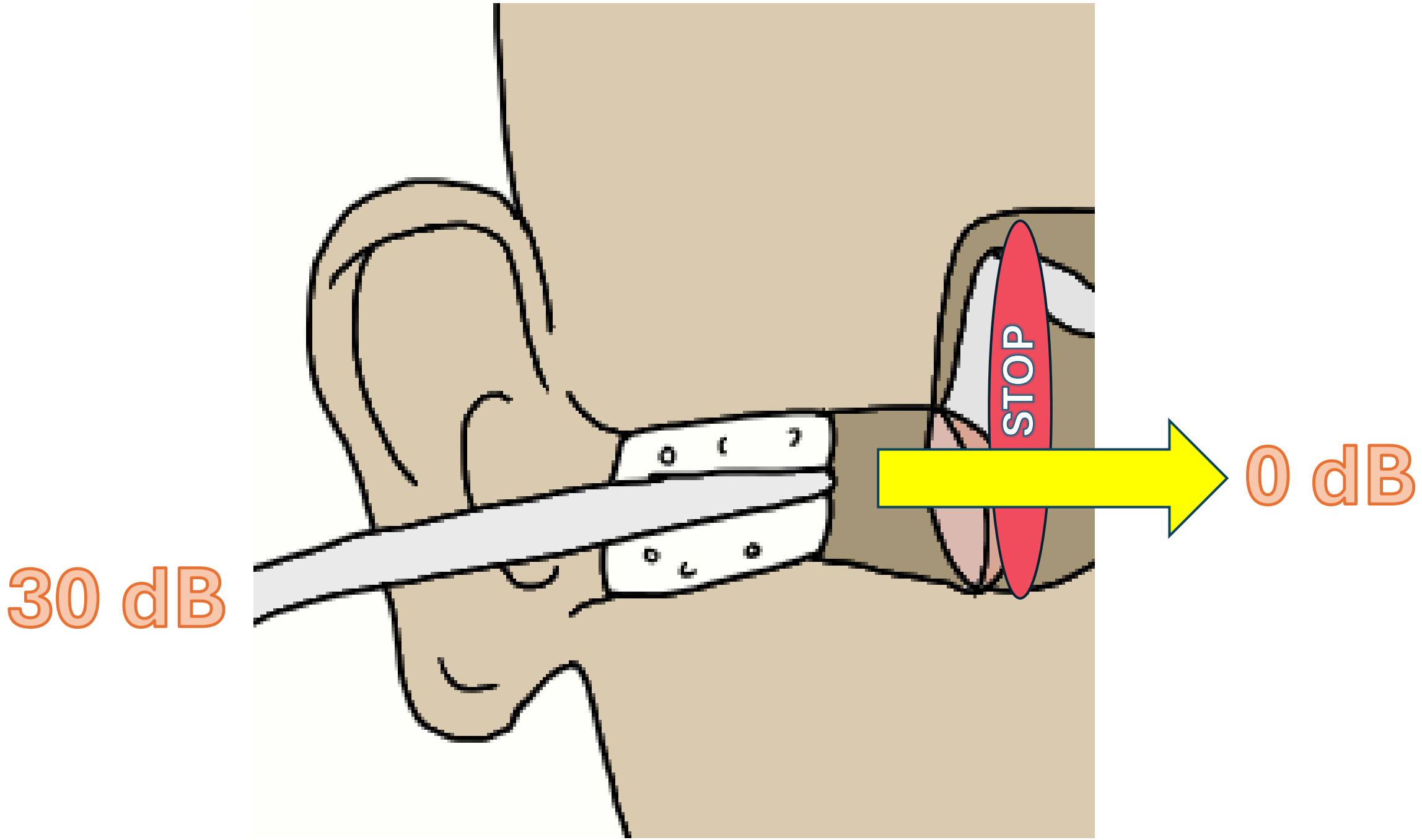
“…an **air-bone gap cannot be greater than the IA…**”

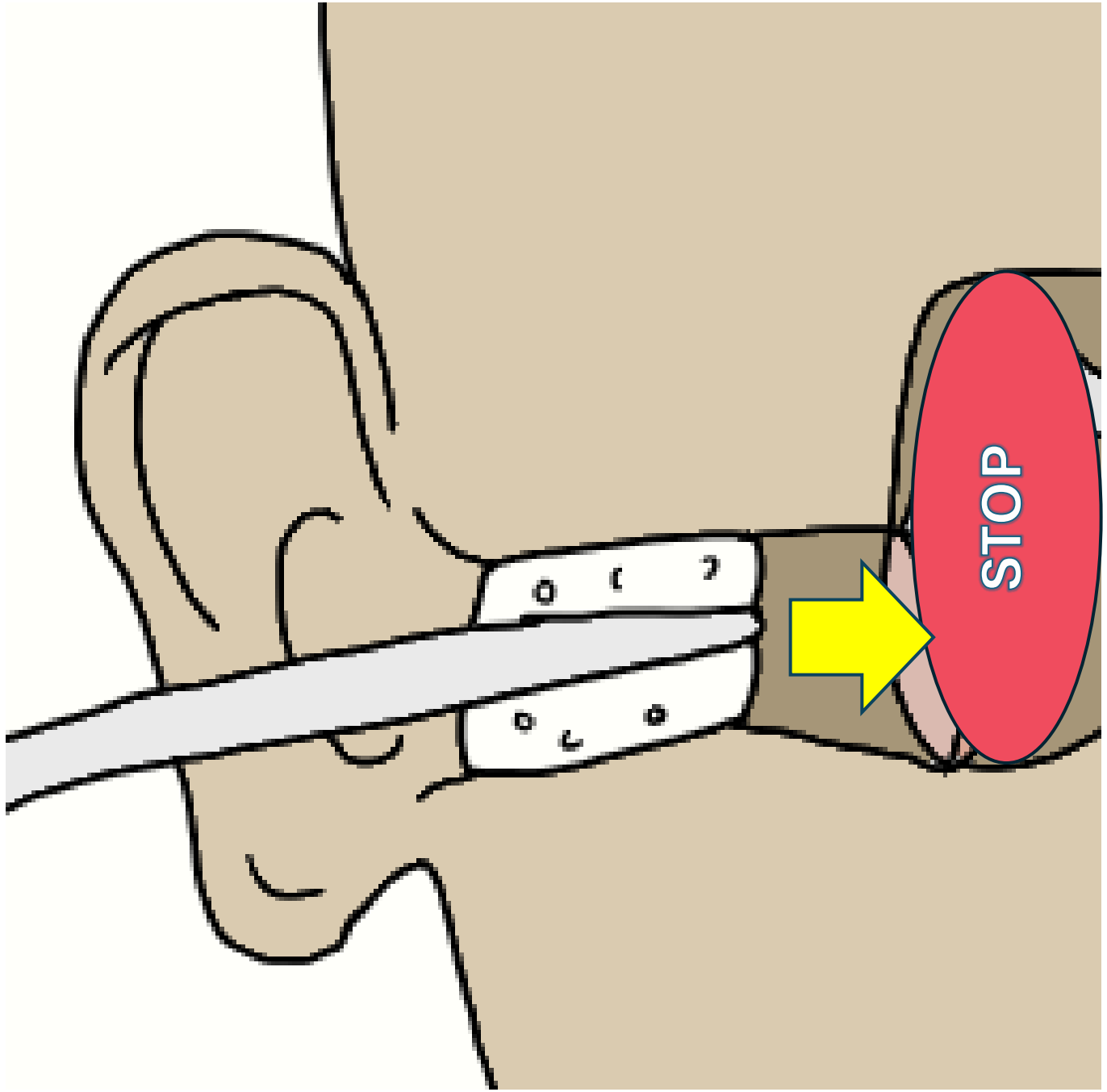
- Robert Turner, 2004



The **IA cannot be less than an air-bone gap**…even an unmasked one.

