Maximum Conductive Hearing Loss-Revisited

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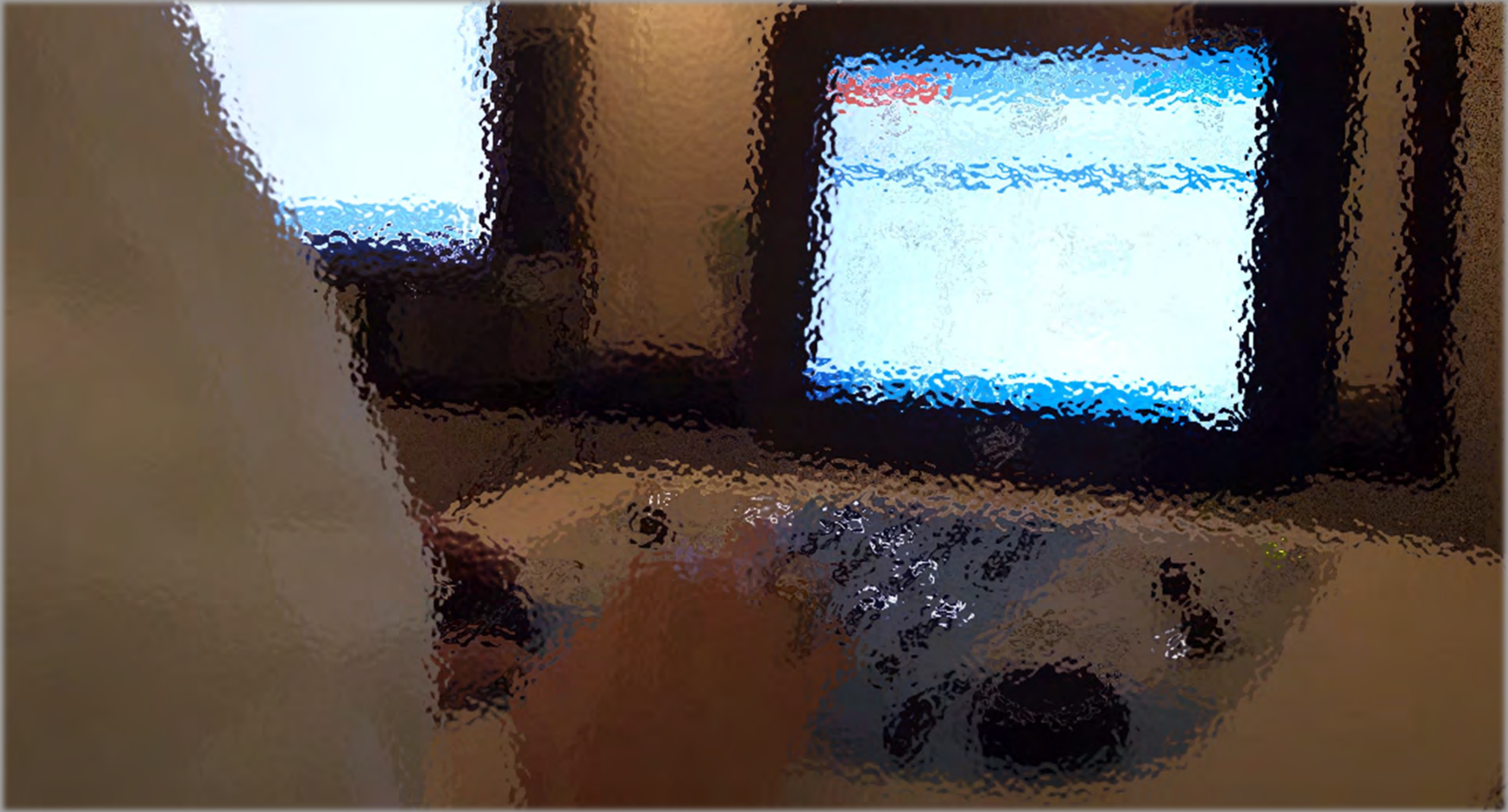

The audiologist’s most fundamental core competency: Pure tone audiometry

Pure tone audiometry: Uncomplicated for symmetric SNHL

Pure tone audiometry:
Complicated for significant air/bone gap, especially when bilateral

Describe

Explain

Describe

Summarize

Describe

Explain

Describe

Summarize

why maximum conductive hearing loss (maximum CHL) has been accepted to be around 60 dB for decades

Describe

why maximum conductive hearing loss (maximum CHL) has been accepted to be around 60 dB for decades

Explain

how interaural attenuation (IA) and maximum CHL are related

Describe

Summarize

Describe

Explain

Describe

Summarize

why maximum conductive hearing loss (maximum CHL) has been accepted to be around 60 dB for decades

how interaural attenuation (IA) and maximum CHL are related

why maximum CHL can feasibly be upward of 105 dB

Describe

why maximum conductive hearing loss (maximum CHL) has been accepted to be around 60 dB for decades

Explain

how interaural attenuation (IA) and maximum CHL are related

Describe

why maximum CHL can feasibly be upward of 105 dB

Summarize

the implications of maximum CHL being dependent on the transducer used

Today's Journey

1. Prevalence of the Assertion
2. Physics of Sound Transmission
3. What the Research Tells Us
4. Case Studies
5. Implications

1

Prevalence of the Assertion

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maximum conductive hearing loss

maximum conductive hearing loss

maximum conductive hearing loss **skull vibration**

maximum conductive hearing loss **would be approximately ___ db**

maximum conductive hearing loss **db**

why maximum conductive hearing loss **is 60 db**

how common is conductive hearing loss

is noise induced hearing loss conductive

does conductive hearing loss **get worse**

maximal conductive hearing loss

conductive hearing loss **frequency**

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The Belief of Maximum Conductive Hearing Loss has been Unwavering

https://vr4hearingloss.net › what › conductive-hearing-l...

2 – Conductive Hearing Loss Causes

When there is complete disarticulation of the ossicles, the person will have the maximum conductive loss possible, **about 60 dB HL**, which is in the 'moderate' ...

The Belief of Maximum Conductive Hearing Loss has been Unwavering

Conductive hearing losses can range up to a maximum of about **50-60 dB HL** (mild to moderate hearing loss). People with conductive hearing losses, who use hearing aids, generally do very well.

https://www.boystownhospital.org › knowledge-center › t...

Types of Hearing Loss - Boys Town National Research Hospital

The Belief of Maximum Conductive Hearing Loss has been Unwavering

https://jamanetwork.com › jamaotolaryngology › fullarticle

[Effects of Aural Atresia on Speech Development and Learning](https://jamanetwork.com)

by DR Jensen · 2013 · Cited by 63 — Nearly all subjects demonstrated pure tone averages around 60 dB HL in the affected **ear**, consistent with **maximal conductive loss**, and normal ...

https://www.google.com/search?q=maximum+conductive+hearing+loss&sca_esv=345267d81bec8f30&sca_upv=1&...

Google

maximum conductive hearing loss

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It appears that an approximate **60-dB loss** is the maximal air-conduction impairment (with accompanying normal bone conduction) to be anticipated with middle-ear defects.

American Academy of Audiology
https://www.audiology.org › audiology-today › articles

Maximum Conductive Hearing Loss—Revisited

About featured snippets · Feedback

People also ask

How severe can conductive hearing loss be?

Can I use a hearing aid with conductive hearing loss?

What causes maximum hearing loss?

What is the difference between mixed and conductive hearing loss?

https://www.google.com/search?q=maximum+conductive+hearing+loss&sca_esv=345267d81bec8f30&sca_upv=1&...

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maximum conductive hearing loss

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Maximum Conductive Hearing Loss—Revisited

About featured snippets • Feedback

People also ask

How severe can conductive hearing loss be?

Can I use a hearing aid with conductive hearing loss?

What causes maximum hearing loss?

What is the difference between mixed and conductive hearing loss?

"It appears that an approximate 60-dB loss is the maximal air-conduction impairment (with accompanying normal bone conduction) to be anticipated with middle-ear defects. Therefore, if the air-conduction loss in a patient with apparently typical middle-ear pathology exceeds 60 dB, it is likely that inner-ear impairment is superimposed on the middle-ear lesion, the extent of which will be revealed by bone-conduction measurements."

Source: Reger, Scott (1944)

maximum conductive hearing loss

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It is the aim of this article to disabuse audiologists and otolaryngologists of the idea that a conductive hearing loss cannot be greater than 60 dB. It will be demonstrated that air-bone gaps are both transducer specific and frequency specific and can feasibly be upward of 105 dB.

American Academy of Audiology
https://www.audiology.org › audiology-today › articles

Maximum Conductive Hearing Loss—Revisited

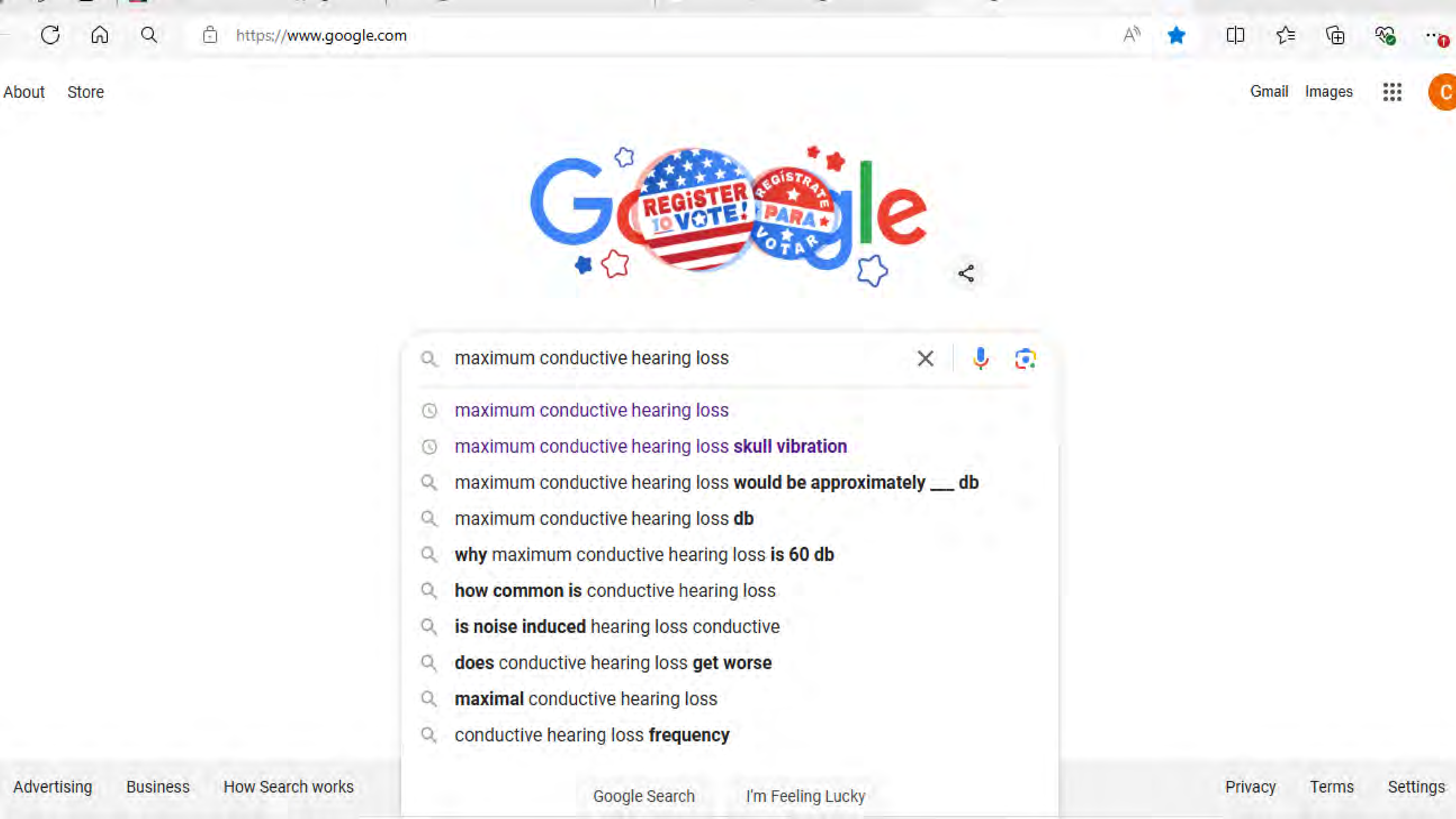
About featured snippets · Feedback

People also ask

What is the maximum amount of conductive hearing loss?

What is the most common cause of conductive hearing loss?

How do you fix conductive hearing loss?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Store
Gmail
Images
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REGISTER TO VOTE!
REGÍSTRATE PARA VOTAR
maximum conductive hearing loss
maximum conductive hearing loss
maximum conductive hearing loss skull vibration
maximum conductive hearing loss would be approximately ___ db
maximum conductive hearing loss db
why maximum conductive hearing loss is 60 db
how common is conductive hearing loss
is noise induced hearing loss conductive
does conductive hearing loss get worse
maximal conductive hearing loss
conductive hearing loss frequency
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“At 60 dB SPL the bones of the skull begin to vibrate, bypassing the middle ear system. This direct vibration of the skull can cause the cochlea to vibrate and, thus, the hair cells to shear and to start the process of hearing.”

Source: National Research Council

Mother and audiologist know best

Why is a conductive hearing loss not more than 60 dB?

All related (33) Sort Recommended

Leah
Hearing parent of deaf child · Author has **3.2K** answers and **6.5M** answer views · 6y

It's not always not more than 60 dB. My daughter has a severe-profound conductive loss on one side (her consultant agrees that the books say that isn't possible, but there it is).

Today's Journey

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Physics of Sound Transmission

Efficiency of Sound Transmission

Bone-Conduction

- Very efficient
- Interaural attenuation can be as little as 0 dB
- It is because of this efficiency that we mask for bone-conduction thresholds so much more readily than for air- conduction thresholds

Air-Conduction

- Very inefficient compared with other elastic media
- Crossing over of the signal is via bone conduction (bone conduction by air conduction)
- Minimum interaural attenuation
  - 40 dB using a headphone transducer
  - 55 dB using an insert transducer
  - Variability

Efficiency of Sound Transmission: Bone-Conduction

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Killion et al (1985)
Sklare and Denenberg (1987)

Relationship Between Pressure and Area

Pressure = Force/Area

$P=F/A$

For our purposes

- Pressure (measured in Pa, or N/m^2) = sound pressure
- Force (measured in N) = force exerted on the skull by the sound pressure
- Area (measured in m^2) = area of the skull being stimulated