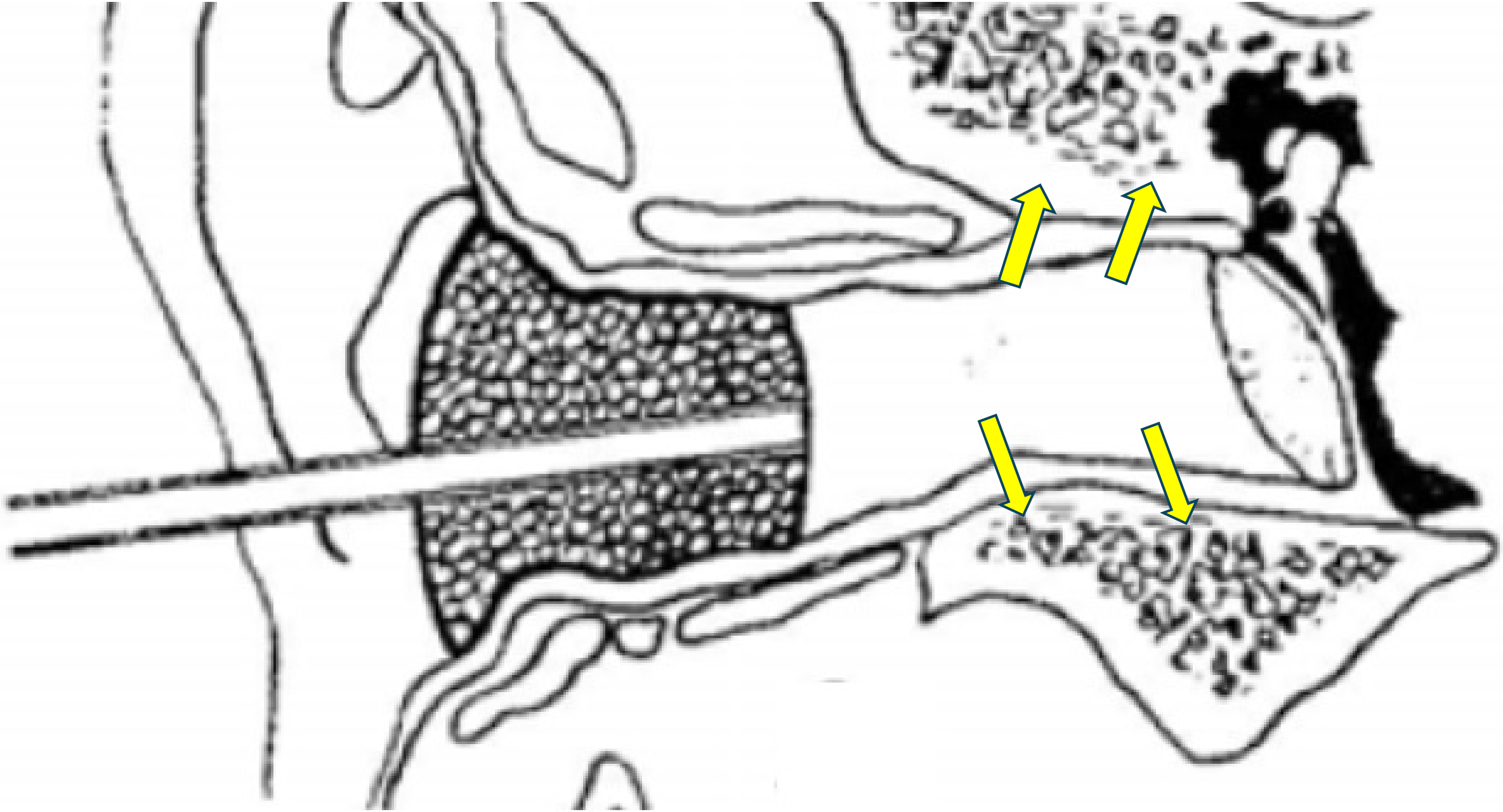

0 dB
0 dB


30 dB
STOP
0 dB



60 dB

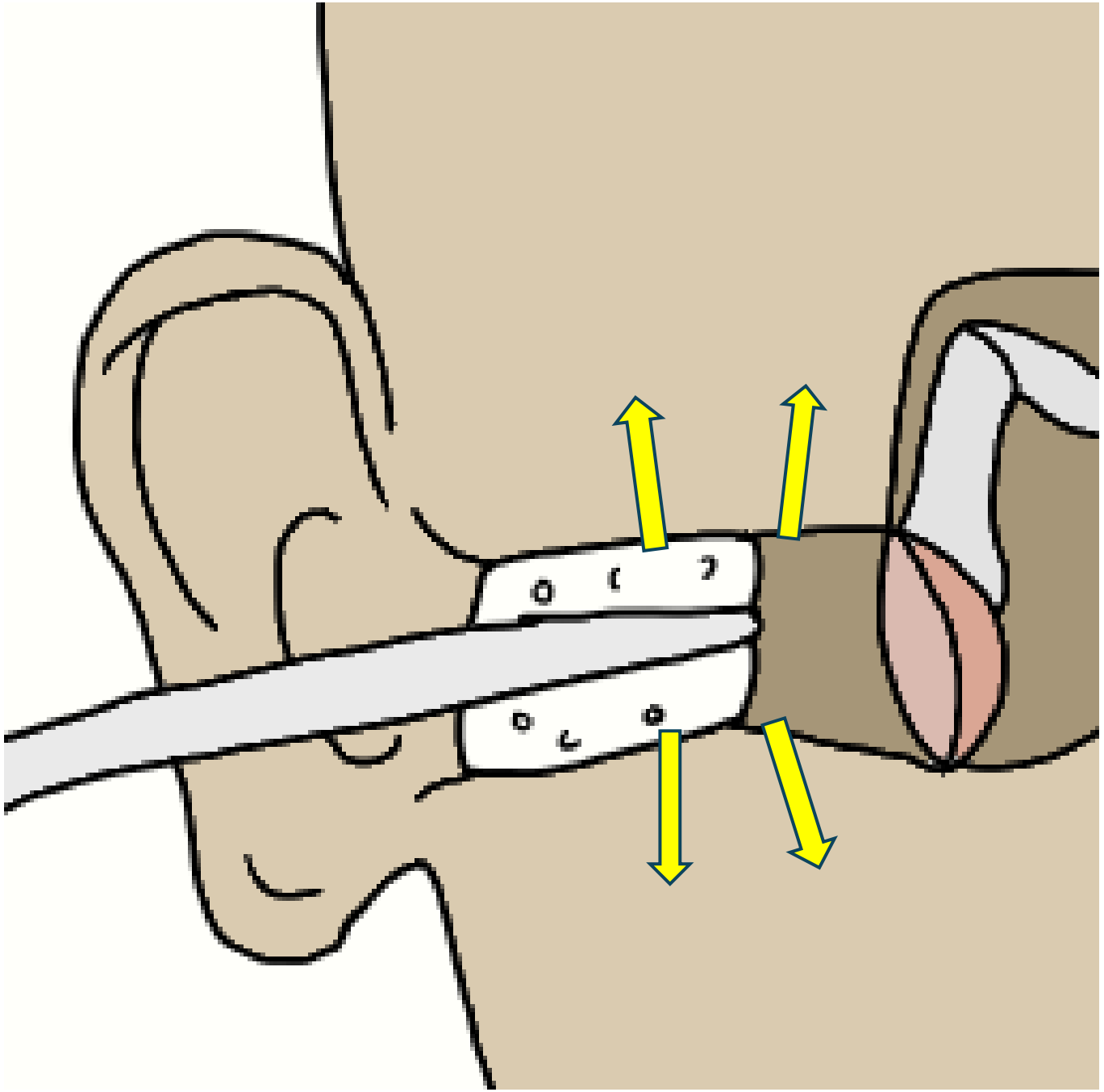
0 dB



Cross-hearing, IA and air-bone gaps

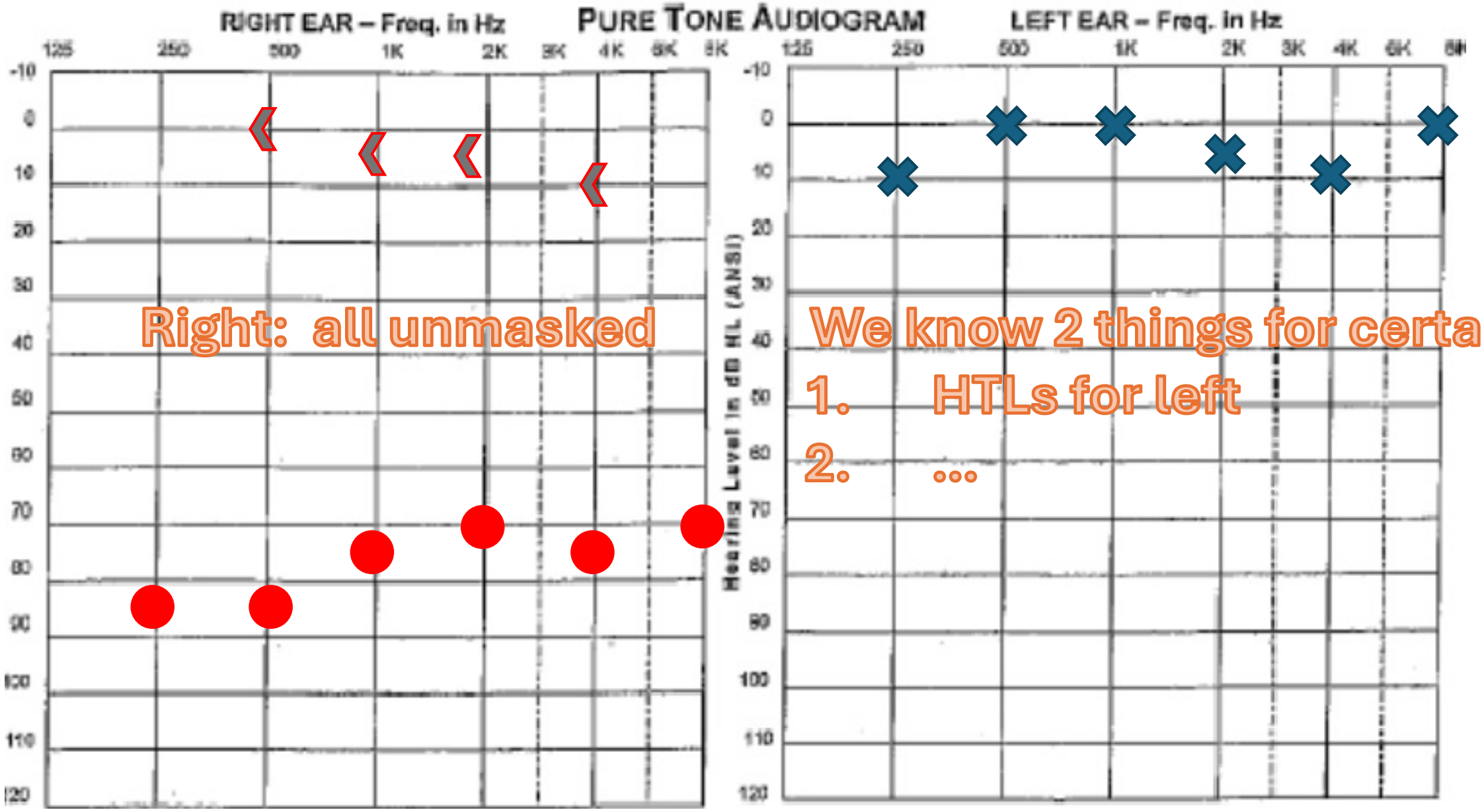
VIA THE SKULL

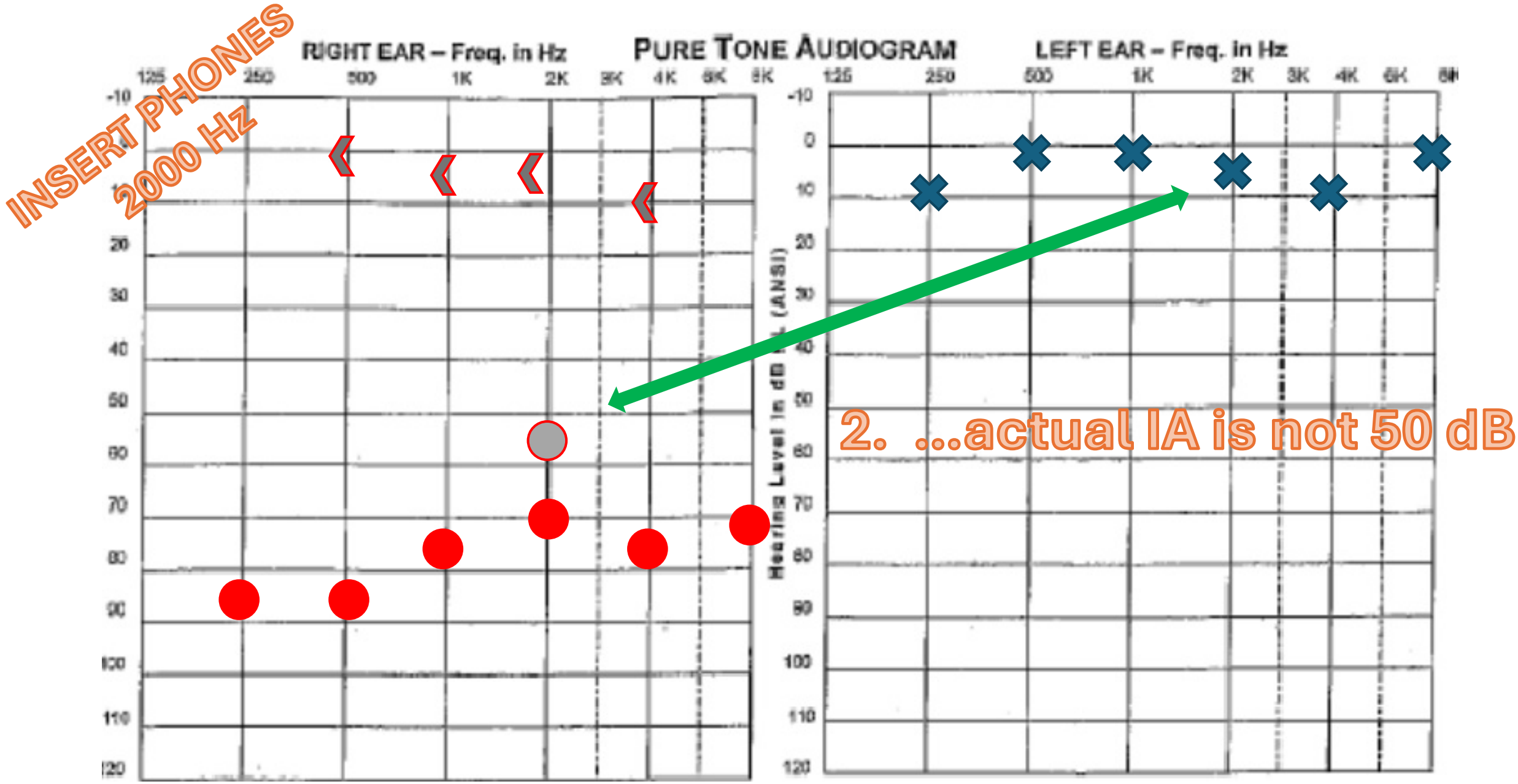
...can be same event pathway

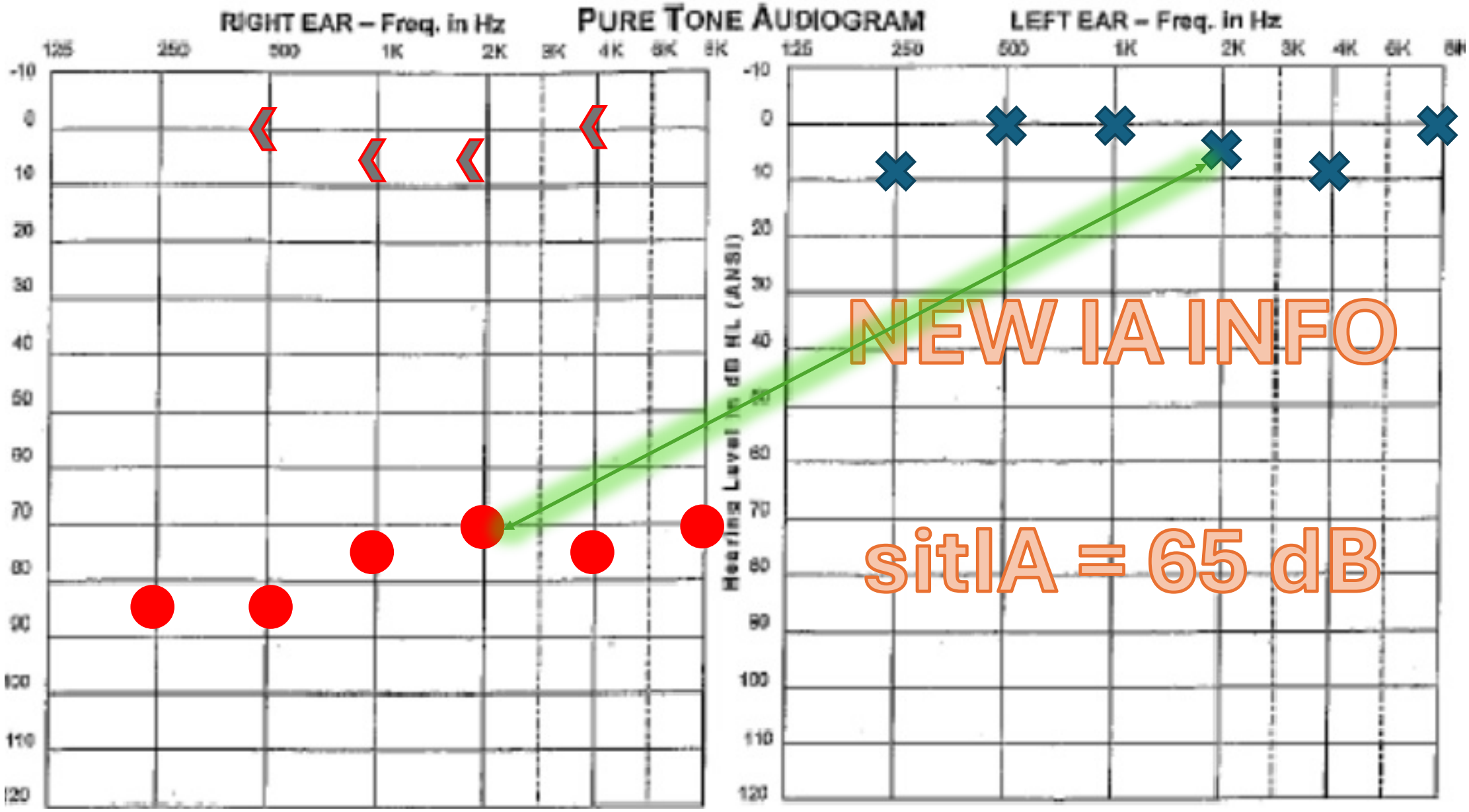


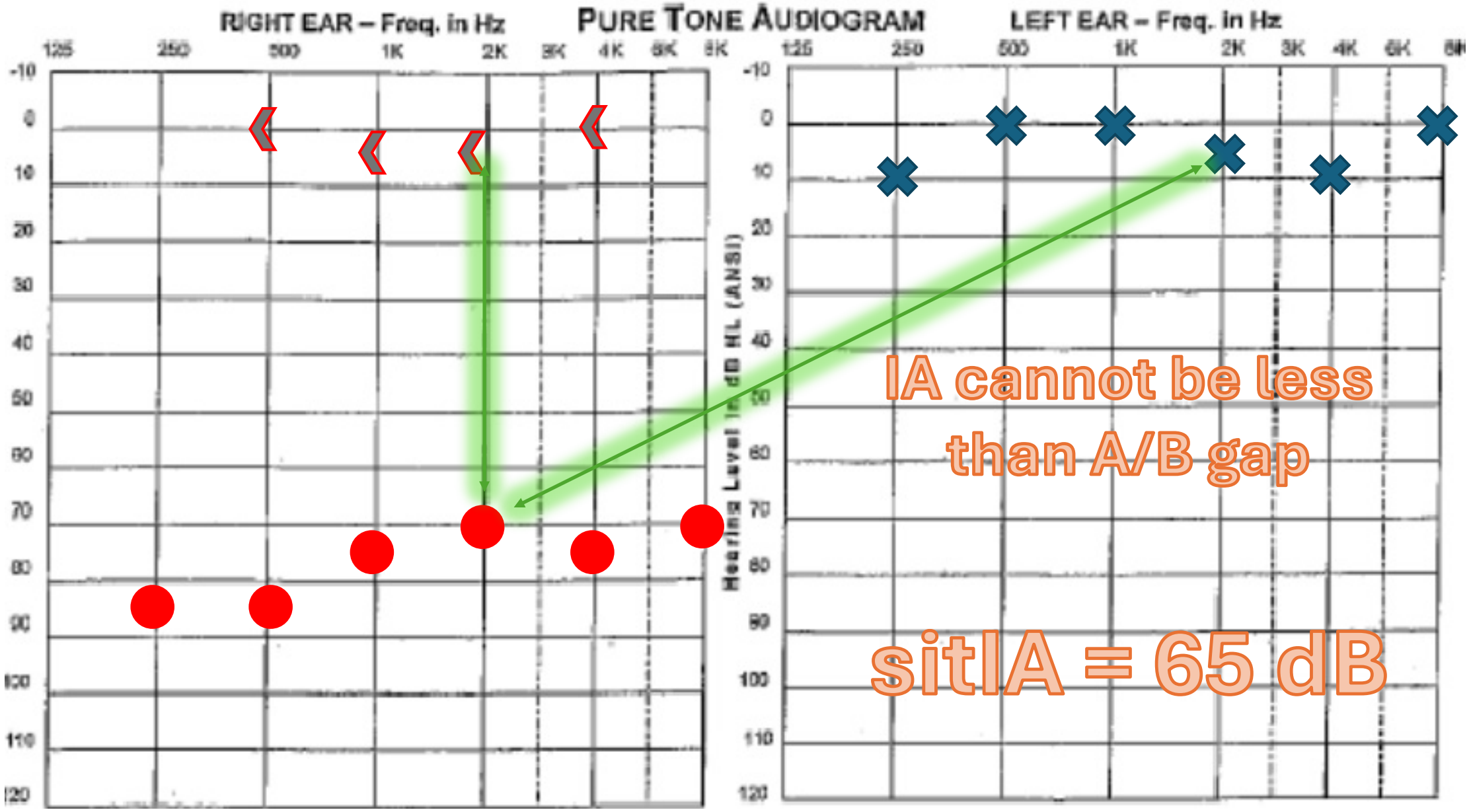
CONCEPT #2

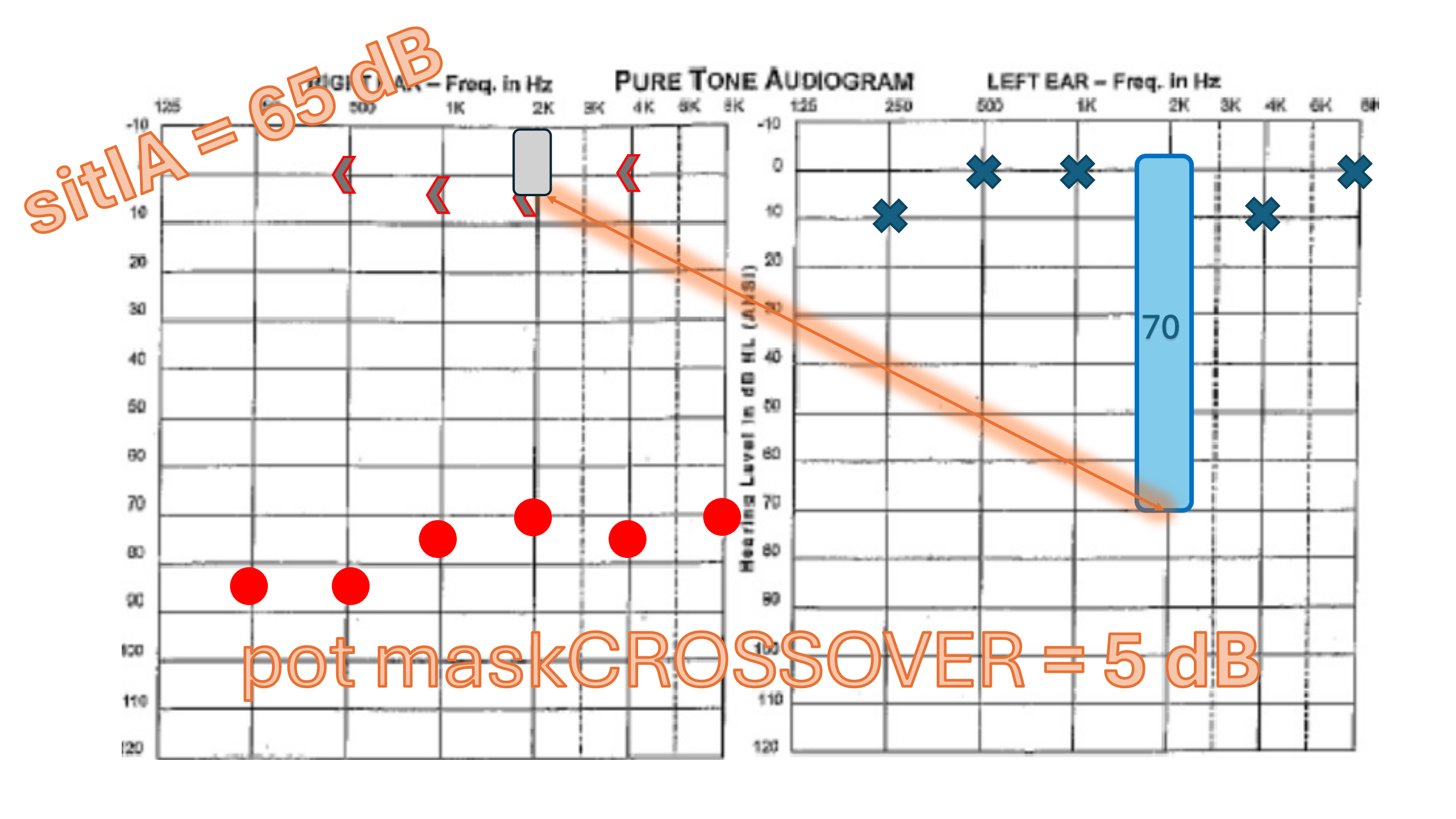
sitIA


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