Relationship Between Pressure and Area

Force = Pressure · Area

$$F = PA$$

For our purposes

- Pressure (measured in Pa, or N/m^2) = sound pressure
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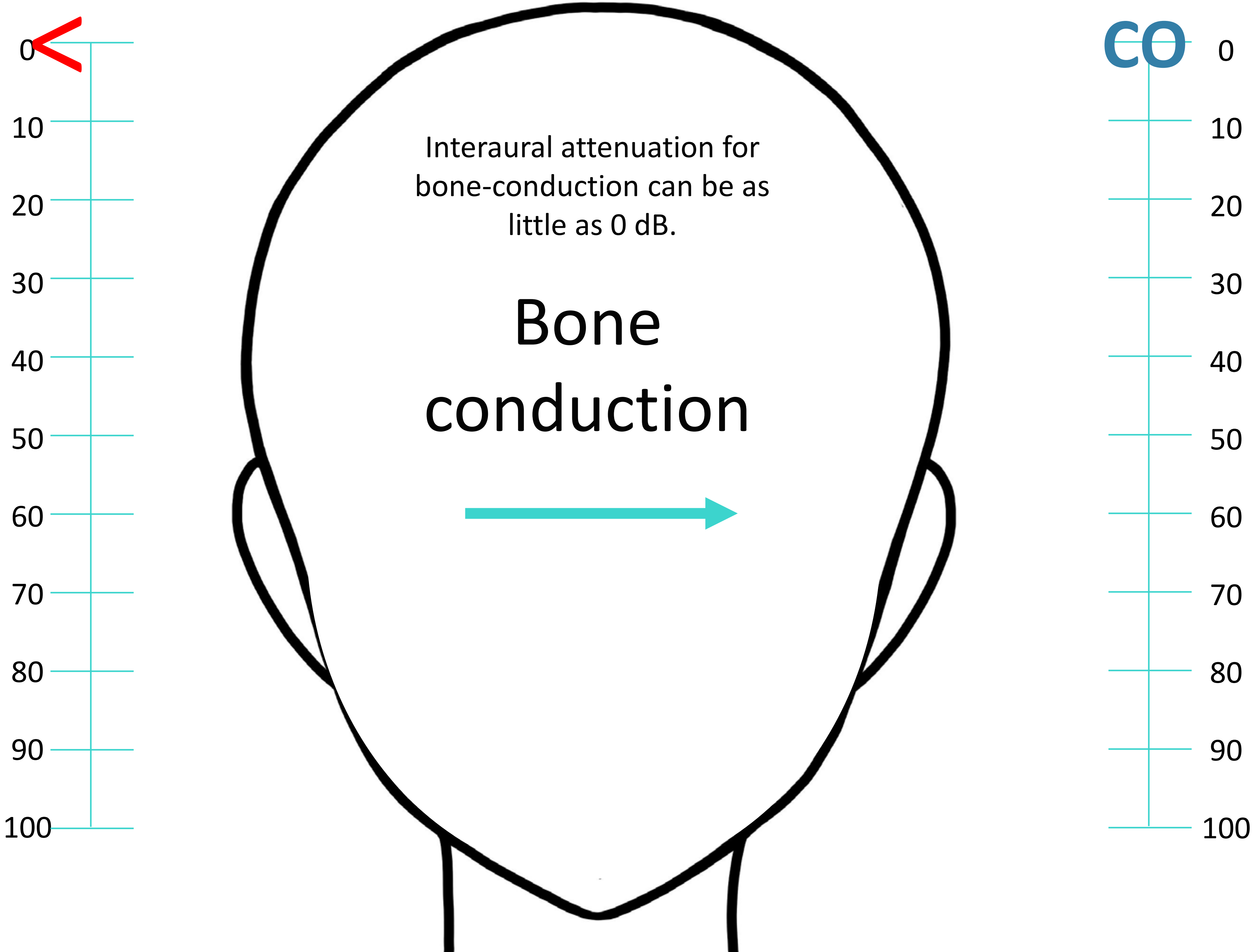
$$\text{Force} = \text{Pressure} \cdot \text{Area}$$

$$F = PA$$

Force = Pressure · Area

$$F = pA$$

A Thought Experiment



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Interaural attenuation for bone-conduction can be as little as 0 dB.
Bone conduction
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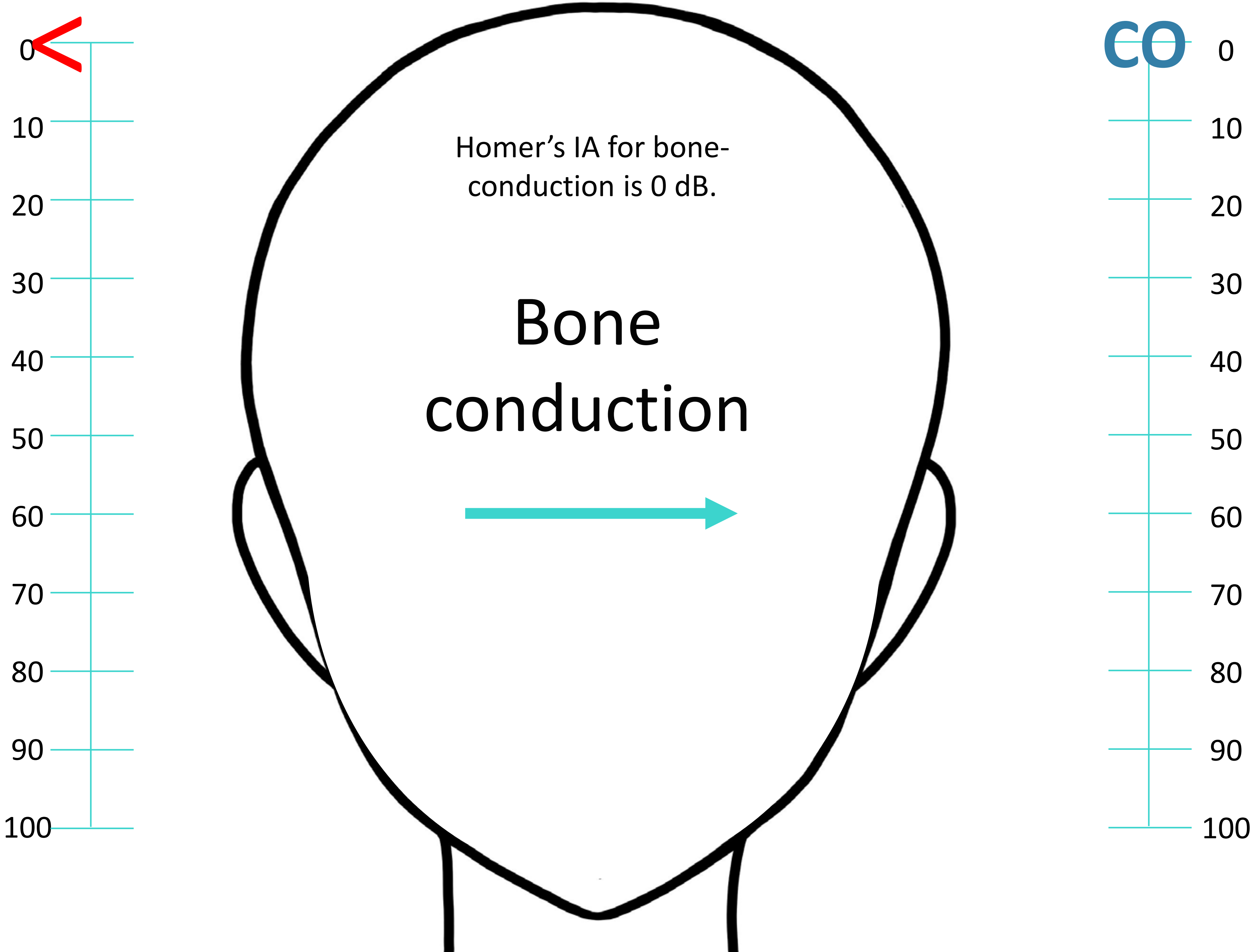

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Homer's IA for bone-conduction is 0 dB.
Bone conduction
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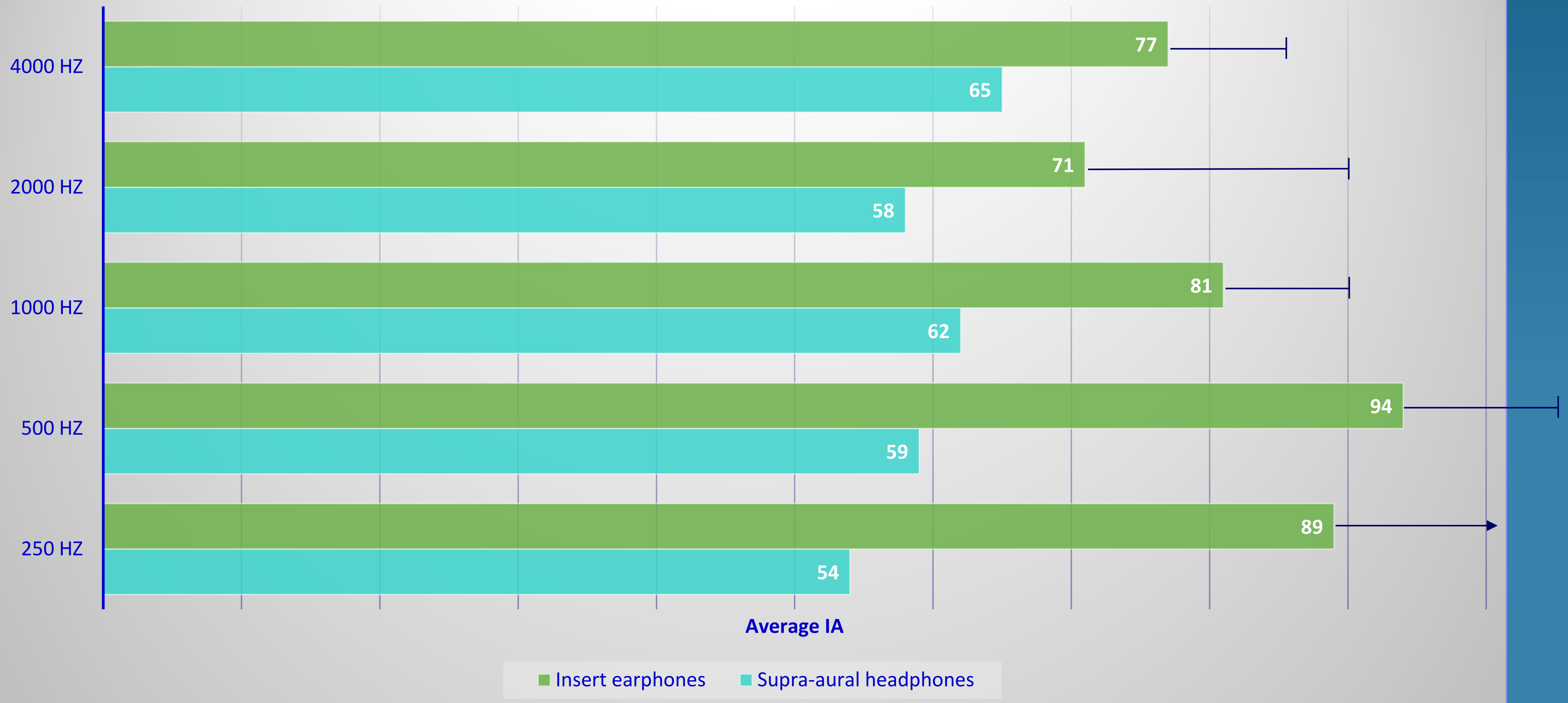
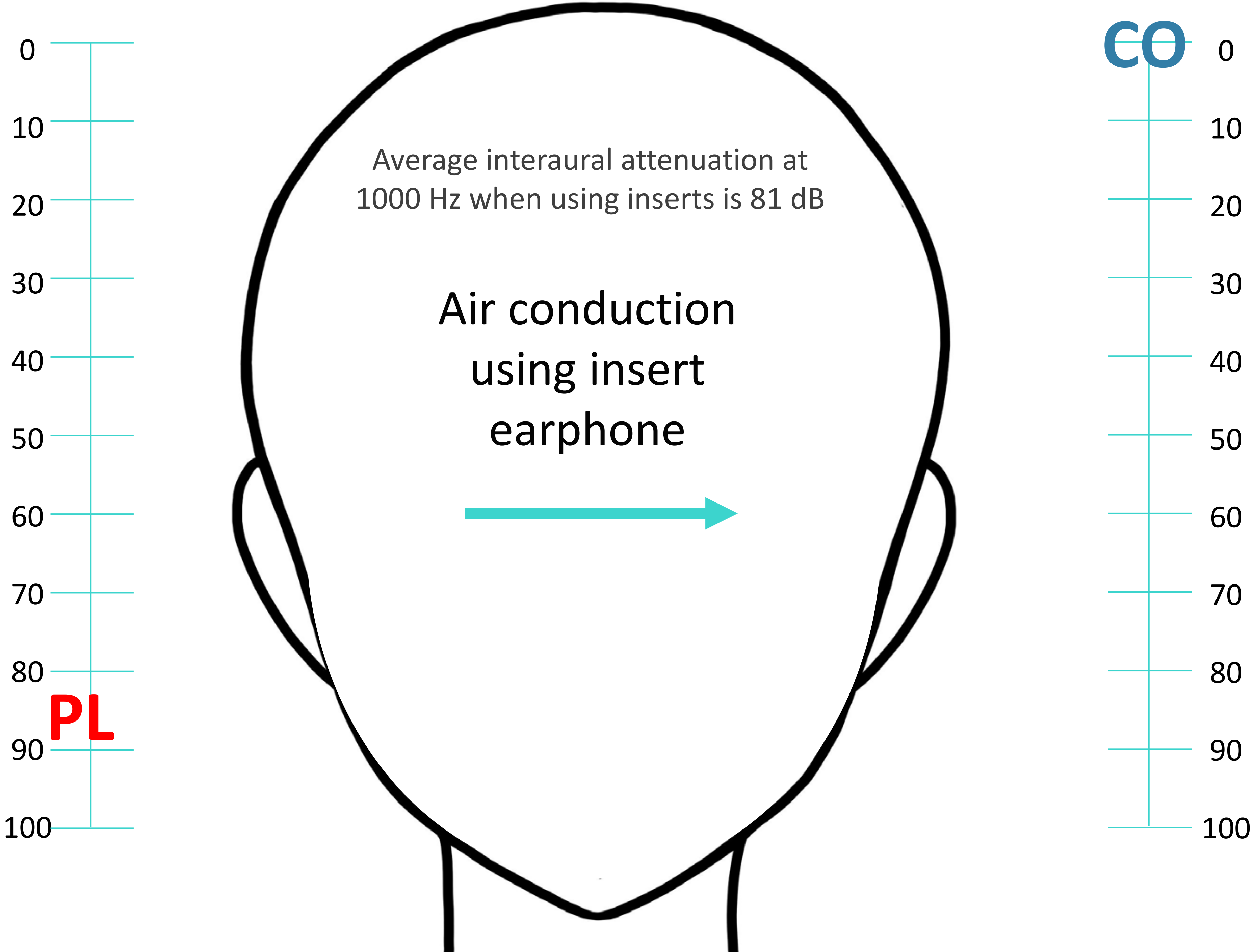
Interaural Attenuation when using inserts vs. headphones



Sklare and Denenberg, (1987)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Average interaural attenuation at
1000 Hz when using inserts is 81 dB
Air conduction
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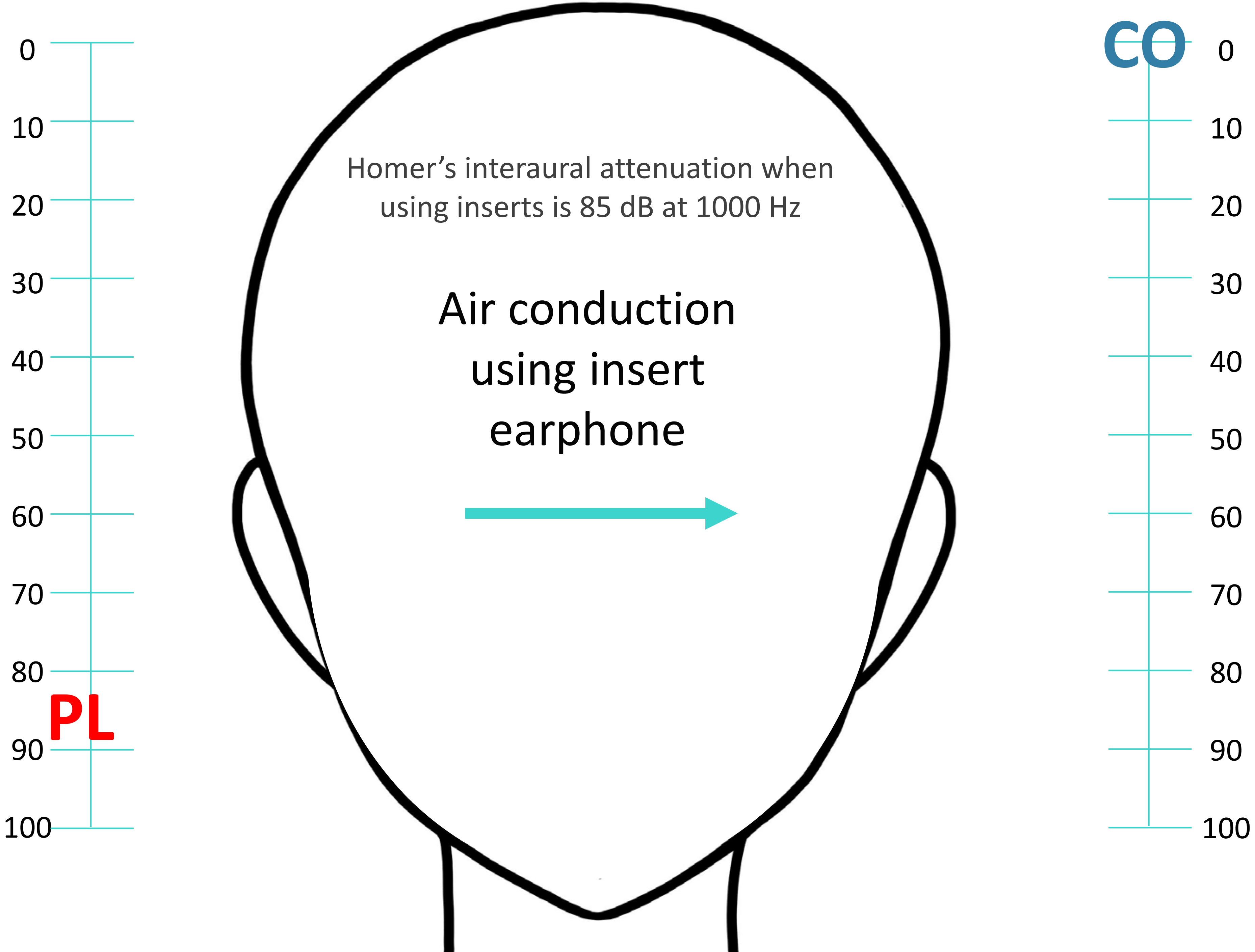