Right: all unmasked
We know 2 things for certain:
1. HTLs for left
2. …

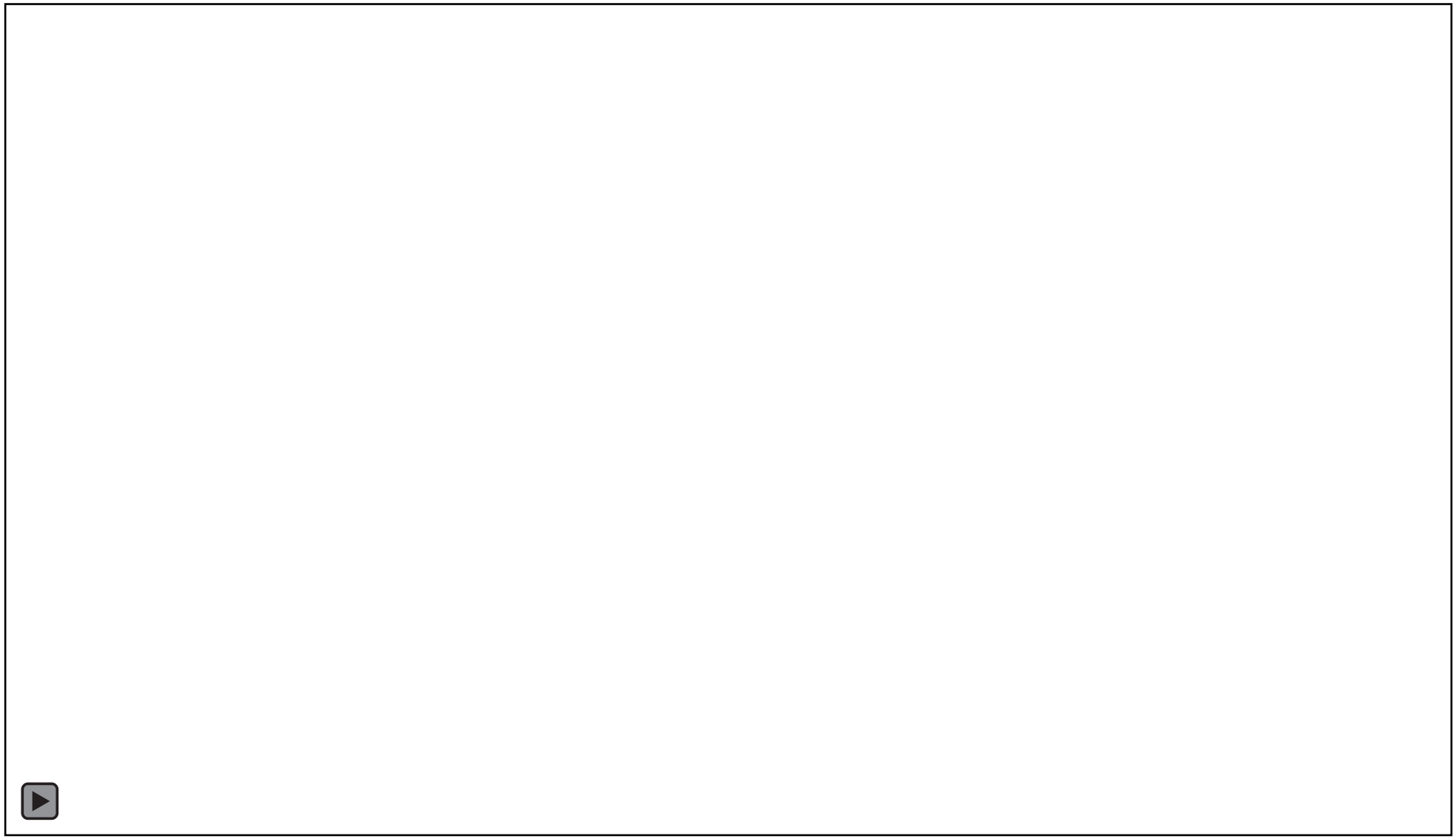

INSERT PHONES
2000 Hz
RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB
(ANSI)
2. ...actual IA is not 50 dB

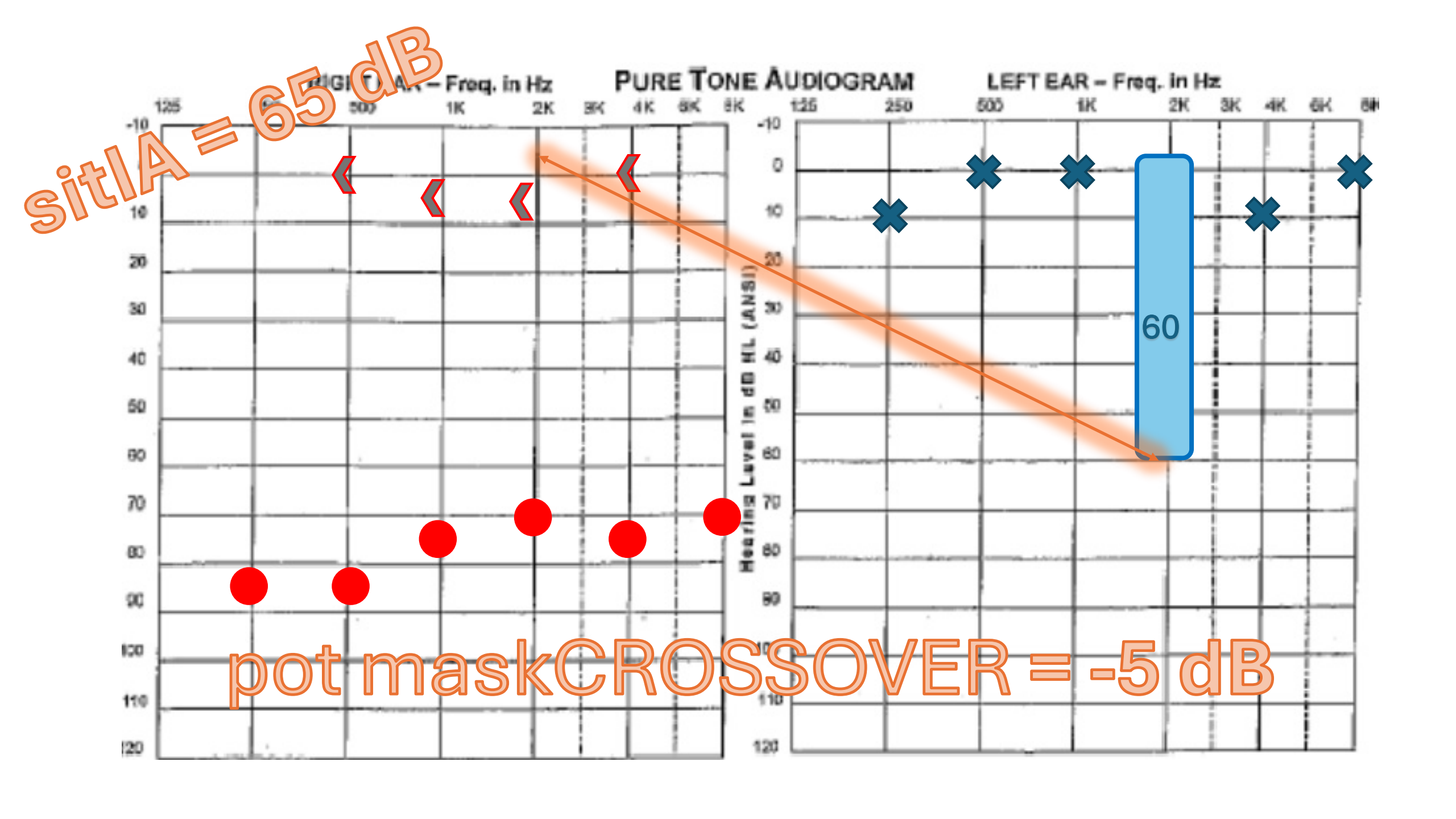

RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
NEW IA INFO
sitIA = 65 dB


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
IA cannot be less than A/B gap
sitIA = 65 dB

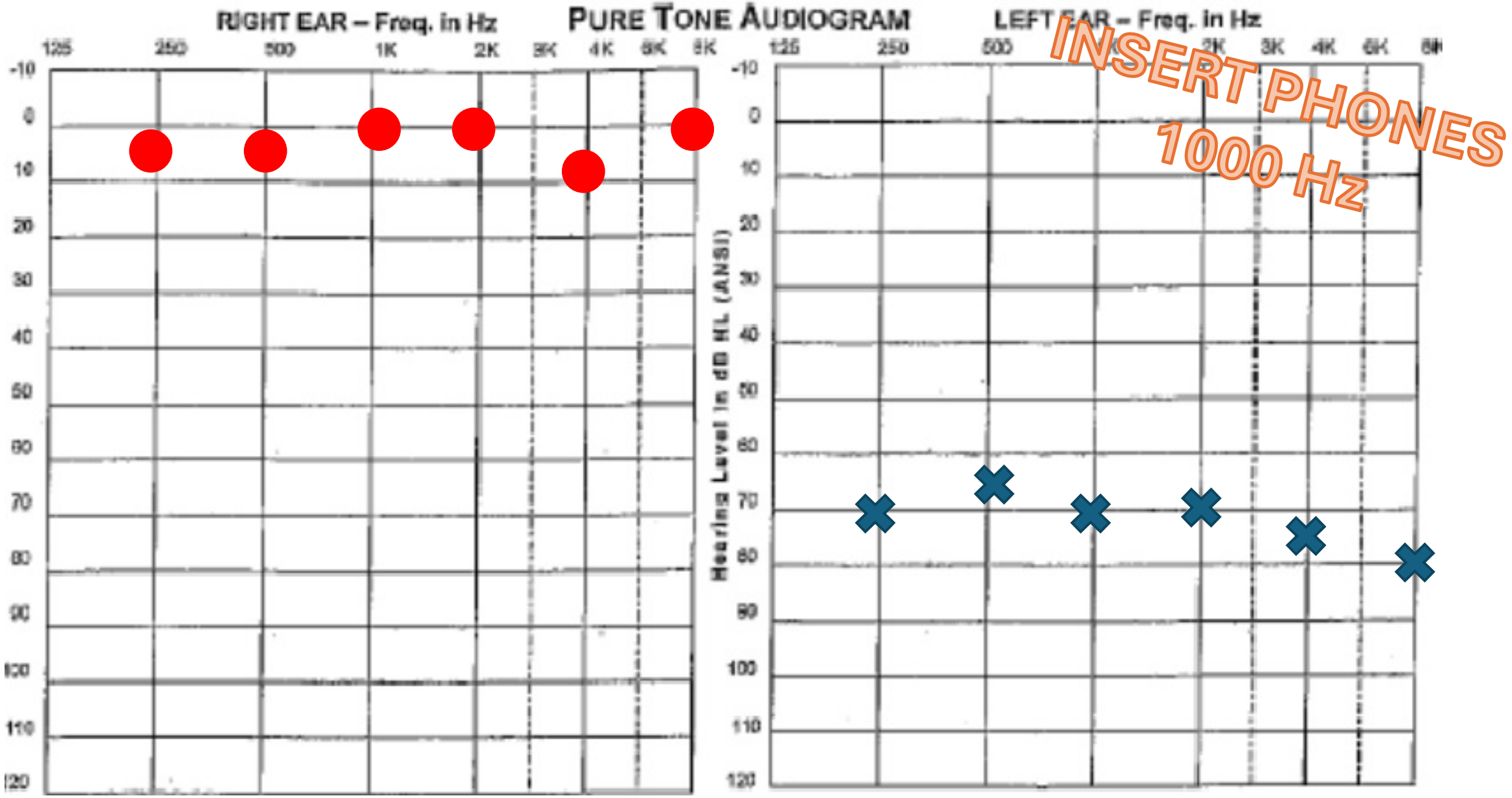

sitIA = 65 dB
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
Hearing Level in dB HL (ANSI)
70
pot maskCROSSOVER = 5 dB