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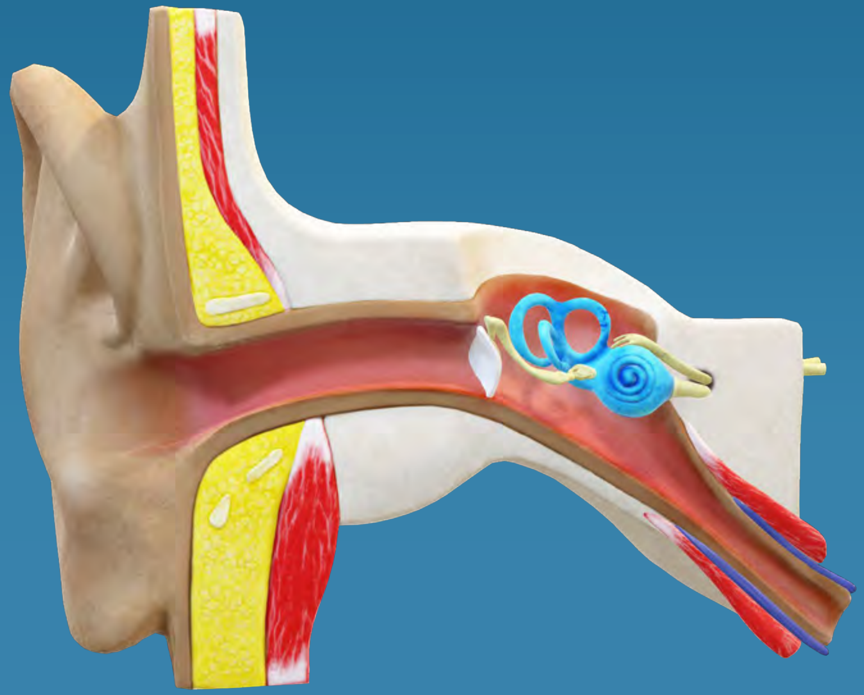
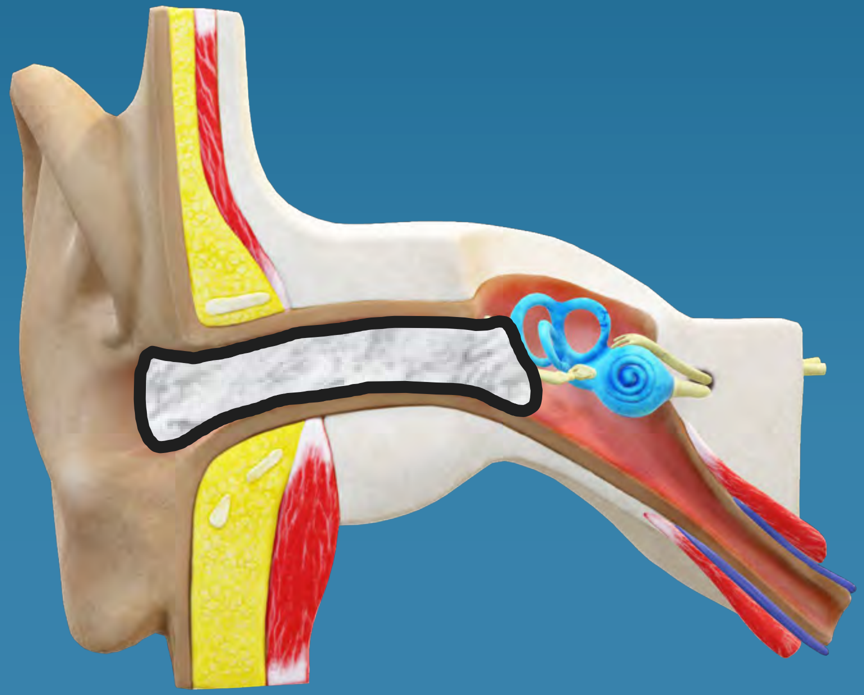
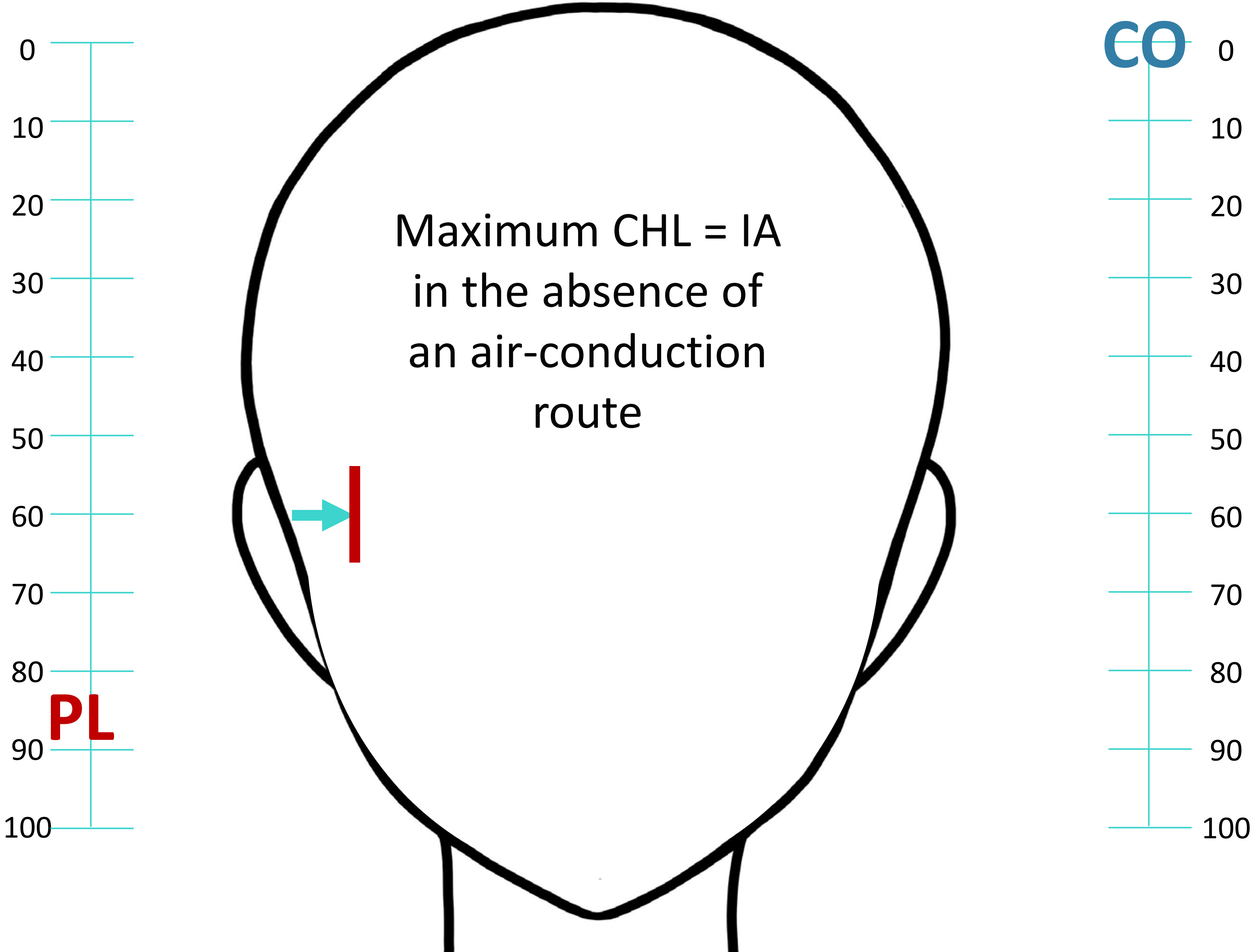
Homer's interaural attenuation when using inserts is 85 dB at 1000 Hz
Air conduction using insert earphone







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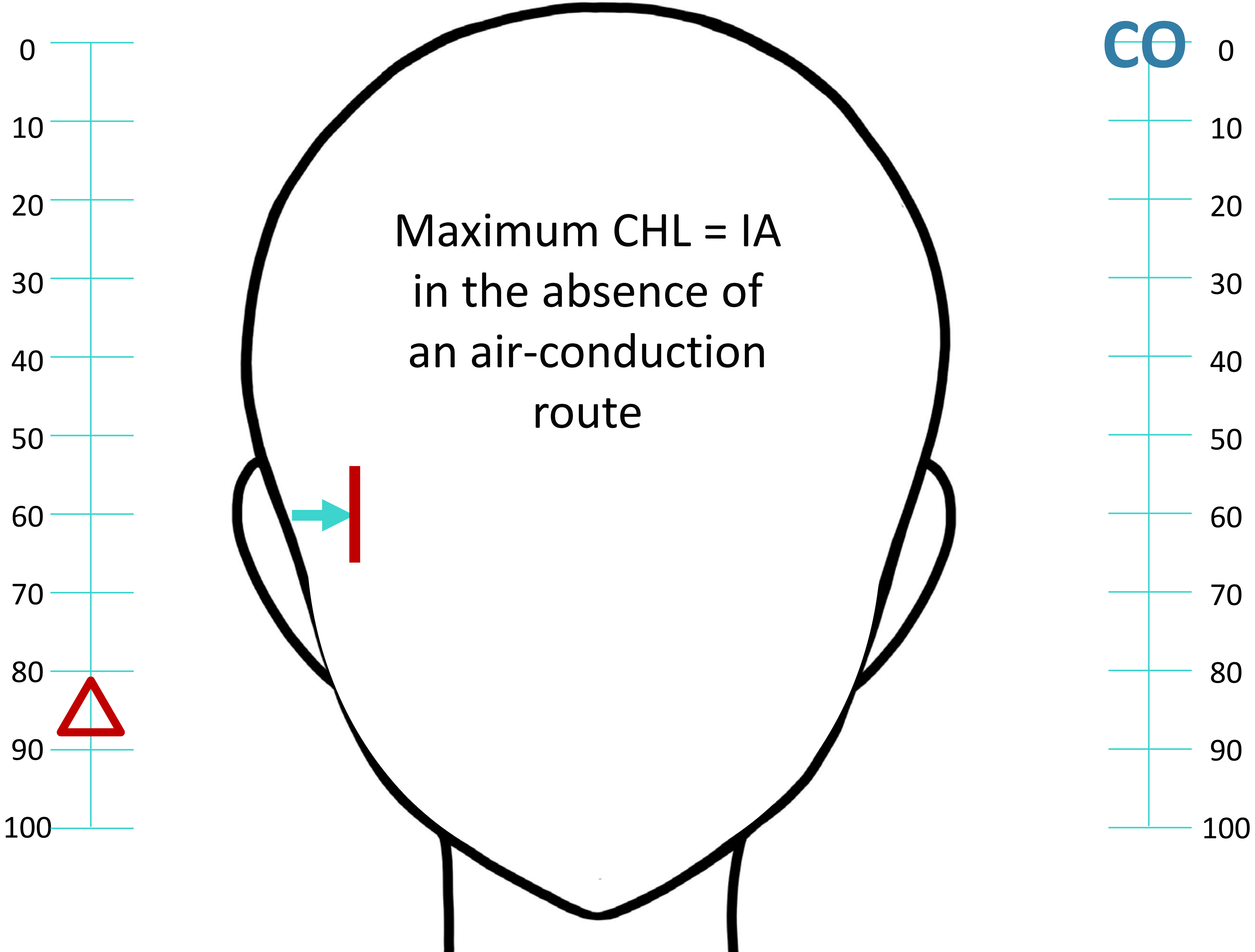
Maximum CHL = IA
in the absence of
an air-conduction
route



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3

What the Research Tells Us

A Good Idea for a Study with an Erroneous Conclusion

American Speech-Language-Hearing Association | ASHA
https://pubs.asha.org › doi › pdf › jshr.0602.157

Maximum Air-Conduction Hearing Loss

by AS Feldman · 1963 · Cited by 24 — Thus, if **hearing** at **maximum** levels in **conductive** losses is actually a result of stimulation by bone-**conduction**, the semi-insert **ear**-phone should be able to ...

Alan S. Feldman, Maximal Air-Conduction Hearing Loss (1963)

- Compared air-bone gaps of 38 otosclerotic ears
  - When using cushion earphones
  - When using semi-insert earphones
- Supposition: "If the 60 dB air-bone gap is a function of the area of the earphone in contact with the skull, then it should be possible to measure greater air-conduction hearing losses with earphones providing less transmission by bone-conduction."

Diagnosis

Degree of Loss

Assumption

Conclusion

Diagnosis

Degree of Loss

Assumption

Conclusion

Only otosclerotic ears were included

Diagnosis

Degree of Loss

Assumption

Conclusion

Only otosclerotic ears were included

Minimum air-conduction hearing loss was set at 50 dB

Diagnosis

Degree of Loss

Assumption

Conclusion

Only otosclerotic ears were included

Minimum air-conduction hearing loss was set at 50 dB HL

"If hearing at maximum levels in conductive losses is actually a result of stimulation by bone-conduction, the semi-insert earphone should be able to measure an air-bone gap of greater than 60 dB."

Diagnosis

Degree of Loss

Assumption

Conclusion

Only otosclerotic ears were included

Minimum air-conduction hearing loss was set at 50 dB HL

"If hearing at maximum levels in conductive losses is actually a result of stimulation by bone-conduction, the semi-insert earphone should be able to measure an air-bone gap of greater than 60 dB."

Results from 2 patients were given short shrift

Alan S. Feldman, Maximal Air-Conduction Hearing Loss (1963)

- Overall, there was no statistically significant difference between the transducers
- Differences in air-conduction thresholds for Subject B

Transducer	125 Hz	250 Hz	500 Hz	1000 Hz	4000 Hz
Cushion earphones	~65 dB HL	~75 dB HL	~65 dB HL	~60 dB HL	~60 dB HL
Semi-insert earphones	NR at ~75 dB HL	NR at ~95 dB HL	~95 dB HL	~95 dB HL	~65 dB HL

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> ~10 dB

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	> ~10 dB	> ~20 dB			

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	> ~10 dB	> ~20 dB	~30 dB	~35 dB	~5 dB

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Case Studies

Rinne Test

Weber Test

Rinne Test

Weber Test

Tuning fork test used to determine if there is an air/bone gap by having the patient say whether the sound is louder when held close to the auditory meatus or when held against the mastoid process

Rinne Test

Weber Test

When the patient hears better through the air route than through the bone route, the test is positive.

When the patient hears better through bone, it is negative, or reversed

Rinne Test

Weber Test

When the patient hears better through the air route than through the bone route, the test is positive.

When the patient hears better through bone, it is negative, or reversed

Rinne Test

Weber Test

Tuning fork test used to determine the nature of a hearing loss as conductive or sensorineural by asking the patient to lateralize sound when the tuning fork is placed mid-line

Rinne Test

Weber Test

Sound that lateralizes to the better ear indicates a SNHL of the poorer ear

Sound that lateralizes to the poorer ear indicates a CHL of the poorer ear

Rinne Test

Weber Test

Sound that lateralizes to the better ear indicates a SNHL of the poorer ear

Sound that lateralizes to the poorer ear indicates a CHL of the poorer ear

Twenty-two-year-old female

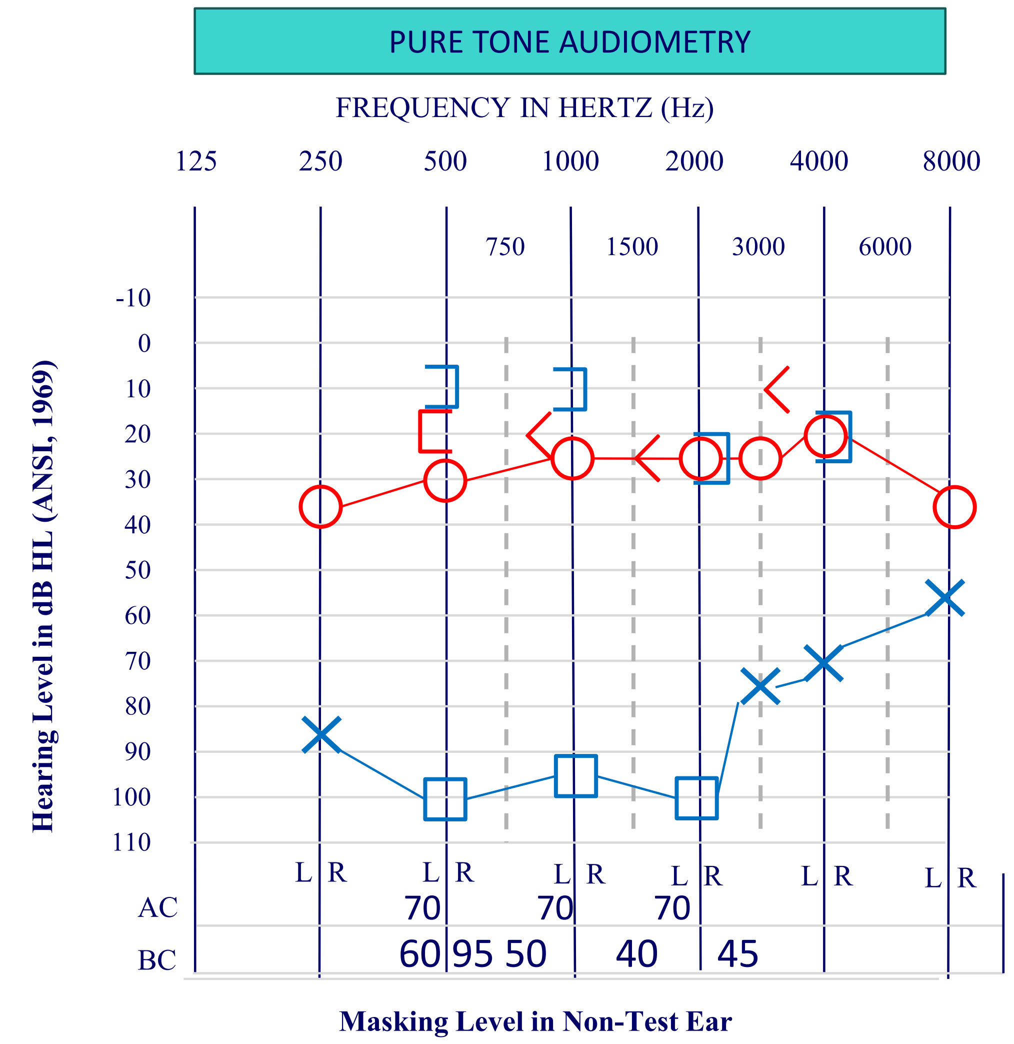
- Worse ear: left
- The Rinne exhibited bone-conduction greater than air-conduction of the left ear
- The Weber lateralized to the left
- These results are suggestive of conductive component of the left ear at 512 Hz

Case History

Twenty-two-year-old female

Status-post removal of extensive tympanosclerosis

Type B tympanogram, AS



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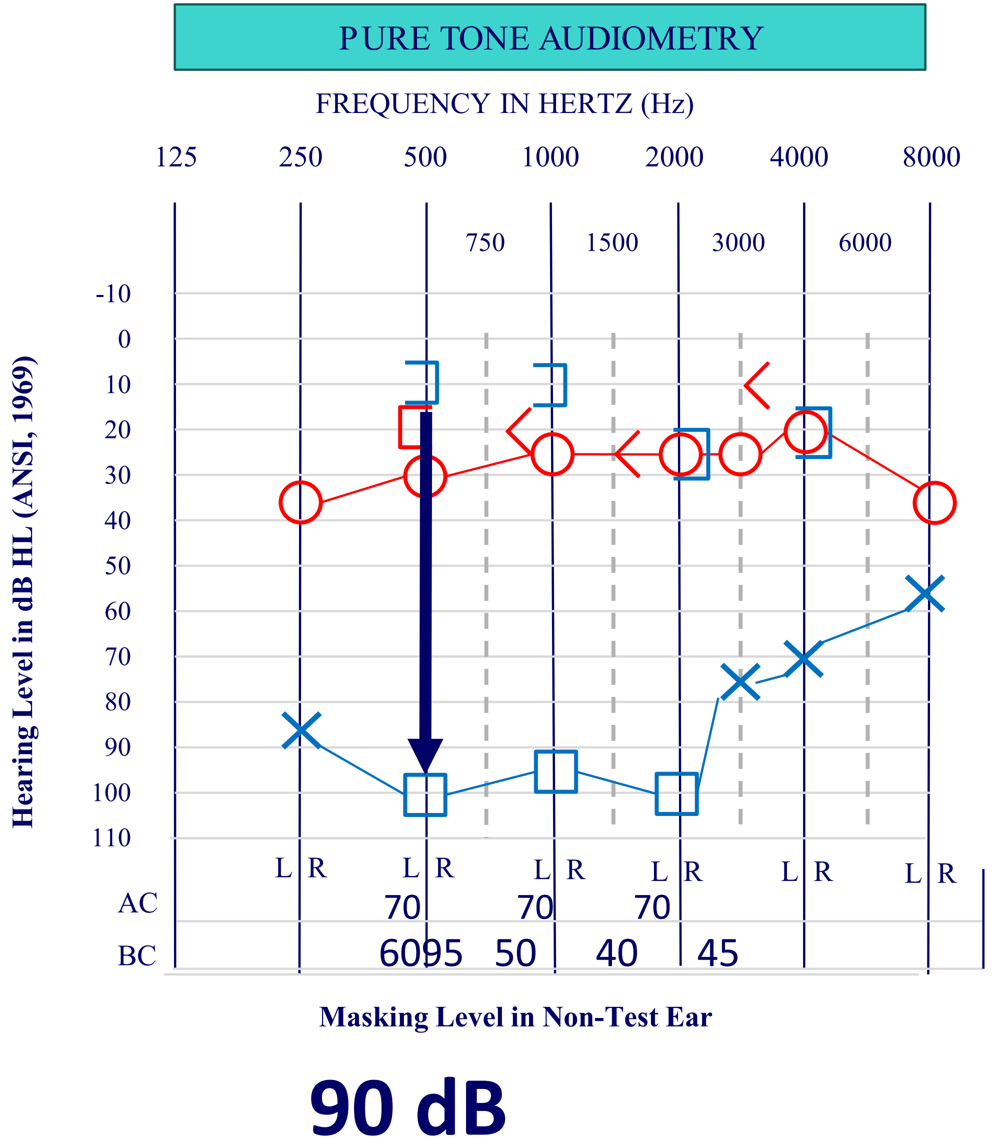

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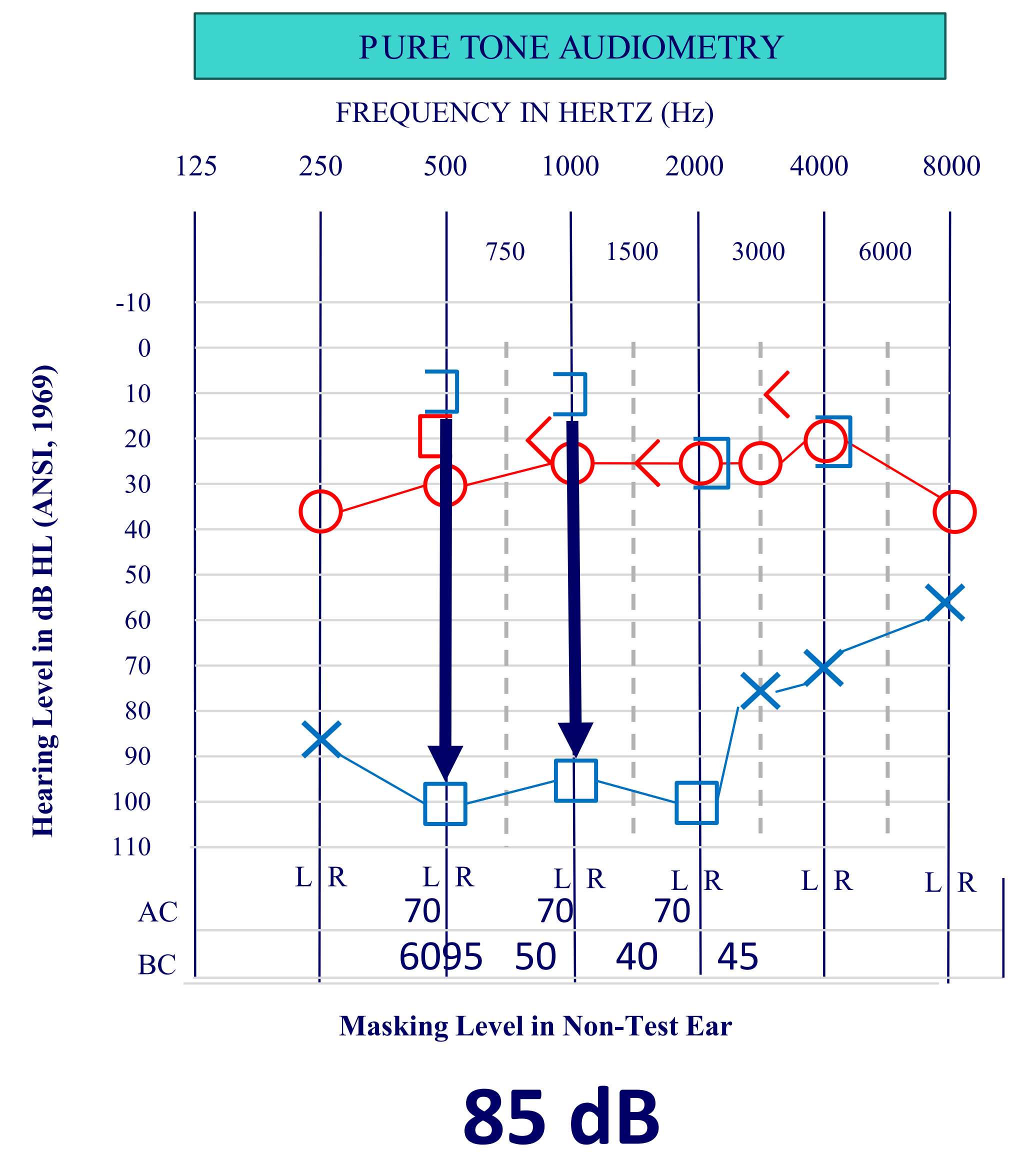

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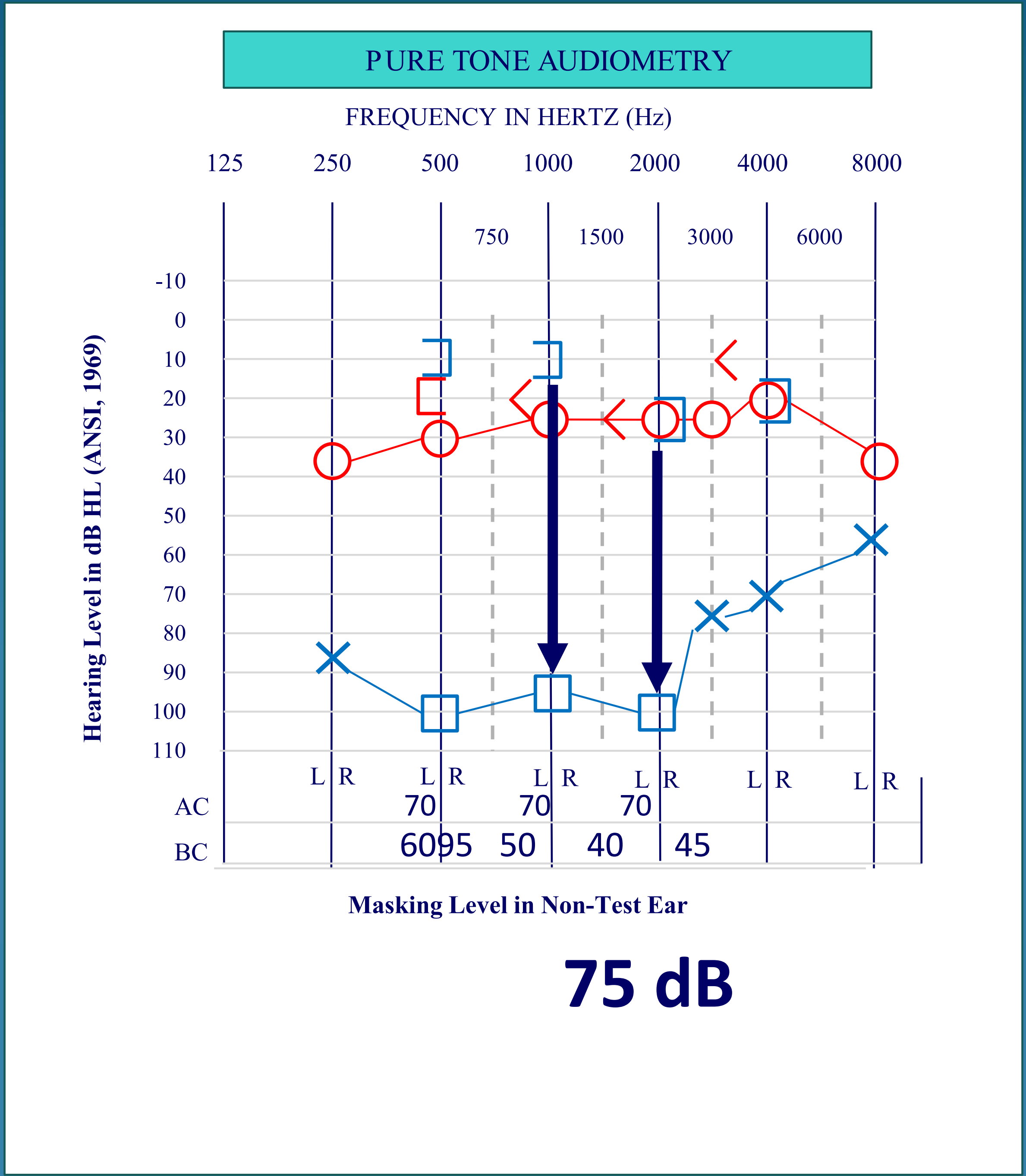
Type B tympanogram, AS