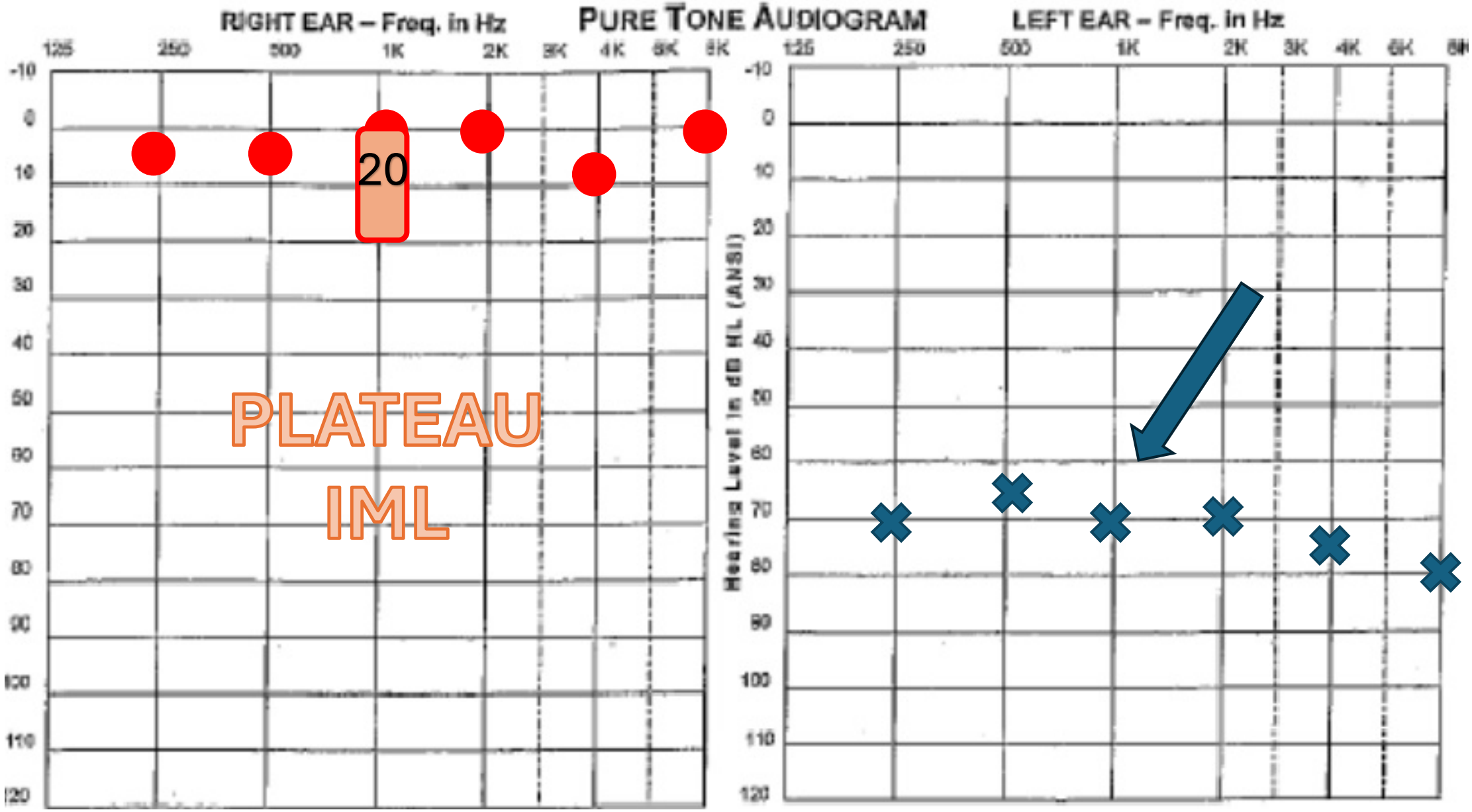
OVERMASKING AND TE BONE HTLs

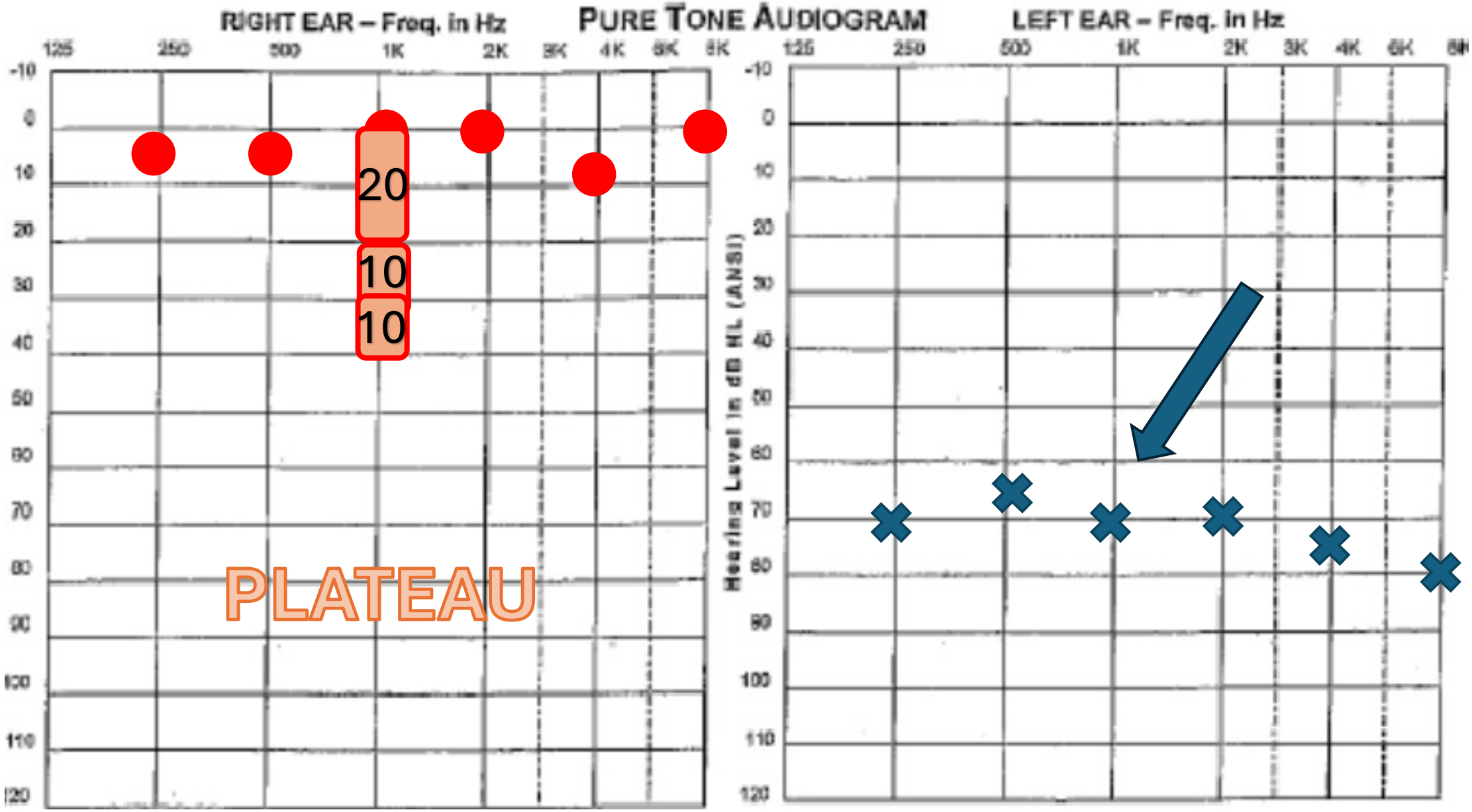


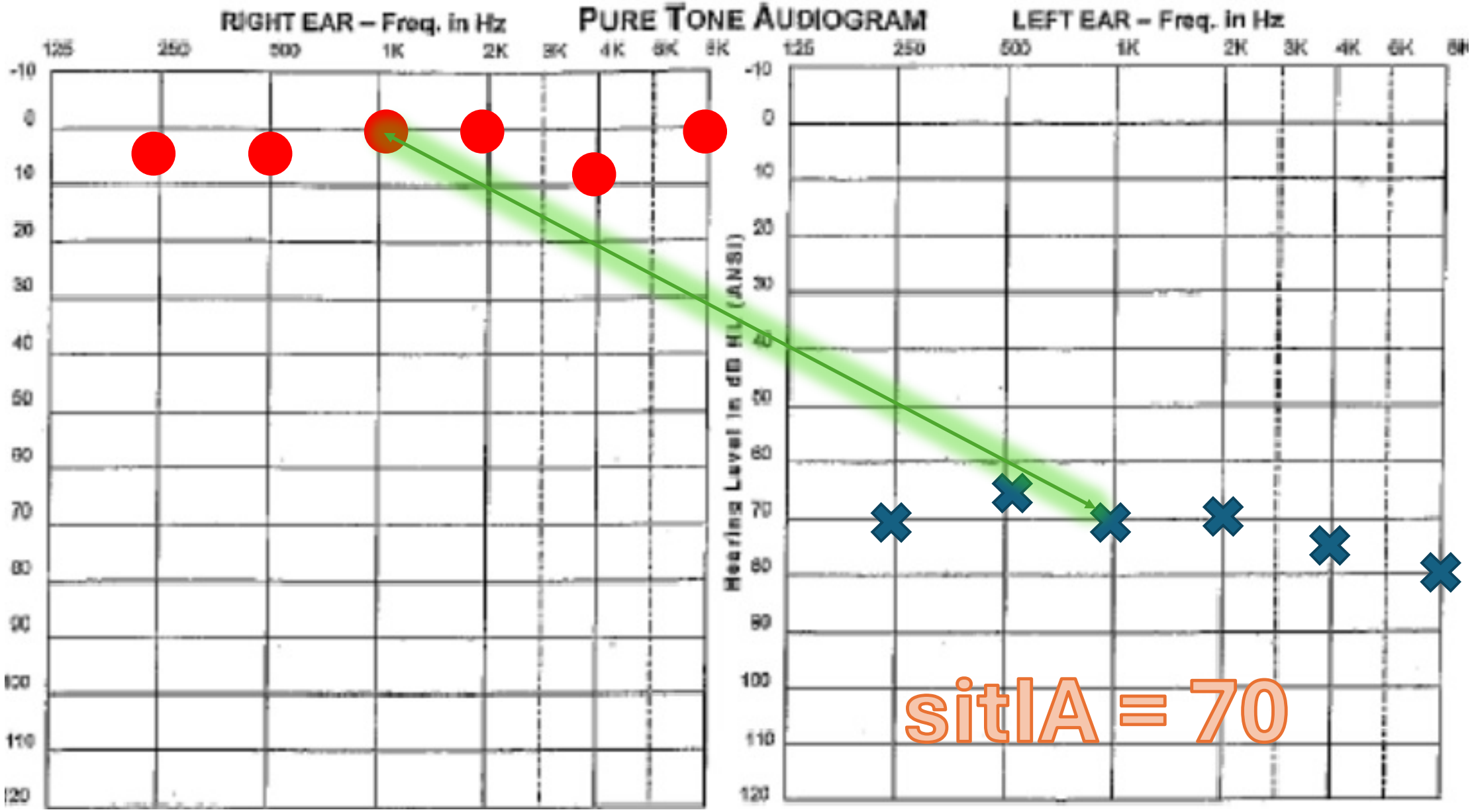

sitIA = 65 dB
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
Hearing Level in dB HL (ANSI)
60
pot maskCROSSOVER = -5 dB