Sixty-year-old female

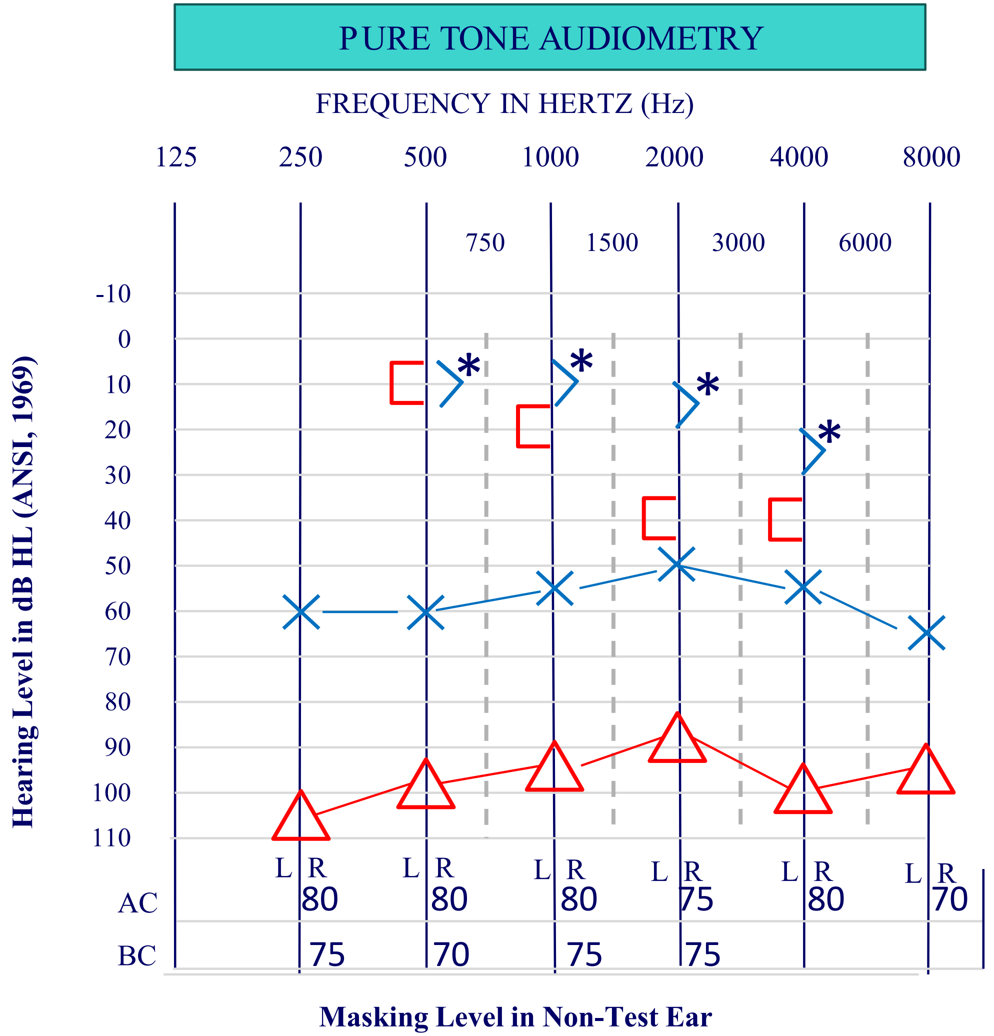
- Worse ear: right
- Rinne reversed, bilaterally
- Weber did not lateralize
- These results are suggestive of conductive component bilaterally at 512 Hz

Case History

Sixty-year-old female

Right myringosclerosis and ottorhea

Type B tympanograms, AU



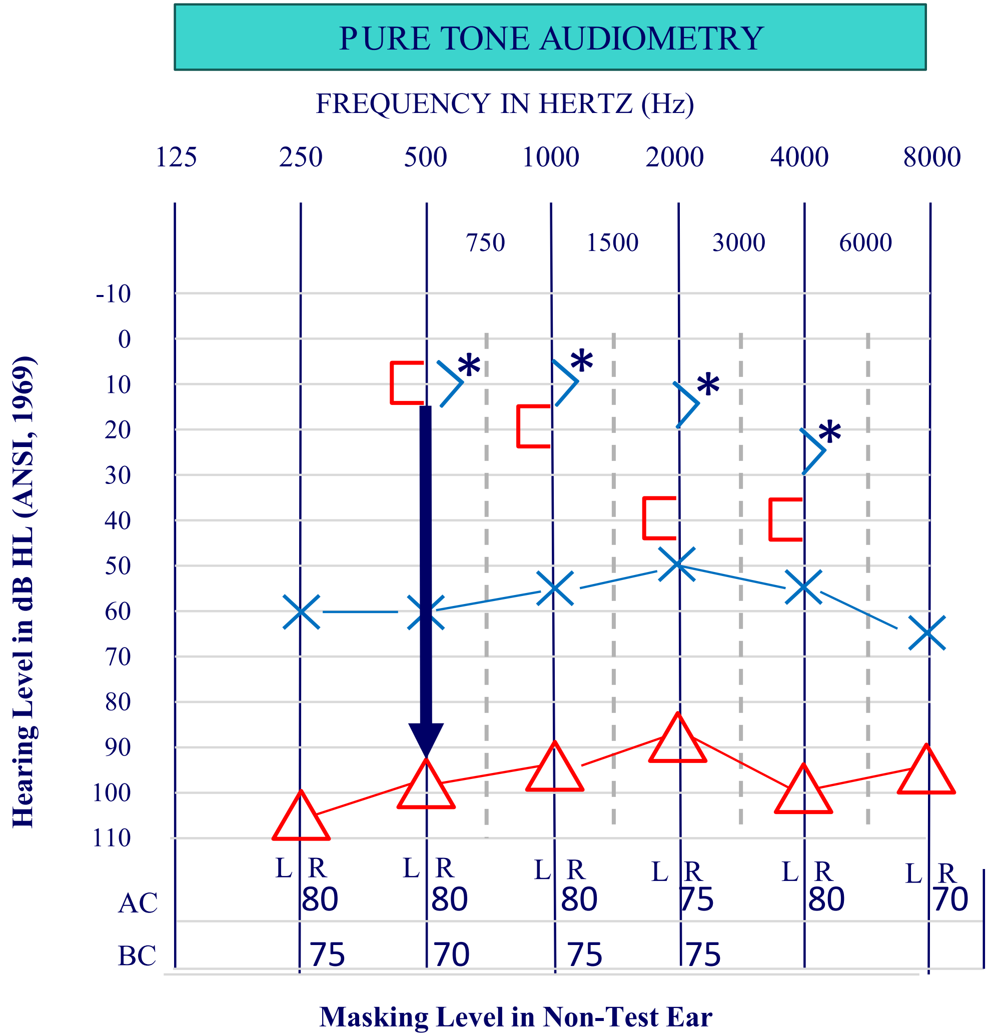
*Masking dilemma

Case History

Sixty-year-old female

Right myringosclerosis and ottorhea

Type B tympanograms, AU



90 dB

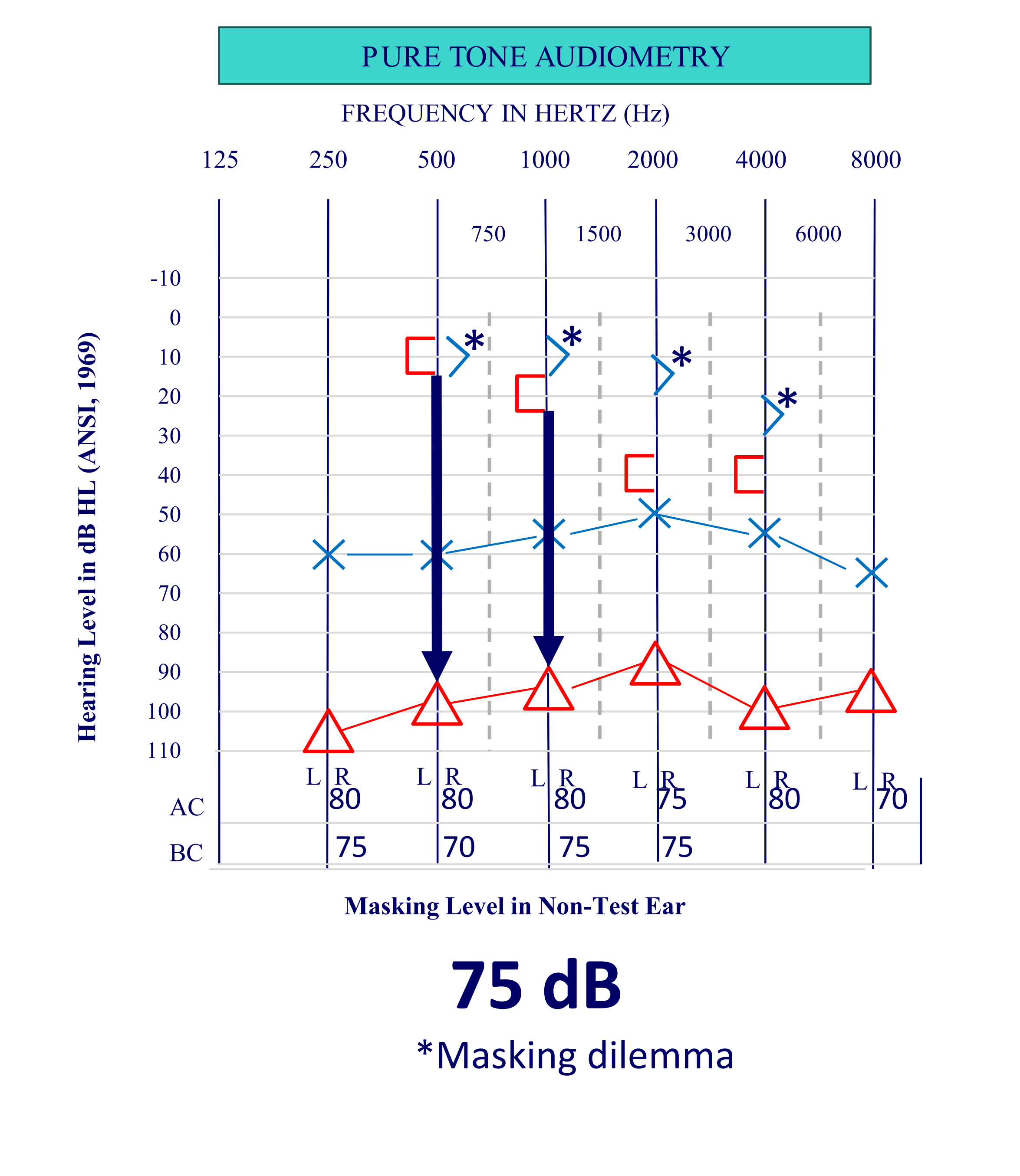
*Masking dilemma

Case History

Sixty-year-old female

Right myringosclerosis and ottorhea

Type B tympanograms, AU



Sixty-three-year-old female

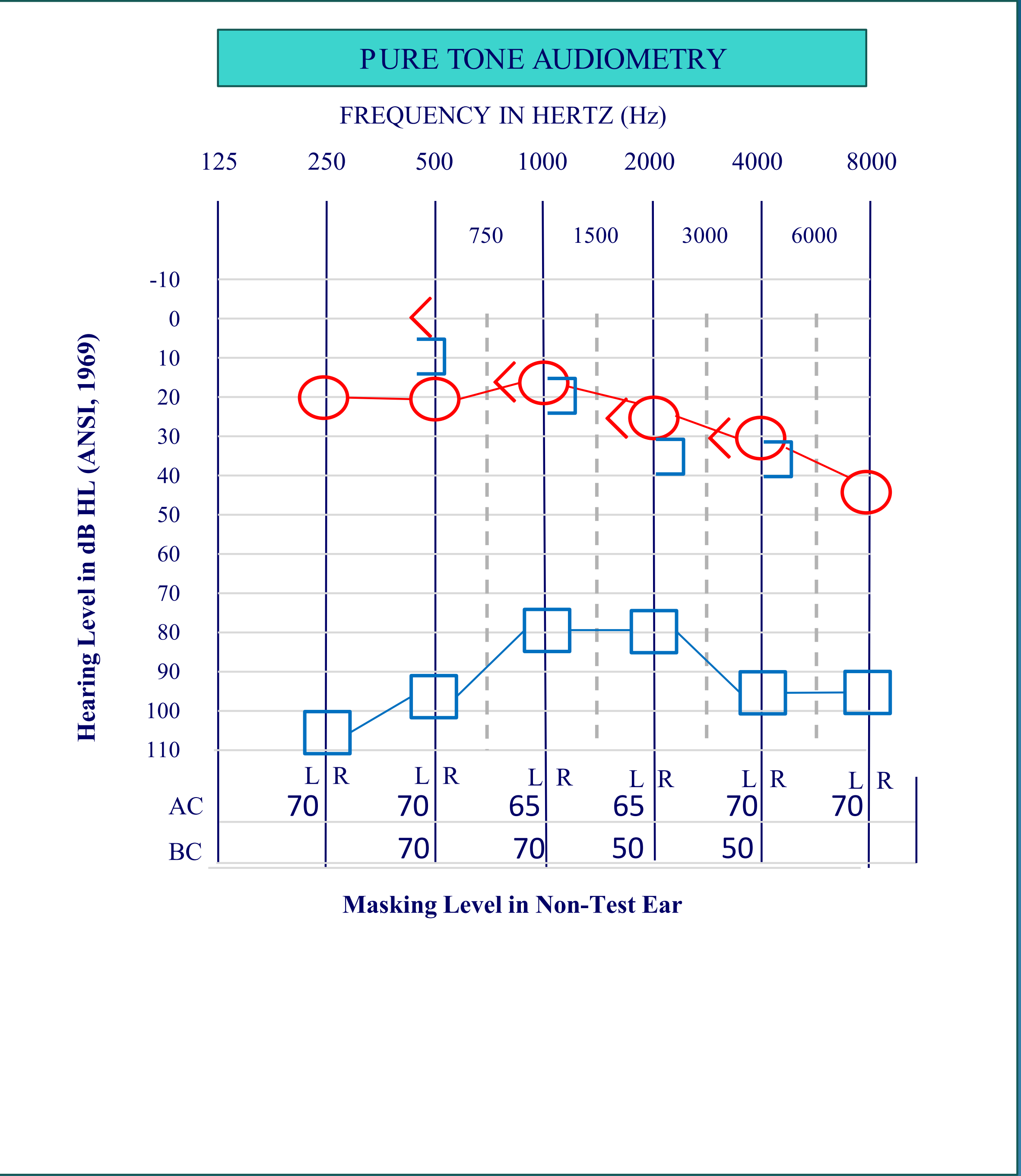
- Worse ear: left
- Rinne reversed on the left
- Weber lateralized to the left
- These results are suggestive of conductive component of the left ear at 512 Hz

Case History

Sixty-three-year-old female

TM perforation in the ‘90s with subsequent tympanoplasty

Type A_{DD} tympanogram, AS

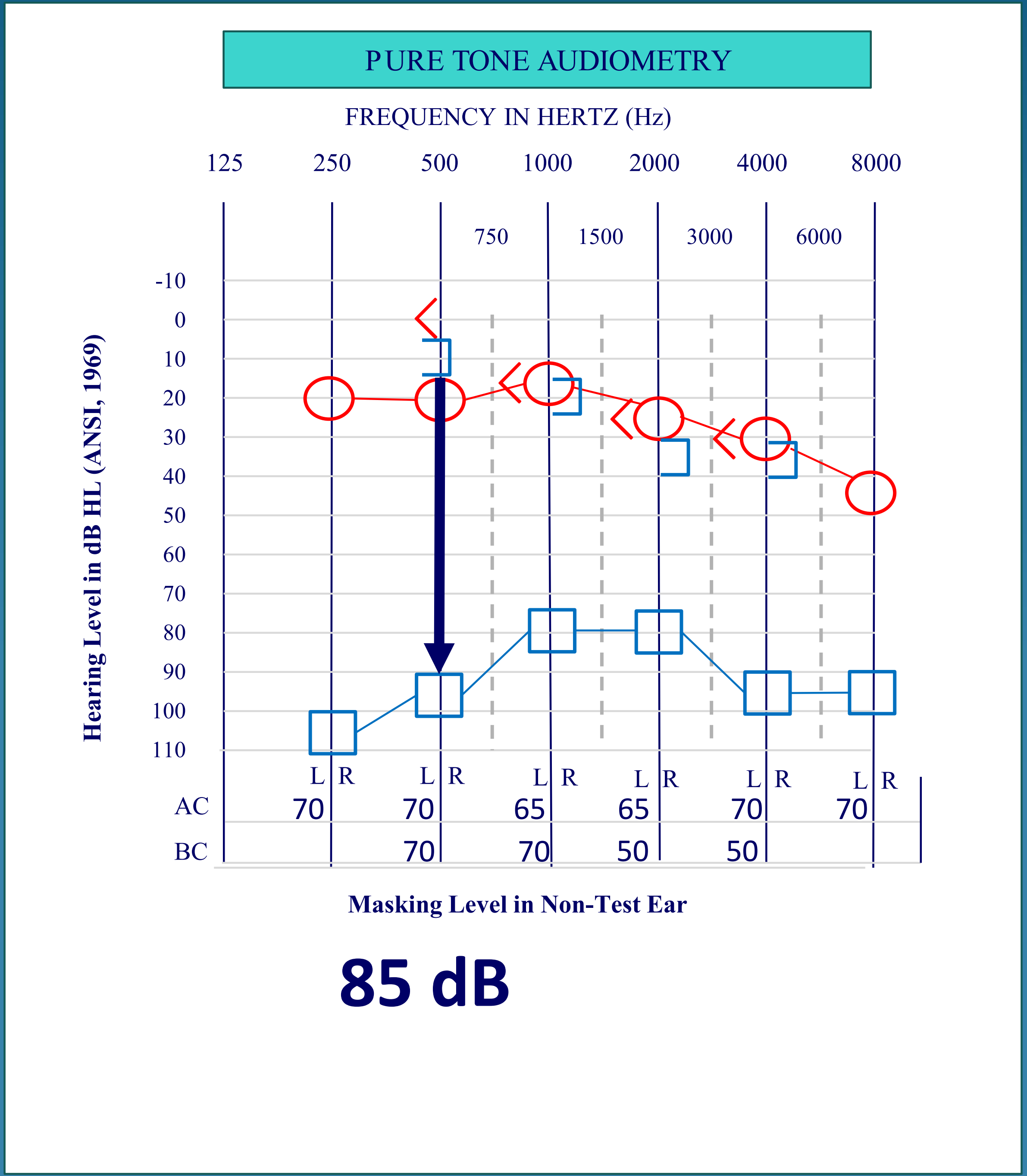


Case History

Sixty-three-year-old female

TM perforation in the '90s with subsequent tympanoplasty

Type A_{DD} tympanogram, AS



Thirteen-year-old male

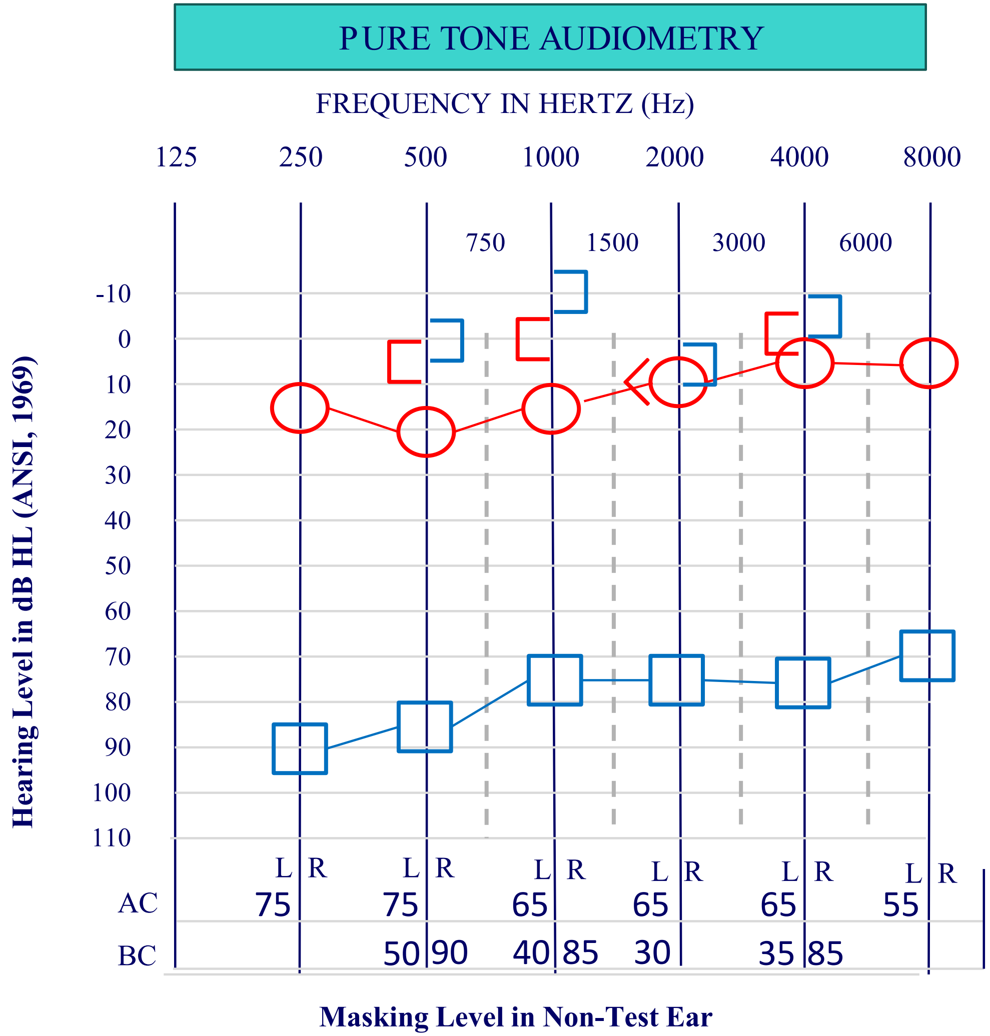
- Worse ear: left
- Tuning fork tests were not conducted

Case History

Thirteen-year-old male

Initially presented with otorrhea and granulation of the left ear

Status/post Canal Wall Down Mastoidectomy, left



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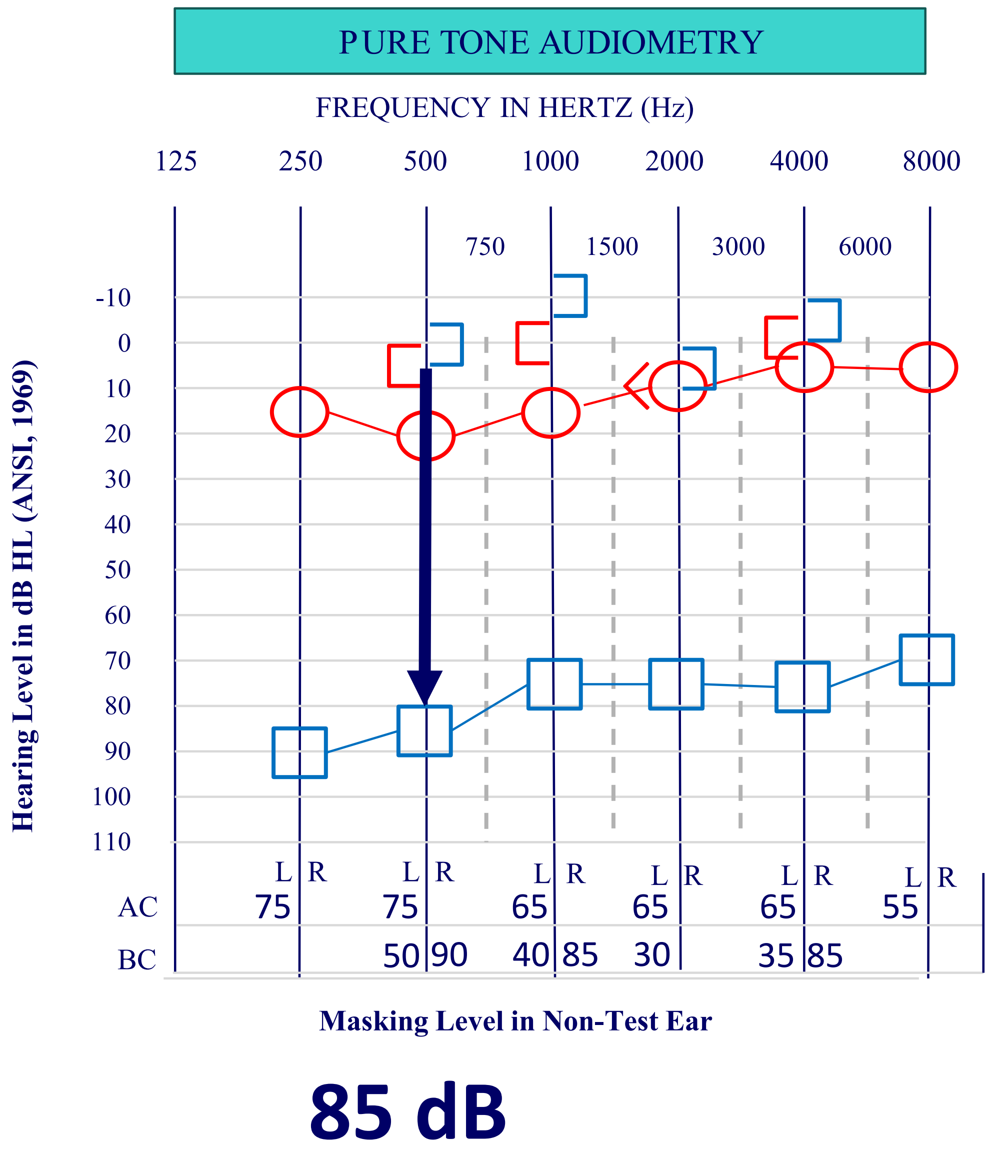
Initially presented with otorrhea and granulation of the left ear

Status/post Canal Wall Down Mastoidectomy, left



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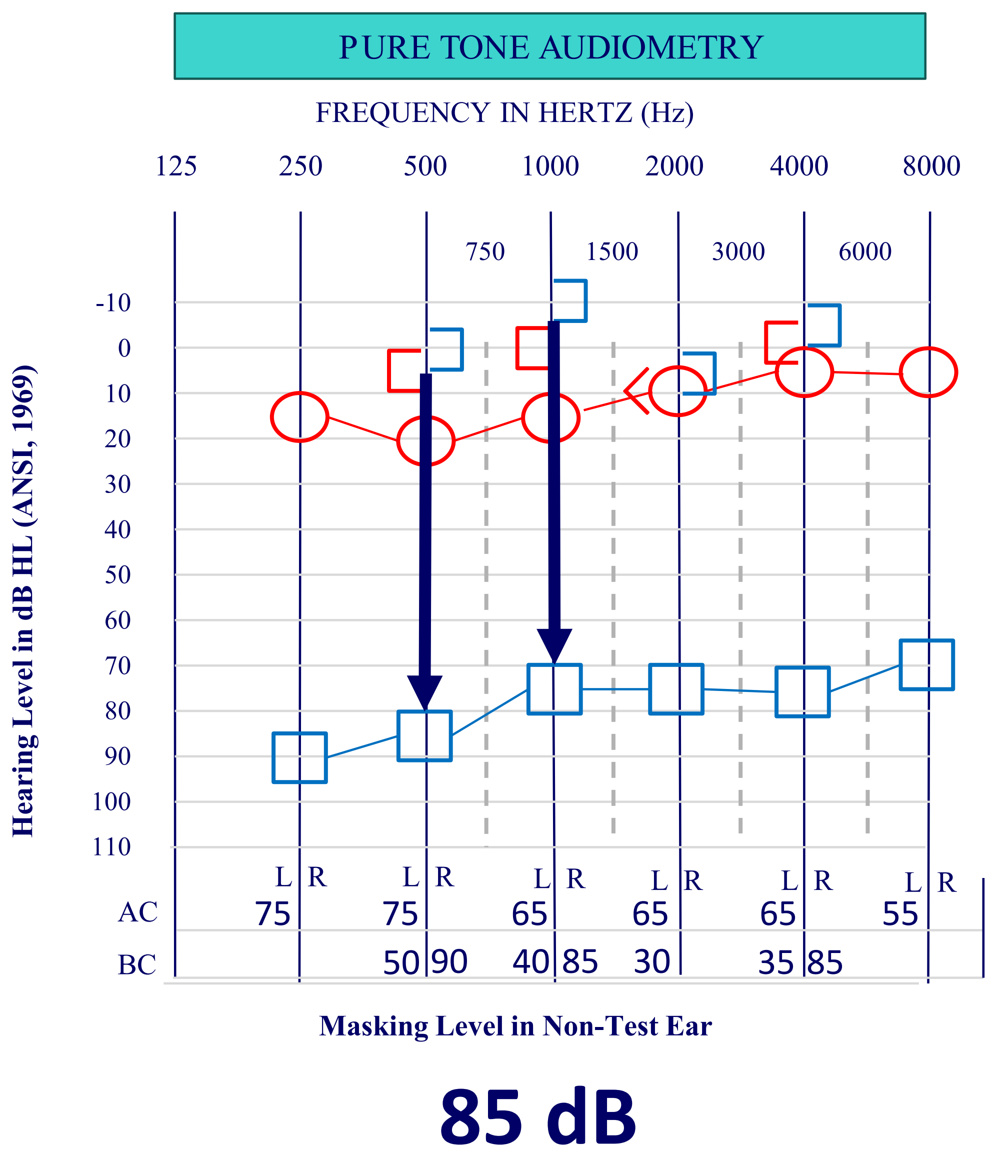
Thirteen-year-old male