OPTIMIZED METHOD CASE STUDY


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
INSERT PHONES
1000 Hz


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
20
PLATEAU
IML


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
20
10
10
PLATEAU

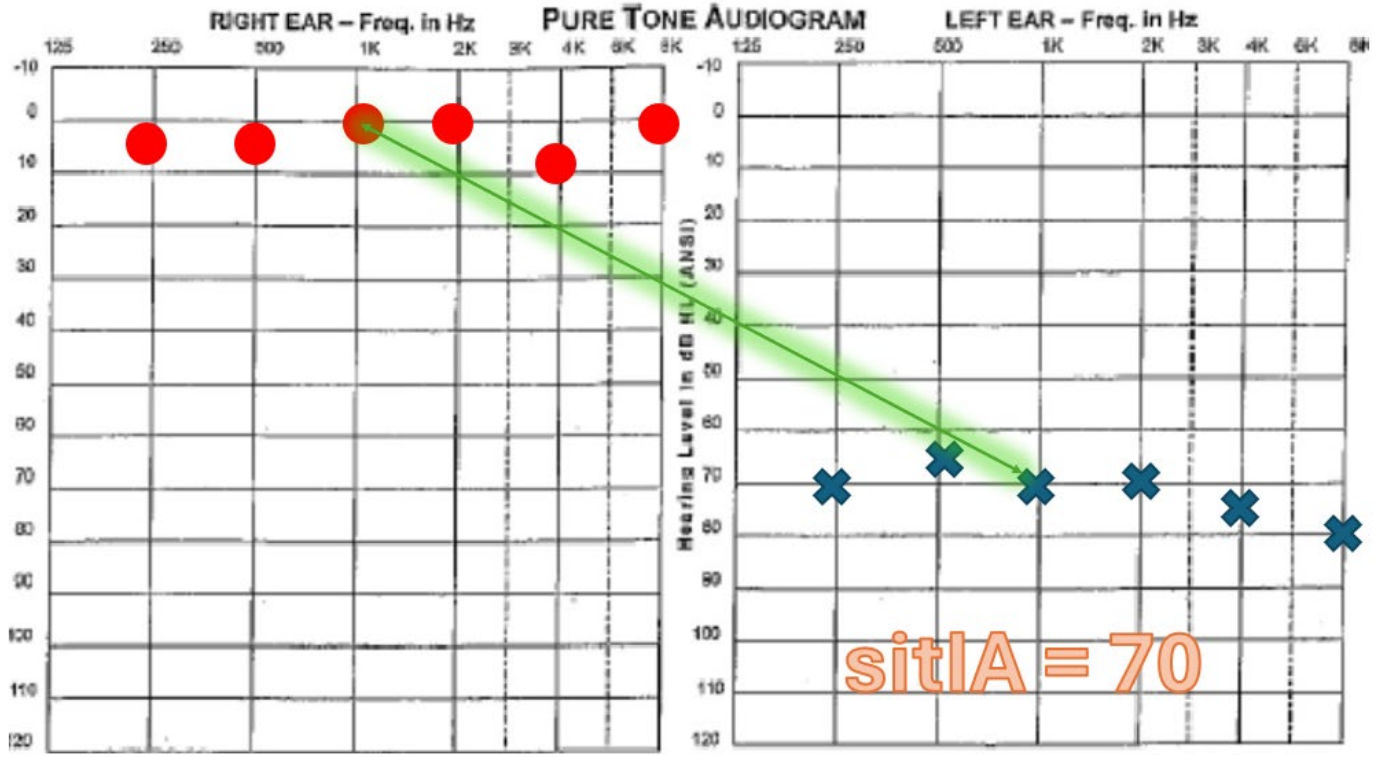

RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
sitIA = 70

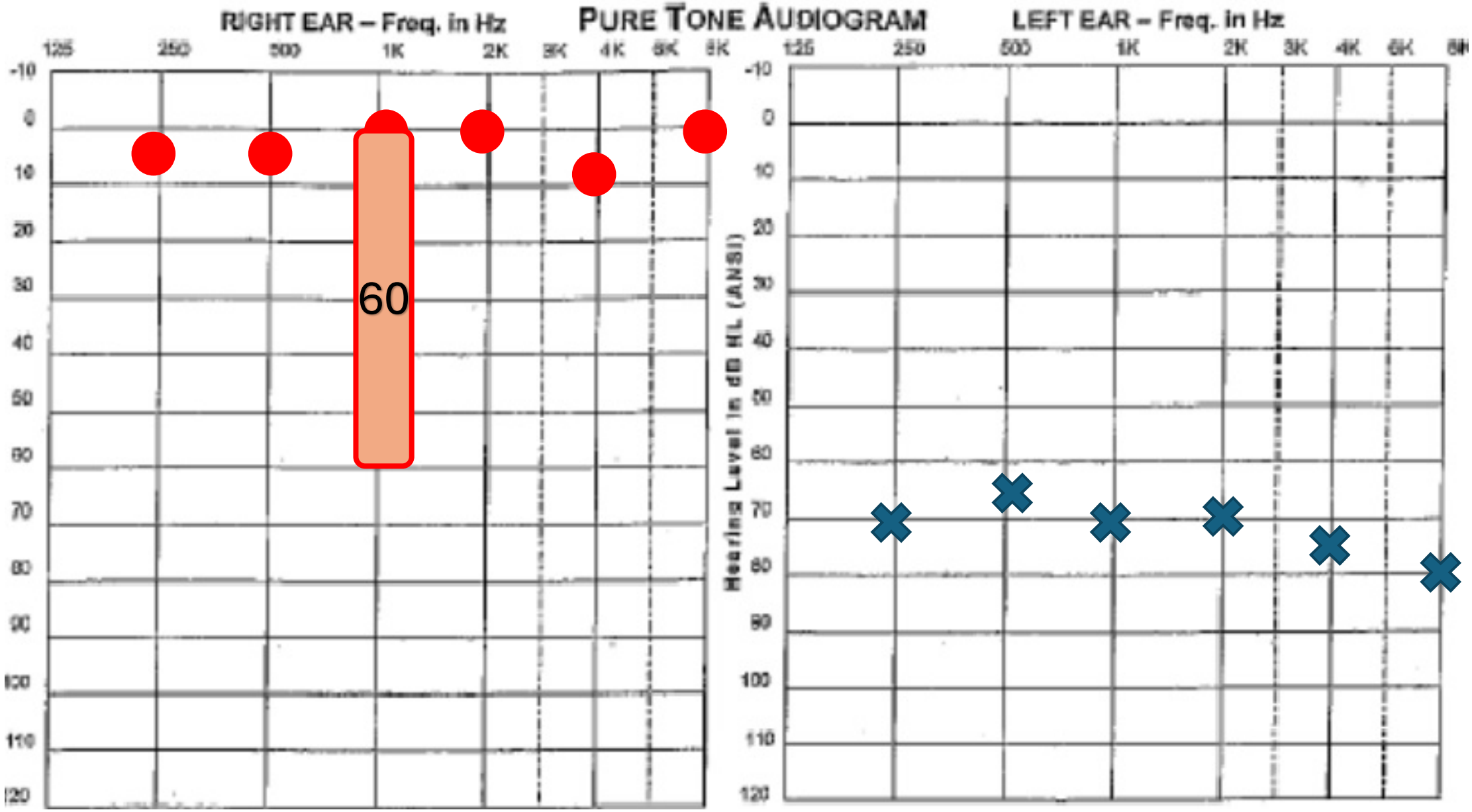
OPTIMIZED INITIAL MASKING LEVEL

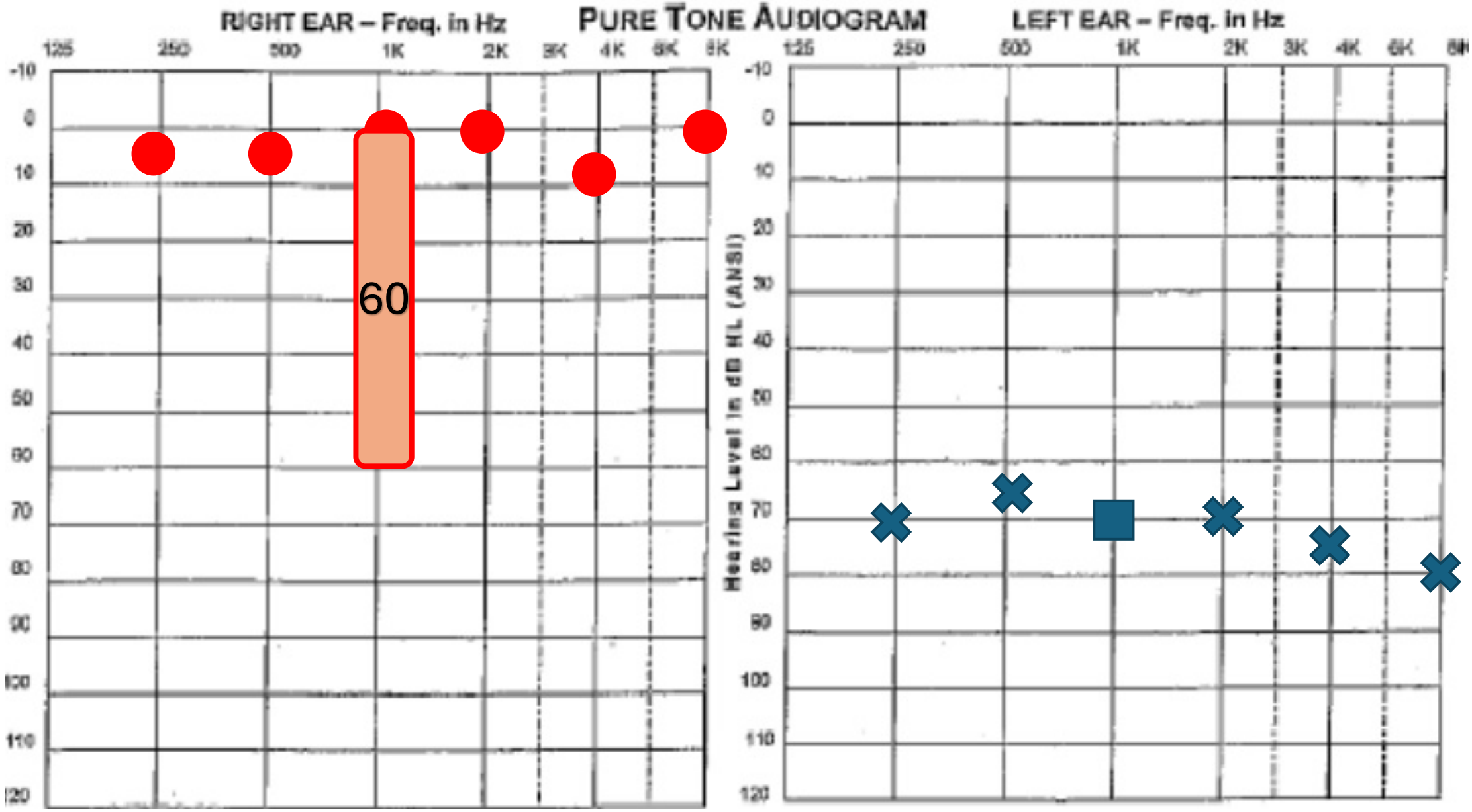
- IML = AC TE – 10 dB

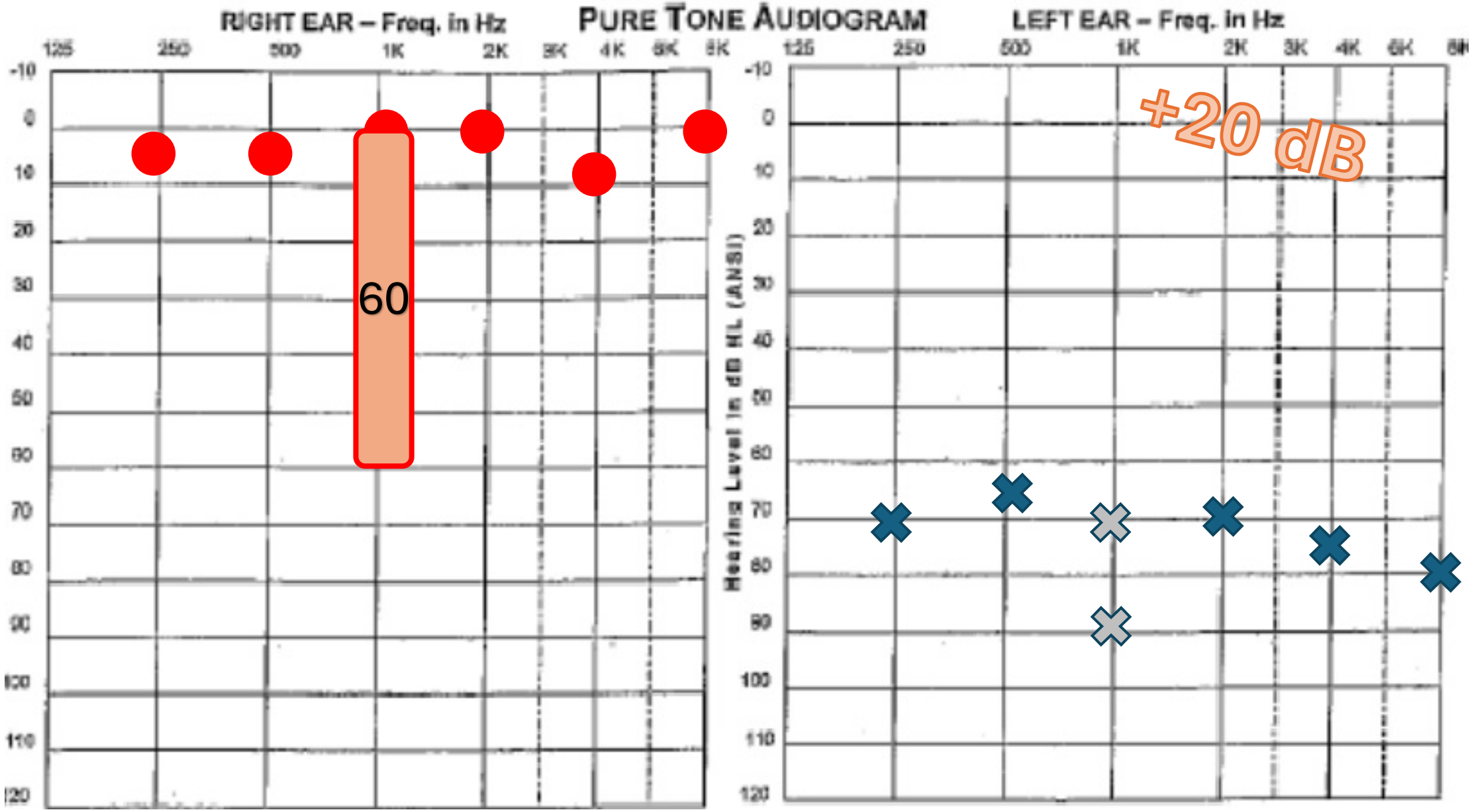
INITIAL MASKING LEVEL OPTIMIZED METHOD

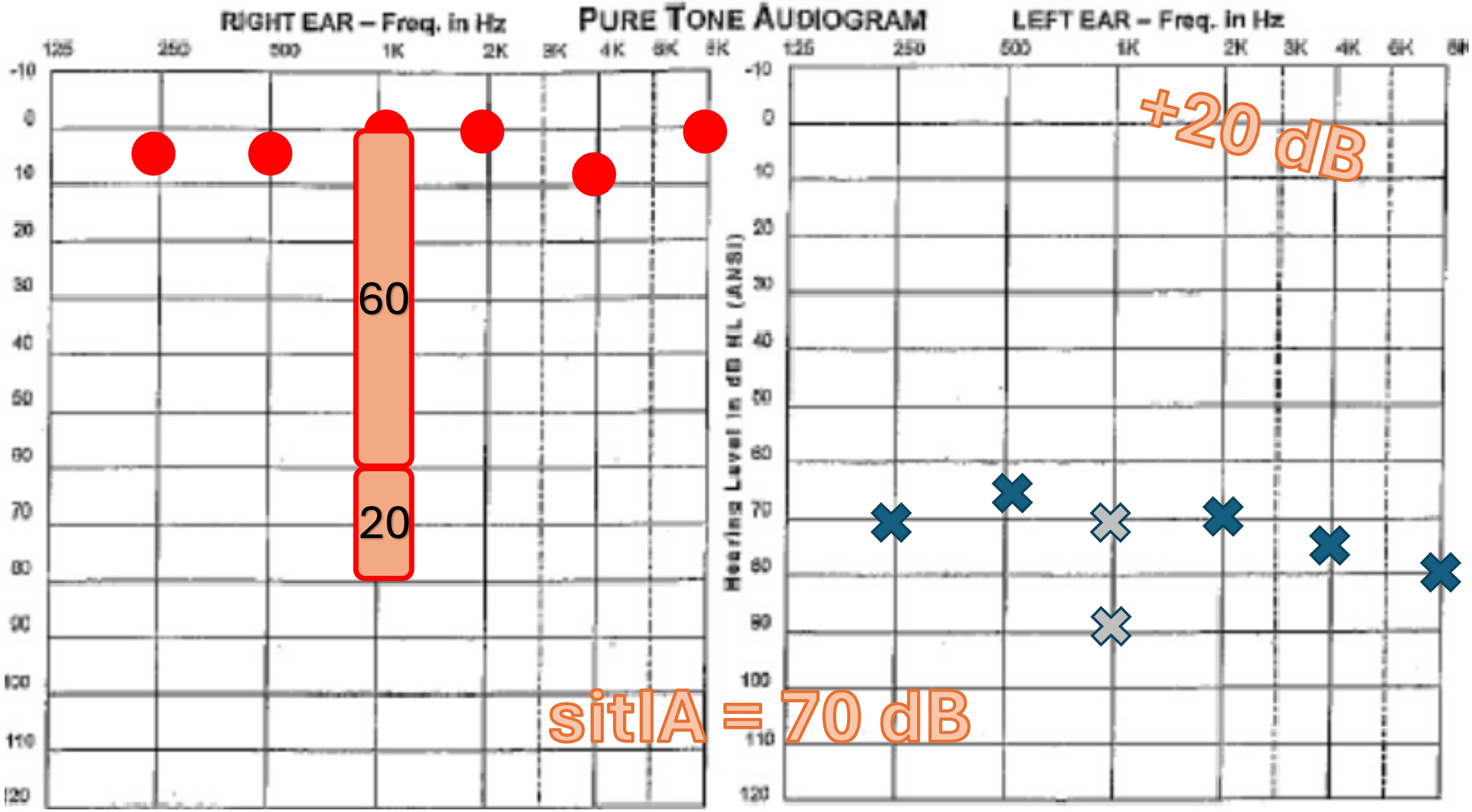
- IML = **AC TE** – 10 dB
- IML = **70** – 10 dB
- IML = **60 dB**

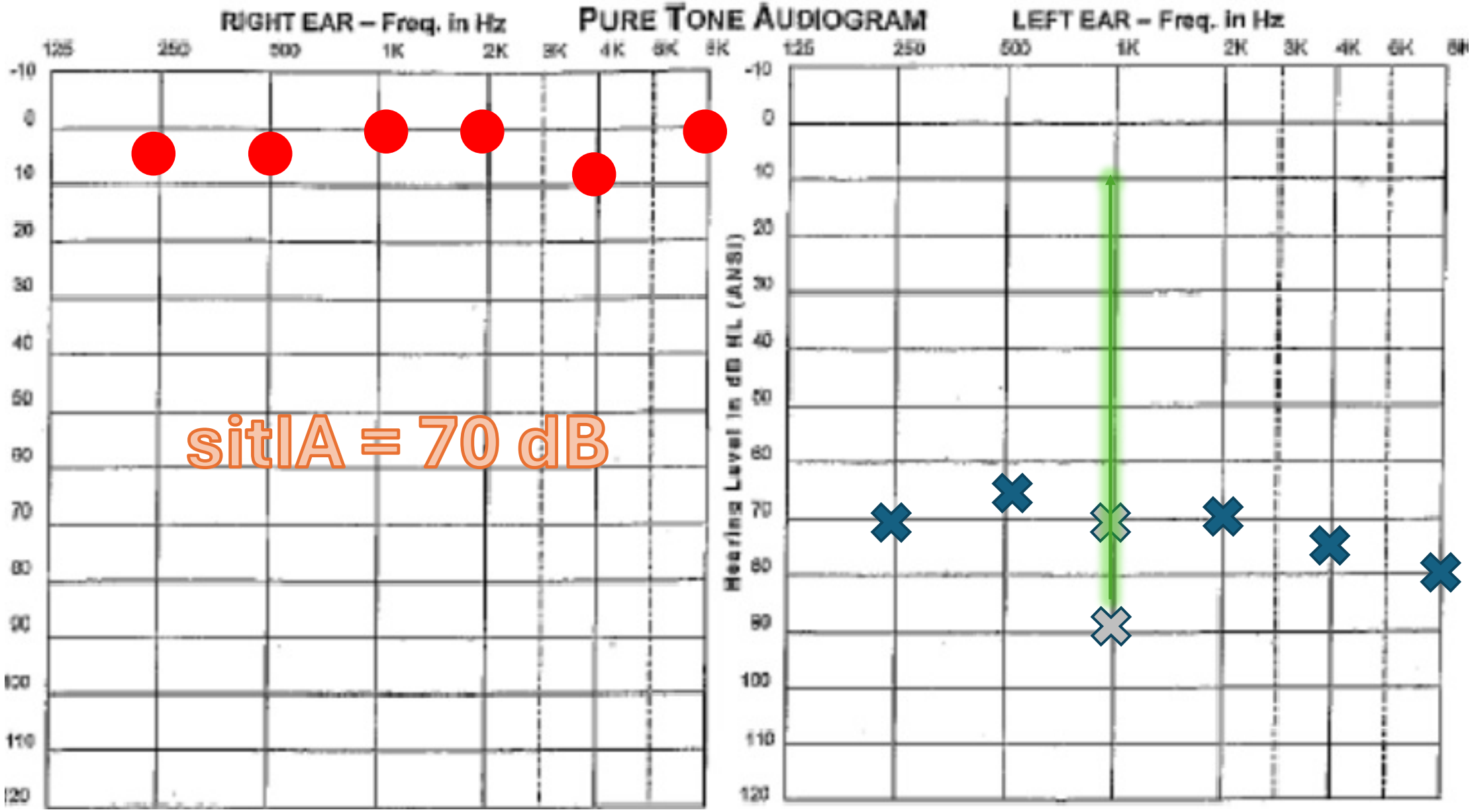



RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
60
Hearing Level in dB HL (ANSI)


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
60
Hearing Level in dB HL (ANSI)


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
60
+20 dB

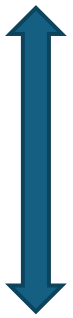

RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
60
20
+20 dB
sitIA = 70 dB


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)
sitIA = 70 dB

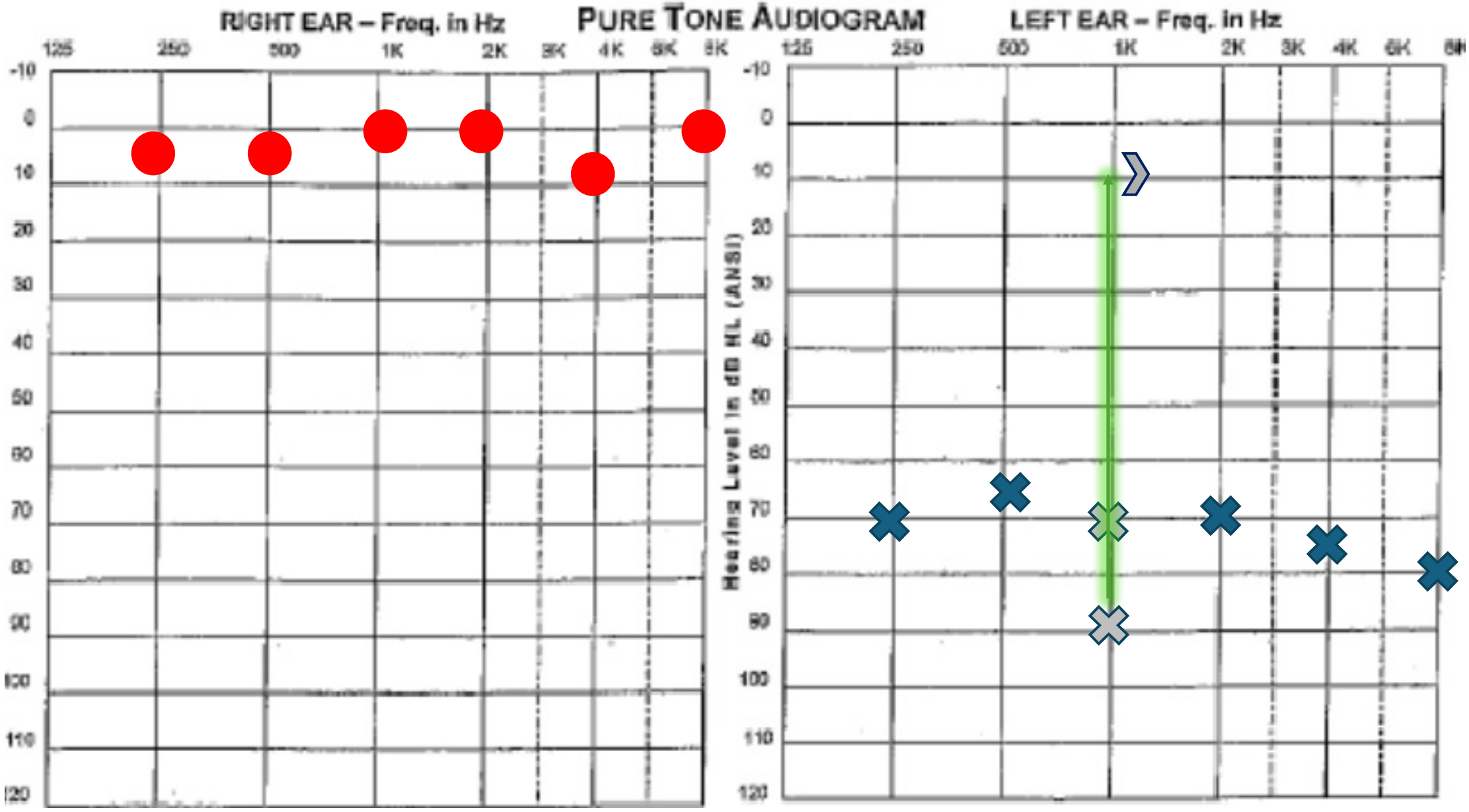
“Masking Redux I: An Optimized Masking Method”