Initially presented with otorrhea and granulation of the left ear

Status/post Canal Wall Down Mastoidectomy, left

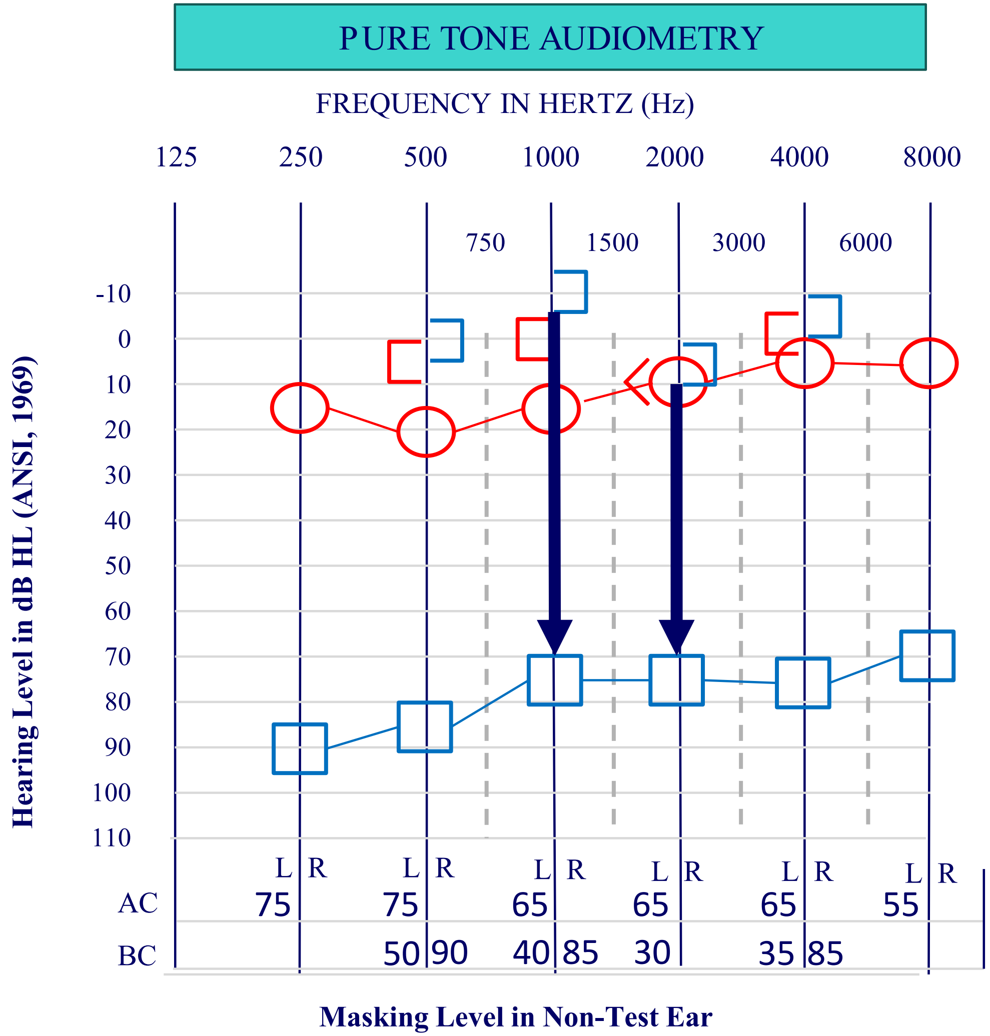


Case History

Thirteen-year-old male

Initially presented with otorrhea and granulation of the left ear

Status/post Canal Wall Down Mastoidectomy, left



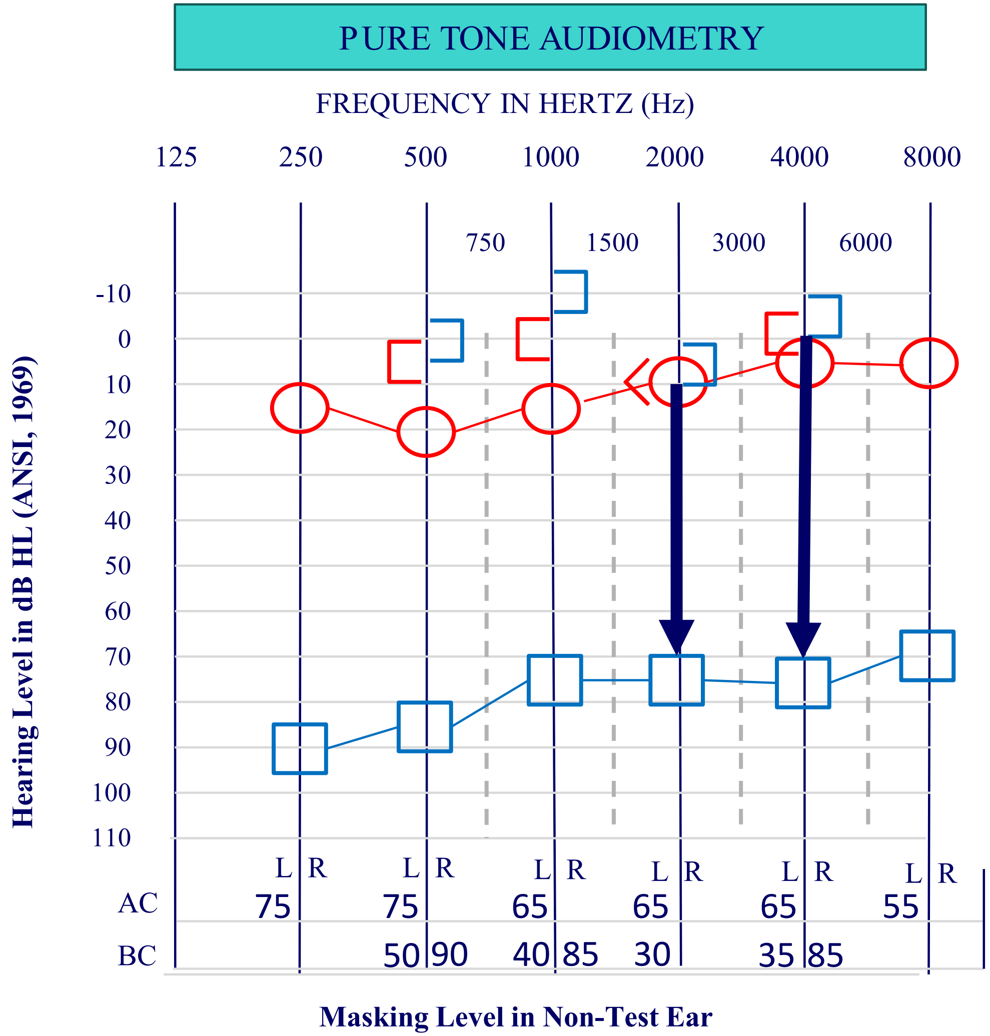
70 dB

Case History

Thirteen-year-old male

Initially presented with otorrhea and granulation of the left ear

Status/post Canal Wall Down Mastoidectomy, left



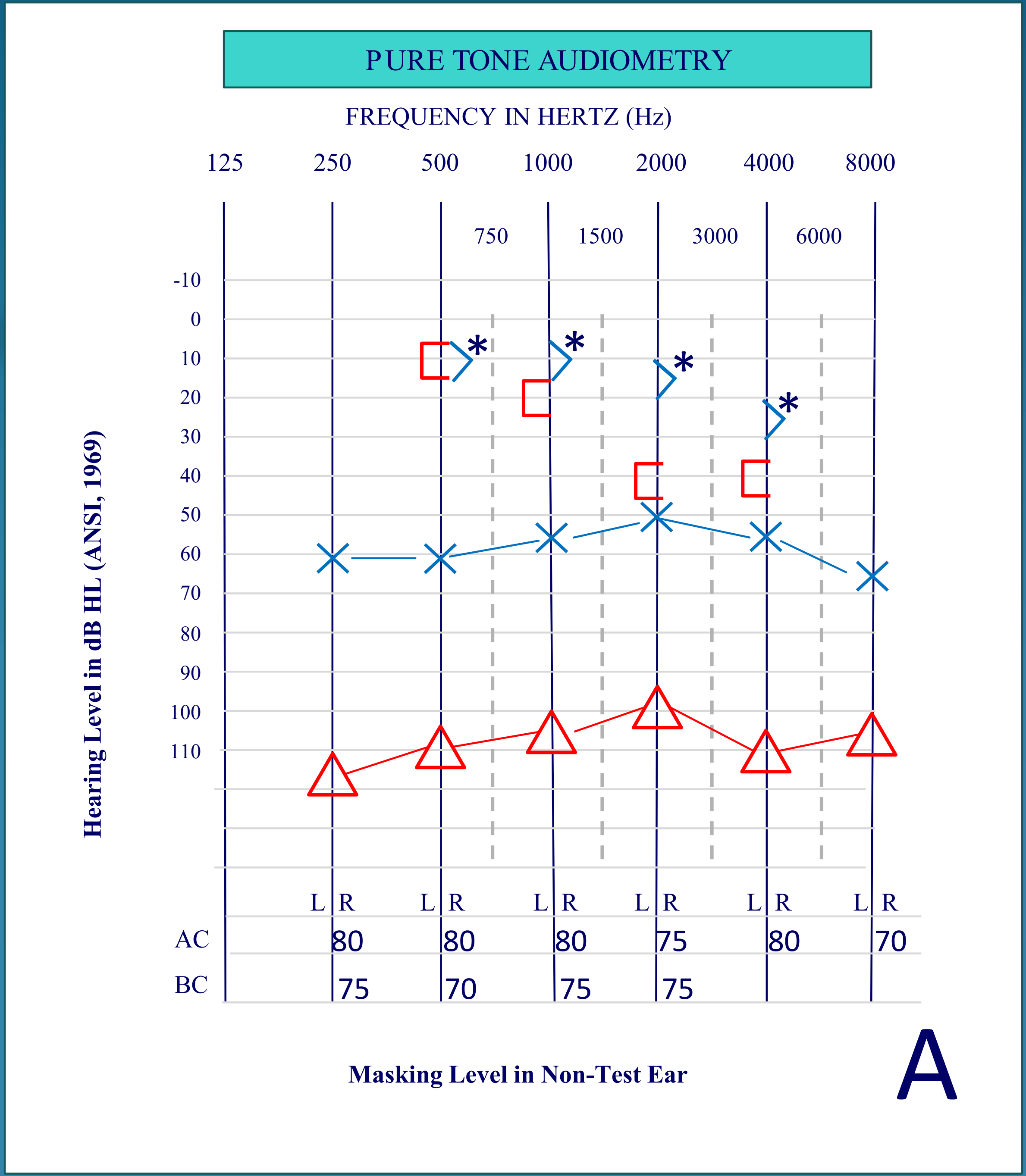
80 dB

Today's Journey

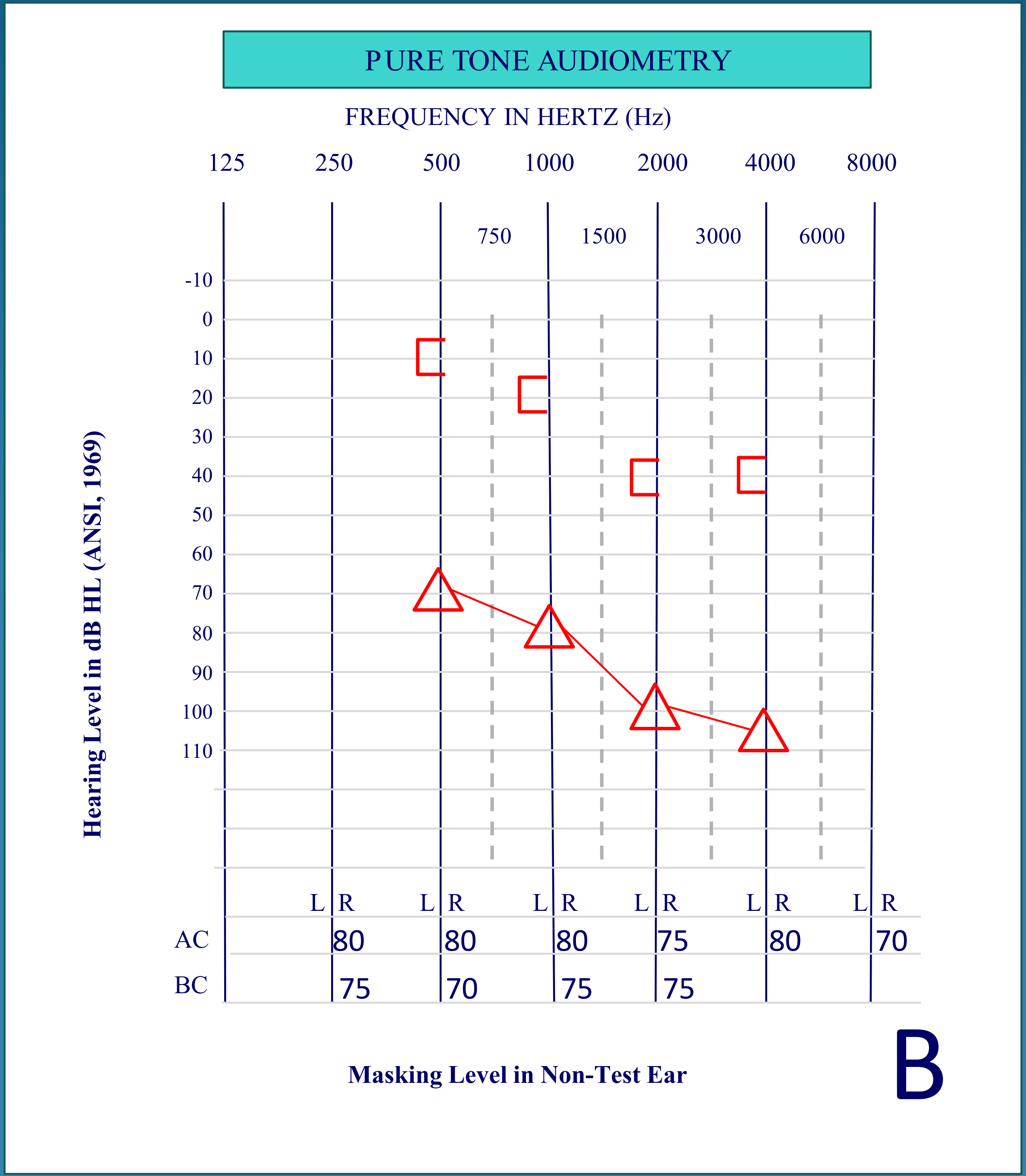
1. Prevalence of the Assertion
2. Physics of Sound Transmission
3. What the Research Tells Us
4. Case Studies
5. Implications

5

Implications

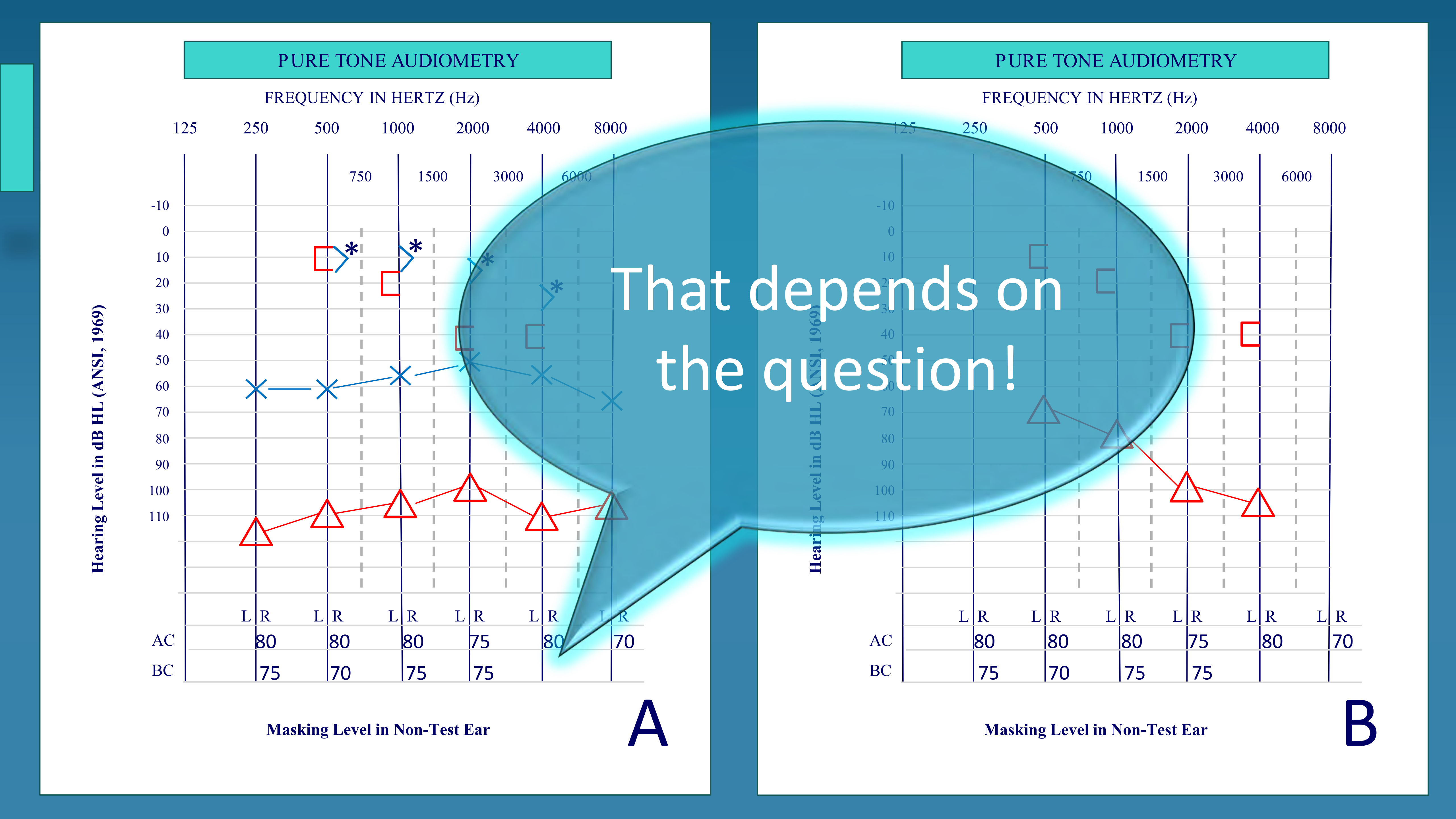


PURE TONE AUDIOMETRY
FREQUENCY IN HERTZ (Hz)
125 250 500 1000 2000 4000 8000
750 1500 3000 6000
-10 0 10 20 30 40 50 60 70 80 90 100 110
Hearing Level in dB HL (ANSI, 1969)
L R L R L R L R L R L R
AC 80 80 80 75 80 70
BC 75 70 75 75
Masking Level in Non-Test Ear
A



PURE TONE AUDIOMETRY
FREQUENCY IN HERTZ (Hz)
125 250 500 1000 2000 4000 8000
750 1500 3000 6000
-10 0 10 20 30 40 50 60 70 80 90 100 110
Hearing Level in dB HL (ANSI, 1969)
L R L R L R L R L R L R
AC 80 80 80 75 80 70
BC 75 70 75 75
Masking Level in Non-Test Ear
B


PURE TONE AUDIOMETRY
FREQUENCY IN HERTZ (Hz)
125 250 500 1000 2000 4000 8000
750 1500 3000 6000
Hearing Level in dB HL (ANSI, 1969)
-10 0 10 20 30 40 50 60 70 80 90 100 110
L R
AC 80 80 80 75 80 70
BC 75 70 75 75
Masking Level in Non-Test Ear
A
PURE TONE AUDIOMETRY
FREQUENCY IN HERTZ (Hz)
Masking Level in Non-Test Ear
B
Which of these is wrong?