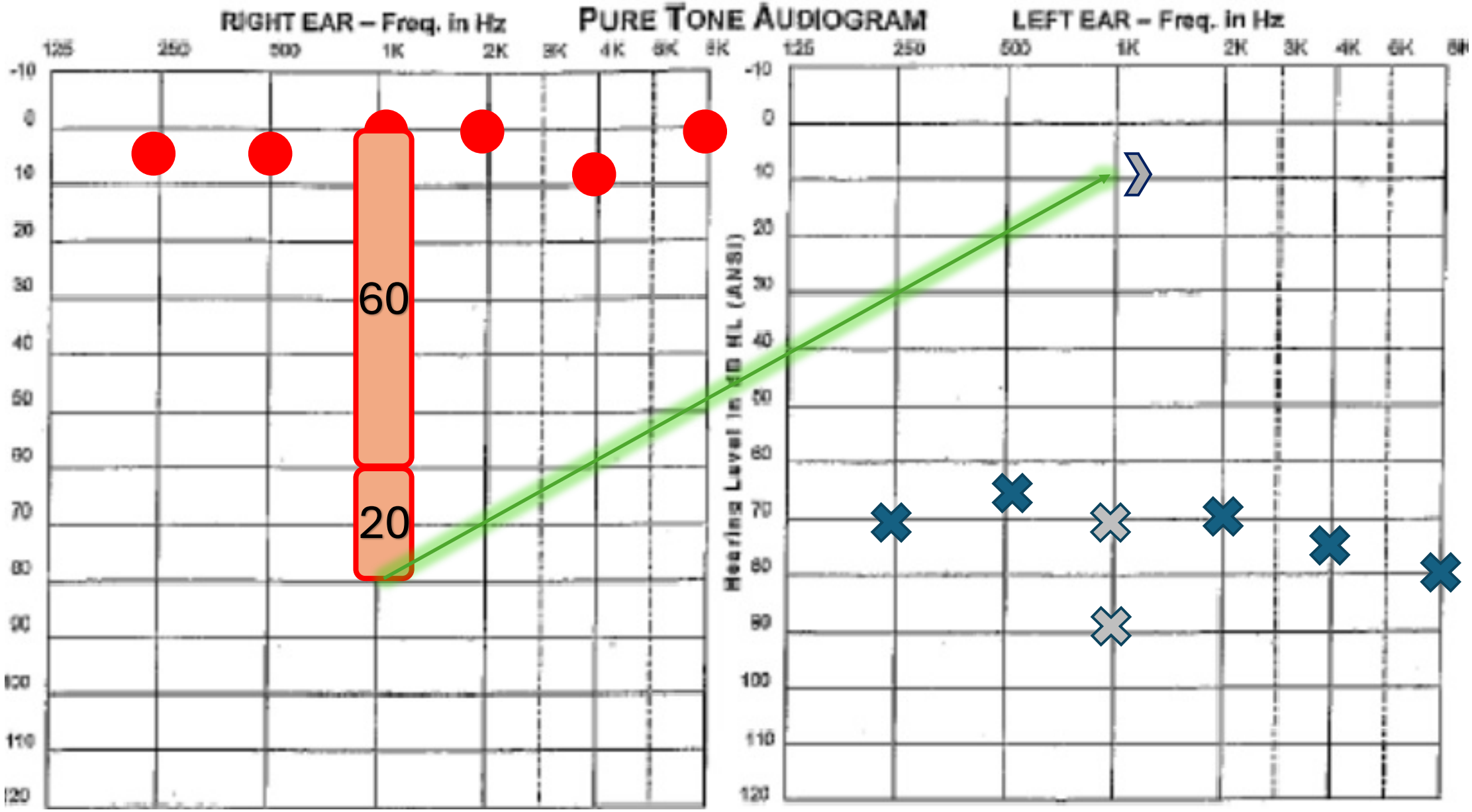
“An air-bone gap cannot be greater than the IA…”

- Turner, 2004



The IA cannot be less than an air-bone gap…even an unmasked one.


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
Hearing Level in dB HL (ANSI)


RIGHT EAR – Freq. in Hz
PURE TONE AUDIOGRAM
LEFT EAR – Freq. in Hz
125
250
500
1K
2K
3K
4K
6K
8K
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
60
20
Hearing Level in dB HL (ANSI)

CAVEAT EMPTOR: ASSUMPTIONS

- We accept that the **IA values inferred from pure-tone** testing **applies to NBN** as well
- We accept that the sitIA values inferred from SRT testing applies to SPN as well

- We assume that a signal radiating from **one side to the other (e.g., from the TE to the NTE**) can also apply to a signal radiating in the opposite direction (from the NTE to the TE direction)

CENTRAL MASKING

CENTRAL MASKING

- When a masking sound is presented to one ear but affects the hearing of the other ear but is not due to cross-hearing via cranial bones
- Central masking event: auditory processing interference
- “Central”: medial olivocochlear region

CENTRAL MASKING

- Some clinicians have applied correction factors to masked threshold measurements

- **1985**: 38% of US audiologists compensated for central masking effects always or in some instances
- **1994**: 23% of US audiologists compensated for CM effects

CENTRAL MASKING RESEARCH



LAB: PSYCHO-ACOUSTICS, PHYSIOLOGY

CLINIC FOCUS

CENTRAL MASKING: CLINICAL

- 1964; Dirks and Malquist (n = 10)
  - MEAN 40 dB CM EFFECT: 1.8 – 3.0 dB [A/C]
  - MEAN 40 dB CM EFFECT: 2.9 – 4.5 [mastoid B/C]
- 1973; Snyder (n = 40)
  - MEAN CM EFFECT A/C: 3.5 – 6.6 dB/**range 0 – 15 dB**
- 1987; Benton and Sheeley (n = 20)
  - CM EFFECT NBN:
  - 59% showed no changes; 18% showed improvements in HTL
- 2011; McQueen and Terhune (n = 11)
  - MEAN CM EFFECT A/C: 3.8 dB

CENTRAL MASKING: CLINICAL

- 1964; Dirks and Malquist (n = 10)
  - MEAN 40 dB CM EFFECT: 1.8 – 3.0 dB [A/C]
  - MEAN 40 dB CM EFFECT: 2.9 – 4.5 [mastoid B/C]

BEKESY

- 1973; Snyder (n = 40)
  - MEAN CM EFFECT A/C: 3.5 – 6.6 dB/**range 0 – 15 dB**

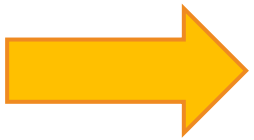
NON-ASCENDING
40 dB NOISE/TDH

- 2011; McQueen and Terhune (n = 11)
  - MEAN CM EFFECT A/C: 3.8 dB

1000 Hz; WHN
1 dB steps

CENTRAL MASKING: CLINICAL

- 1964; Dirks and Malquist (n = 10)
- 1973; Snyder (n = 40)
- **1987; Benton and Sheeley (n = 20)**
- 2011; McQueen and Terhune (n = 11)

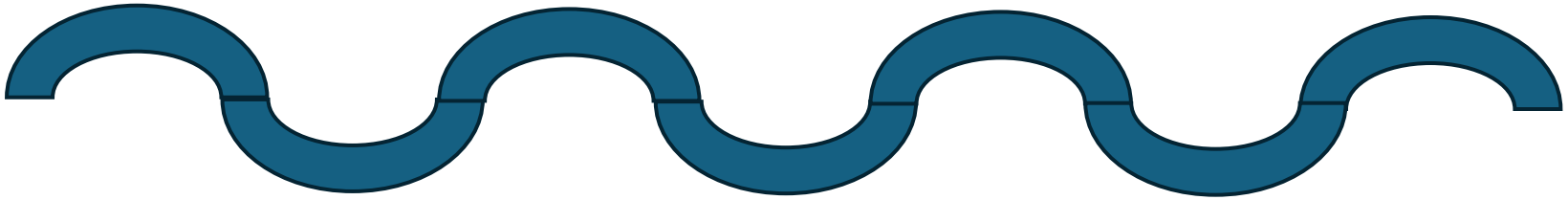


CLINICAL APPROACH

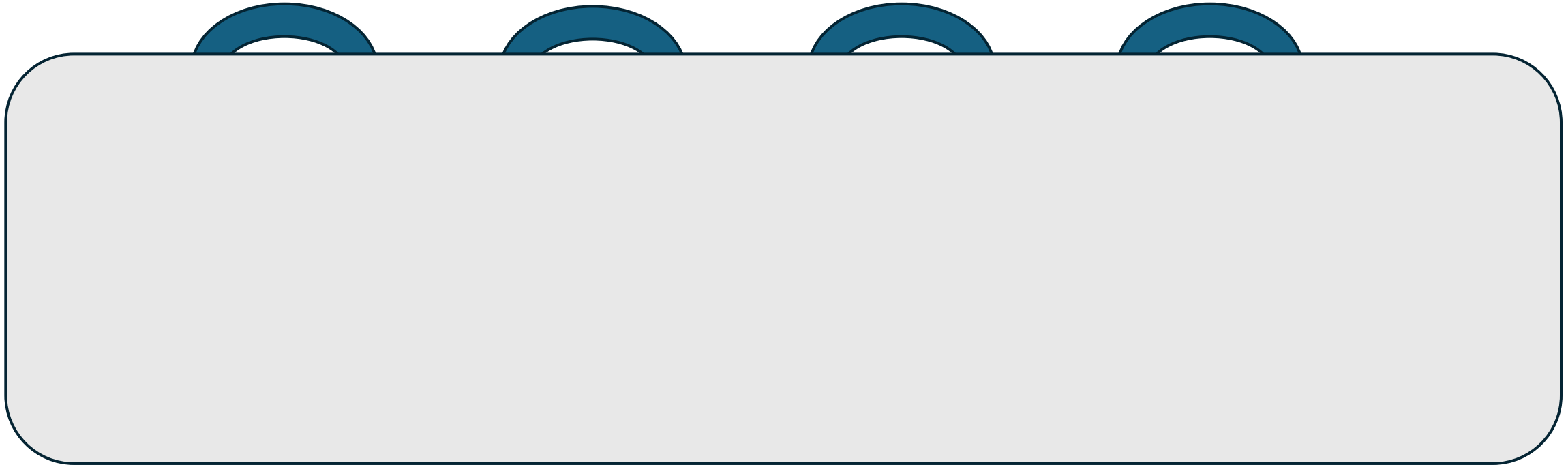
BENTON AND SHEELEY; 1987

	NBN MASKED THRESHOLD SHIFTS			
FREQUENCY	**-5 dB**	**0 dB**	**5 dB**	**10 dB**
500 Hz	3	13	4	0
1000 Hz	6	10	4	0
2000 Hz	5	13	2	0
4000 Hz	0	11	7	2
TOTALS	14	47	17	2
PERCENTAGE	**18%**	**59%**	**21%**	**2%**

“STOCHASTIC RESONANCE”



“STOCHASTIC RESONANCE”



CENTRAL MASKING: REVIEW

- Some concerns about the small amount of clinical research on this topic along with the design of the studies
- Approximate 5 dB test-retest range for variability
- Evidence of central “masking” **improvements** in threshold
- ANSI standard for B/C RETFLs: contra ear masked

THE OCCLUSION EFFECT

OVERVIEW + 2 PAPERS

OCCLUSION EFFECT IN AUDIOMETRY

MASKING FOR BONE-CONDUCTION

“An ironic situation is created when we try to mask…

…the devices that we use to deliver noise can enhance (bone-conducted) signals that we’re trying to mask.”

OCCLUSION EFFECT

- When masking during bone-conduction testing, do you always, 100% of the time, add occlusion effect compensation value?

    - **YES**
    - **NO**

OTOLOGY: BING TEST

- Tuning fork test to Dx conductive versus sensorineural hearing loss



RECOMMENDATIONS
MASKING EARS WITH CONDUCTIVE LOSSES: OCCLUSION COMPENSATION REQUIRED?

Liden et al; 1959	No need to add OE value	Journal article
Martin; 1974	No need to add OE value	Journal article
KatZ 4th Edition; 1994	No need to add OE value	Textbook
Silman and Silverman; 1991	No need to add OA value	Textbook
Katz 6th Edition; 2014	No need to add OE value	Textbook
Yacullo textbook; 1996	No need to add OE value	Textbook

MARTIN ET AL; 1974

AUDIOMETRIC BING TEST FOR DETERMINATION OF MINIMUM MASKING LEVELS FOR BONE-CONDUCTION TESTS

Frederick N. Martin

University of Texas, Austin, Texas

Ernest C. Butler and Paul Burns

Austin Ear, Nose, and Throat Clinic, Austin, Texas

TABLE 1. Frequencies of the magnitudes of occlusion effects at 250 and 500 Hz for 60 subjects (20 in each group).

Hearing Status	*Occlusion Effect* 0 dB	5 dB	10 dB	15 dB	20 dB	25 dB
			At 250 Hz			
Normal	0	0	5	10	5	
Sensorineural Loss	0	0	3	12	5	
Conductive Loss	15	5	0	0	0	
			At 500 Hz			
Normal	0	2	14	4	0	0
Sensorineural Loss	0	0	8	7	3	2
Conductive Loss	15	5	0	0	0	0

Audiometric Bing test for **determination** of **minimum masking levels** for bone-conduction **tests**

FN Martin, EC Butler, P Burns

Journal of Speech and Hearing Disorders, **1974** • pubs.asha.org

Occlusion effects were determined and compared on three groups of subjects (20 nor hearers, 20 with conductive hearing loss, and 20 with sensorineural hearing loss). As i previous studies, the occlusion effects of the conductive group were clearly different fr those of the other two groups, especially at 250 Hz. Two procedures are discussed wh use the principle of the Bing test to determine when and how to compensate for the occlusion effect while masking for bone conduction.

ASHA Publications

☆ Save Cite Cited by 10 Related articles All 6 versions »



TEXTBOOK REVIEW: RECOMMENDED OCCLUSION EFFECT CON

		INSERT PHONES			SUPRA-AURAL		
		250	500	1000	250	500	1000
1988	Larson-Donaldson	n/a	n/a	n/a	15*	15*	10*
1991	Silman and Silverman	CAL	CAL	CAL	CAL	CAL	CAL
1992	Staab; 1992	n/a	n/a	n/a	n/a	n/a	n/a
1994	Goldstein and Newman (Katz ed.)	n/a	n/a	n/a	15**	15**	10**
1996	Yacullo	n/a	n/a	n/a	30*	20*	10*
1997	Gelfand	CAL	CAL	CAL	CAL	CAL	CAL
2000	Roeser and Clark (Roeser et al ed.)	n/a	n/a	n/a	20*	15*	5*
2000	Martin and Clark	CAL	CAL	CAL	CAL	CAL	CAL
2001	Gelfand	CAL	CAL	CAL	CAL	CAL	CAL
2009	Valente	n/a	n/a	n/a	20*	20*	5*
2015	Yacullo (Katz ed.)	10*	10*	0*	30*	20*	10*

* MEAN VALUES ADOPTED

** LESS THAN MEAN ADOPTED

CAL = calculate individual OE

TEXTBOOK REVIEW: RECOMM TION VALUES

		INSERT PHONES			SUPRA-AURAL		
		250	500	1000	250	500	1000
1988	Larson-Donaldson	n/a	n/a	n/a	15*	15*	10*
1991	Silman and Silverman	CAL	CAL	CAL	CAL	CAL	CAL
1992	Staab; 1992	n/a	n/a	n/a	n/a	n/a	n/a
1994	Goldstein and Newman (Katz ed.)	n/a	n/a	n/a	5**	15**	10**
1996	Yacullo	n/a	n/a	n/a	30*	20*	10*
1997	Gelfand	CAL	CAL	CAL	CAL	CAL	CAL
2000	Roeser and Clark (Roeser et al ed.)	n/a	n/a	n/a	20*	15*	5*
2000	Martin and Clark	CAL	CAL	CAL	CAL	CAL	CAL
2001	Gelfand	CAL	CAL	CAL	CAL	CAL	CAL
2009	Valente	n/a	n/a	n/a	20*	20*	5*
2015	Yacullo (Katz ed.)	10*	10*	0*	30*	20*	10*

* MEAN VALUES ADOPTED

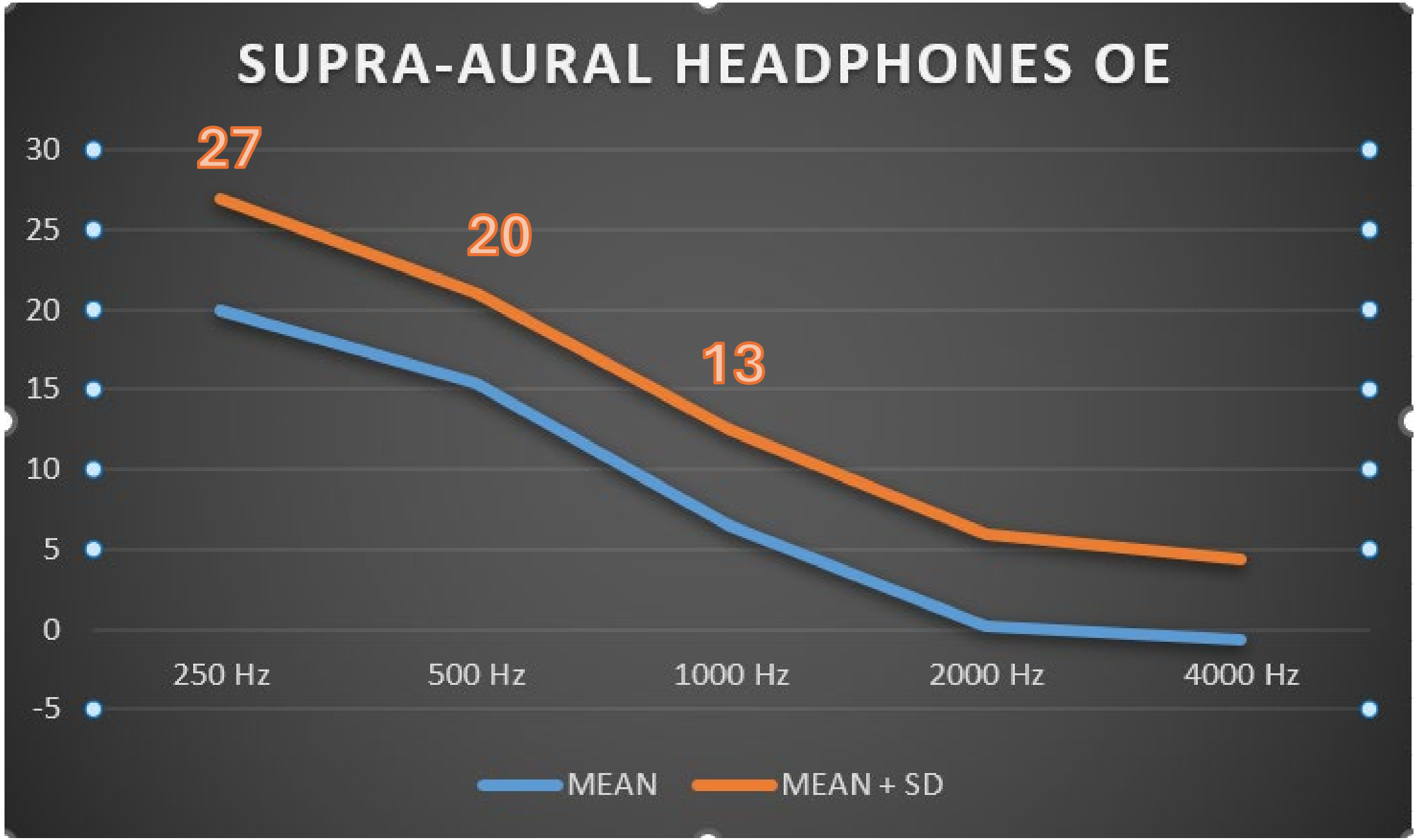
** LESS THAN MEAN ADOPTED

CAL = calculate individual OE

www.maskinghandbook.com

B/C OCCLUSION EFFECT DATA: MASTOID PLACEMENT

ARTICLE	N	TRANSDUCER		FREQUENCY					
				250 HZ	**500 Hz**	**1000 HZ**	**2000 Hz**	**3000 HZ**	**4000 Hz**
SUPRA-AURAL EARPHONES									
2007 Stenfelt and Reinfeldt	20	Supra-aural TDH-39	Median [dB]	12	4	2	1	2	0
			MAX	26	15	15	15	10	5
2000 Dean and Martin	20	Supra-aural TDH-39	Means [dB]	14	13	3			
			SD	4.3	4.4	5.2			
1983 Berger and Kerivan	6	TDH-50 phones	Means [dB]	20.3	21.6	7.5	-1.3		
			SD	7.2	6.3	3	5.1		
1982 Frank	40	Supra-aural TDH-39	Means [dB]	12.2	10.1	5.1	0.3		0.4
			SD	6.1	5.7	5.4	5.4		5.2
1967 Dirks and Swindeman	11	Supra-aural TDH-39	Means [dB]	23.7	19.3	7.5	0.6		
			SD	n/a	n/a	n/a	n/a	n/a	n/a
1963 Elpern and Naunton	12	Supra-aural PDR 10	Means [dB]	31	23	11	0		0
			SD	7.5	4.5	5.5	4.5		3
1963 Elpern and Naunton	12	Supra-aural TDH-39	Means [dB]	28	20	9	0		0
			SD	6.5	4	4.5	4.5		3
1965 Goldstein and Hayes	28	Supra-aural TDH-39	Means [dB]	19.4	12.57	5.71	1.07		-4.14
			SD	8	9.7	7	3.8		9.7
	149								


SUPRA-AURAL HEADPHONES OE
30
25
20
15
10
5
0
-5
27
20
13
250 Hz
500 Hz
1000 Hz
2000 Hz
4000 Hz
MEAN
MEAN + SD

2000; “INSERT EARPHONE DEPTH AND THE OCCLUSION EFFECT”

Insert earphone depth and the occlusion effect

MS Dean, FN Martin

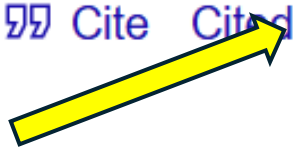
American Journal of Audiology, 2000 • pubs.asha.org

Abstract

Twenty individuals were tested to determine the occlusion effect caused by supr
earphones and by insert earphones with shallow and deep insertion of its foam
bone-conduction oscillator was placed both on the forehead and the mastoid. It
concluded that using deeply inserted earphones is the most practical way in whi
out clinical bone-conduction measurements.

ASHA Publications

☆ Save Cite Cited by 96 Related articles All 9 versions



www.maskinghandbook.com

B/C OCCLUSION EFFECT DATA: MASTOID PLACEMENT

			FREQUENCY			
INSERT PHONES FULL INSERTION			**250**	**500**	**1000**	**2000**
2000 Dean and Martin	20	Mean	9	6	1	
		SD	6	5.6	3.7	
2017 DeSantolo	5	Mean	2	5	5	
		SD	4.5	6.1	5	
2018 Neave-DiToro et al	20	Mean	9.8	7	2.8	
		MAX	20	20	20	

			FREQUENCY			
INSERT PHONES PARTIAL INSERTION			**250**	**500**	**1000**	**2000**
2000 Dean and Martin	20	Mean	16	10	6	
		SD	6.6	4.5	6	
2017 DeSantolo	5	Mean	8	12	12	
		SD	4.5	8.4	4.5	
2018 Neave-DiToro et al	20	Mean	13	12.5	8	
		MAX	25	25	15	

2018; NEAVE-DITORO ET AL

J Am Acad Audiol 29:826–834 (2018)

Accounting for the Occlusion Effect with Insert Earphones

DOI: 10.3766/jaaa.17045

Dorothy Neave-DiToro*
Amanda DeSantolo†
Michael Bergen*
Adrienne Rubinstein*

2018; NEAVE-DITORO ET AL

TEXTBOOK REVIEW: RECOMMENDED OCCLUSION EFFECT COMPENSATION VALUES

		INSERT PHONES		
		250	500	1000
1988	Larson-Donaldson	n/a	n/a	n/a
1991	Silman and Silverman	CAL	CAL	CAL
1992	Staab; 1992	n/a	n/a	n/a
1994	Goldstein and Newman (Katz ed.)	n/a	n/a	n/a
1996	Yacullo	n/a	n/a	n/a
1997	Gelfand	CAL	CAL	CAL
2000	Roeser and Clark (Roeser et al ed.)	n/a	n/a	n/a
2000	Martin and Clark	CAL	CAL	CAL
2001	Gelfand	CAL	CAL	CAL
2009	Valente	n/a	n/a	n/a
2015	Yacullo (Katz ed.)	10*	10*	0*

* MEAN VALUES ADOPTED
** LESS THAN MEAN ADOPTED
CAL = calculate individual OE

MAX OE VALUES [FULL INSERTION] REC'D:

- 250 Hz = 20 dB
- 500 Hz = 20 dB
- 1000 Hz = 20 dB

INSERTS

THE MASKING HANDBOOK (FOR AUDIOMETRY)

250 Hz

Full One

Freq.	%
1	5
4	20
8	40
11	55
17	85
20	100
20	100

20 dB



500 Hz

Full One

Freq.	%
1	5
4	20
11	55
18	90
18	90
20	100
20	100

15 dB



1000 Hz

Full One

Freq.	%
5	25
12	60
15	75
18	90
19	95
20	100
20	100

10 dB



2018; NEAVE-DITORO ET AL

- Research on OE for inserts is slim-pickens
- **Partial insertion** vs **full insertion** of the inserts produced different results
- Legacy recommendations for inserts & TDH have been under-estimated
- Unmasked bone-conduction testing: leave both ears un-occluded

FINAL COMMENT: INSERT EARPHONES

SNUG FIT IN EAR CANAL AND FAIRLY DEEP INSERTION

- Higher interaural attenuation characteristics
- Lower occlusion effect characteristics