PURE TONE AUDIOMETRY
FREQUENCY IN HERTZ (Hz)
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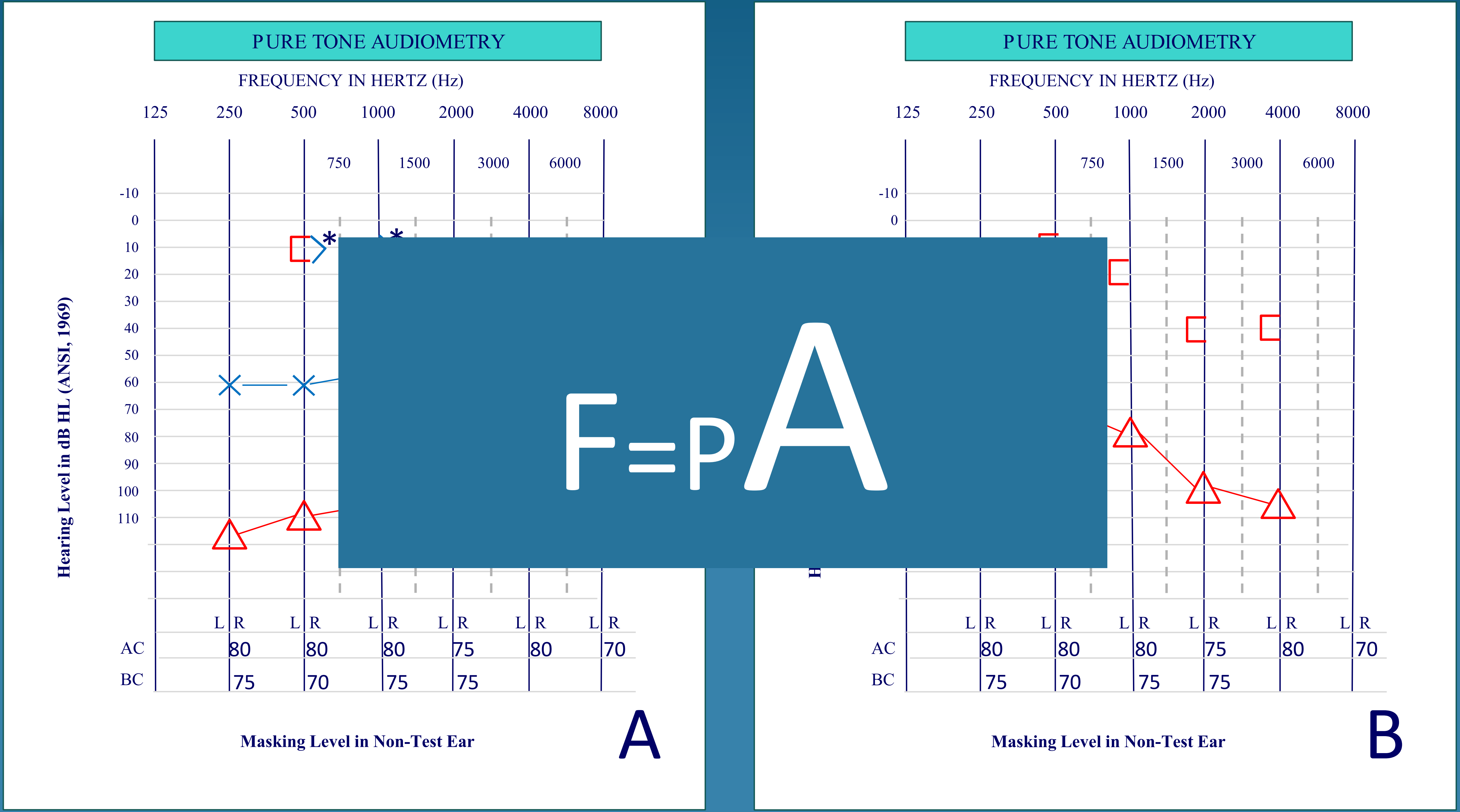
750 1500 3000 6000
-10 0 10 20 30 40 50 60 70 80 90 100 110
Hearing Level in dB HL (ANSI, 1969)
L R L R L R L R L R L R
AC 80 80 80 75 80 70
BC 75 70 75 75
Masking Level in Non-Test Ear
A
PURE TONE AUDIOMETRY
FREQUENCY IN HERTZ (Hz)
125 250 500 1000 2000 4000 8000
750 1500 3000 6000
L R L R L R L R L R L R
AC 80 80 80 75 80 70
BC 75 70 75 75
Masking Level in Non-Test Ear
B
That depends on the question!


PURE TONE AUDIOMETRY
FREQUENCY IN HERTZ (Hz)
125 250 500 1000 2000 4000 8000
750 1500 3000 6000
-10 0 10 20 30 40 50 60 70 80 90 100 110
Hearing Level in dB HL (ANSI, 1969)
L R L R L R L R L R L R
AC 80 80 80 75 80 70
BC 75 70 75 75
Masking Level in Non-Test Ear
A
F=pA
PURE TONE AUDIOMETRY
FREQUENCY IN HERTZ (Hz)
125 250 500 1000 2000 4000 8000
750 1500 3000 6000
-10 0
L R L R L R L R L R L R
AC 80 80 80 75 80 70
BC 75 70 75 75
Masking Level in Non-Test Ear
B

"It appears that an approximate 60-dB loss is the maximal air-conduction impairment (with accompanying normal bone conduction) to be anticipated with middle-ear defects. Therefore, if the air-conduction loss in a patient with apparently typical middle-ear pathology exceeds 60 dB, it is likely that inner-ear impairment is superimposed on the middle-ear lesion, the extent of which will be revealed by bone-conduction measurements."

Source: Reger, Scott (1944)

Have you seen large air-bone gaps yourself?

Have you experienced push-back?

Do you regularly see mixed hearing loss when only a conductive hearing loss is expected based on case history?

Excessive masking is a much bigger problem than is undermasking

Clinical bias introduced when unexpected results are obtained

Audiologists can stray from evidence-based masking procedures

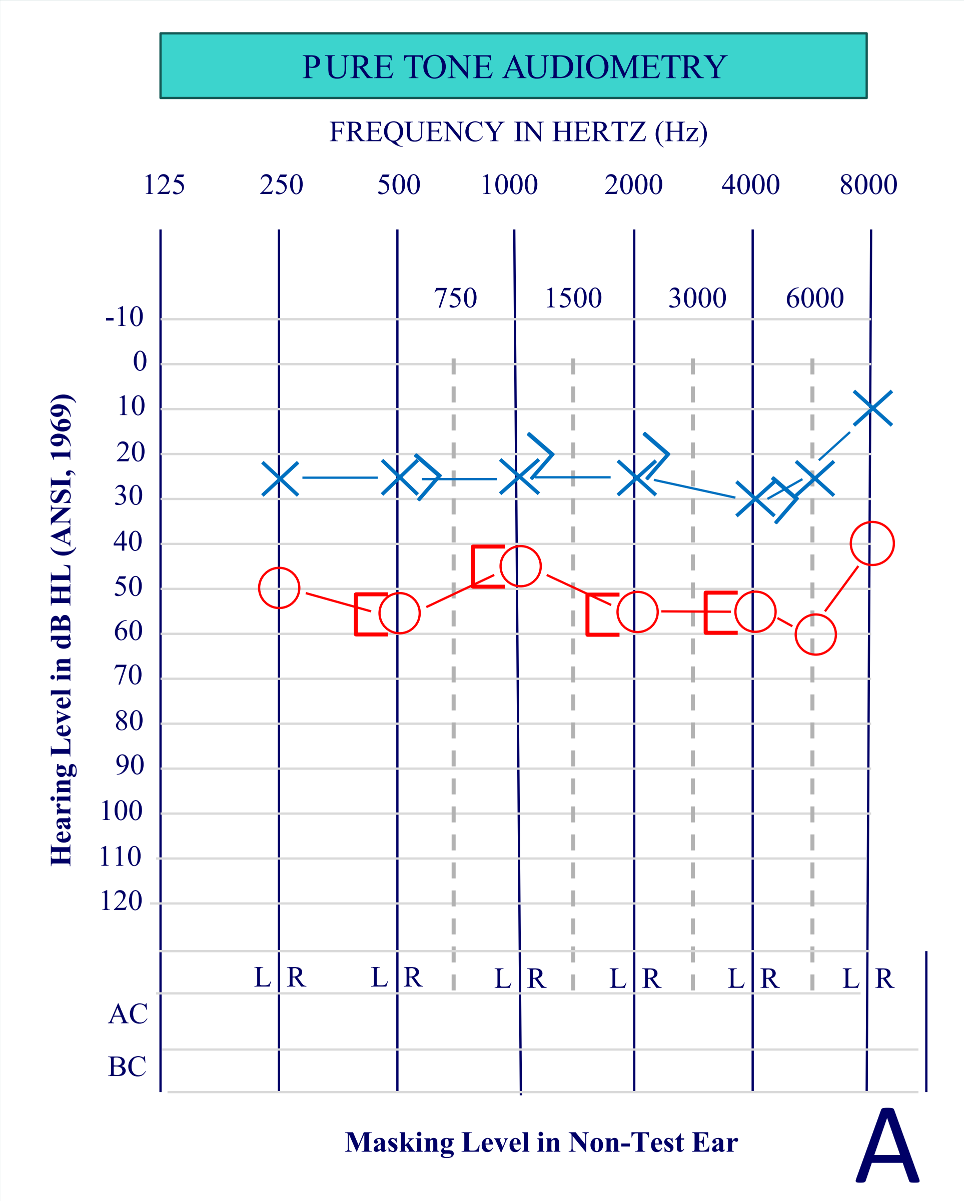
Poor technique is reinforced and perpetuated

Misunderstanding maximum CHL can lead to audiometric errors

- Excessive masking has been a known problem in audiology for decades
- Archives of Otolaryngology 1959: *The Indiscriminate Use of Masking in Bone-Conduction Audiometry*, by Jerger and Wertz
- Ear, Nose, and Throat Journal 2008: *How to Eliminate Air-Bone Gaps Audiometrically: Use Too Much Masking*, by Maurice Miller

Forty-two-year-old female

- History of right tympanomastoidectomy with ossicular chain reconstruction
- Chief complaint: foul-smelling otorrhea of the right ear
- The Weber tuning fork test lateralized to the right, suggestive of a conductive component on the right side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750 1500 3000 6000
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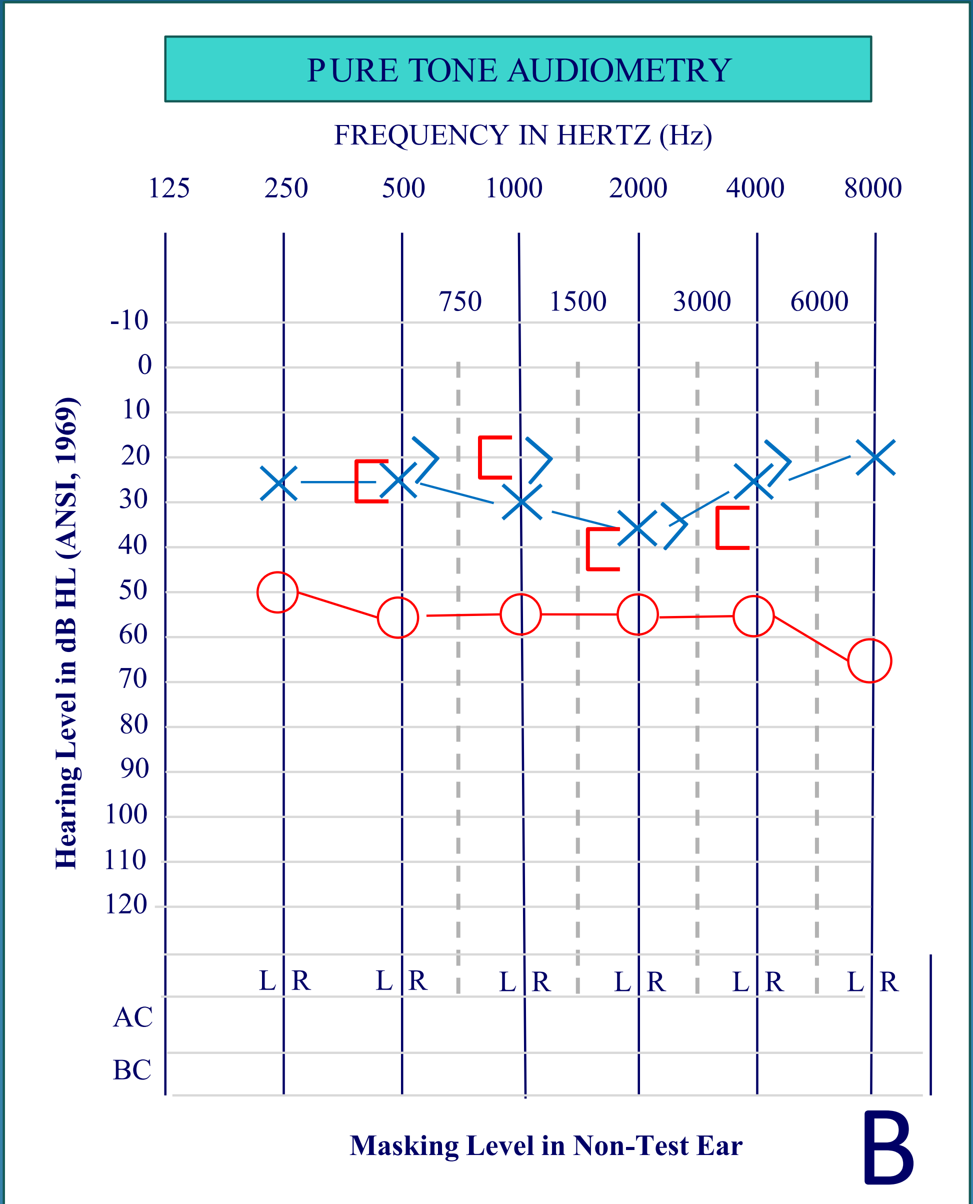
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
L R L R L R L R L R L R
AC
BC
Masking Level in Non-Test Ear
A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Hearing Level in dB HL (ANSI, 1969)
-10 0 10 20 30 40 50 60 70 80 90 100 110 120
L R L R L R L R L R L R
AC
BC
Masking Level in Non-Test Ear
B

Insert remained in left EAC while obtaining unmasked bone-conduction thresholds

Case History

Initial masking:

Mildred's: 60 dB HL

Mine: 40 dB HL

Final masking level:

Mildred's: >100 dB HL

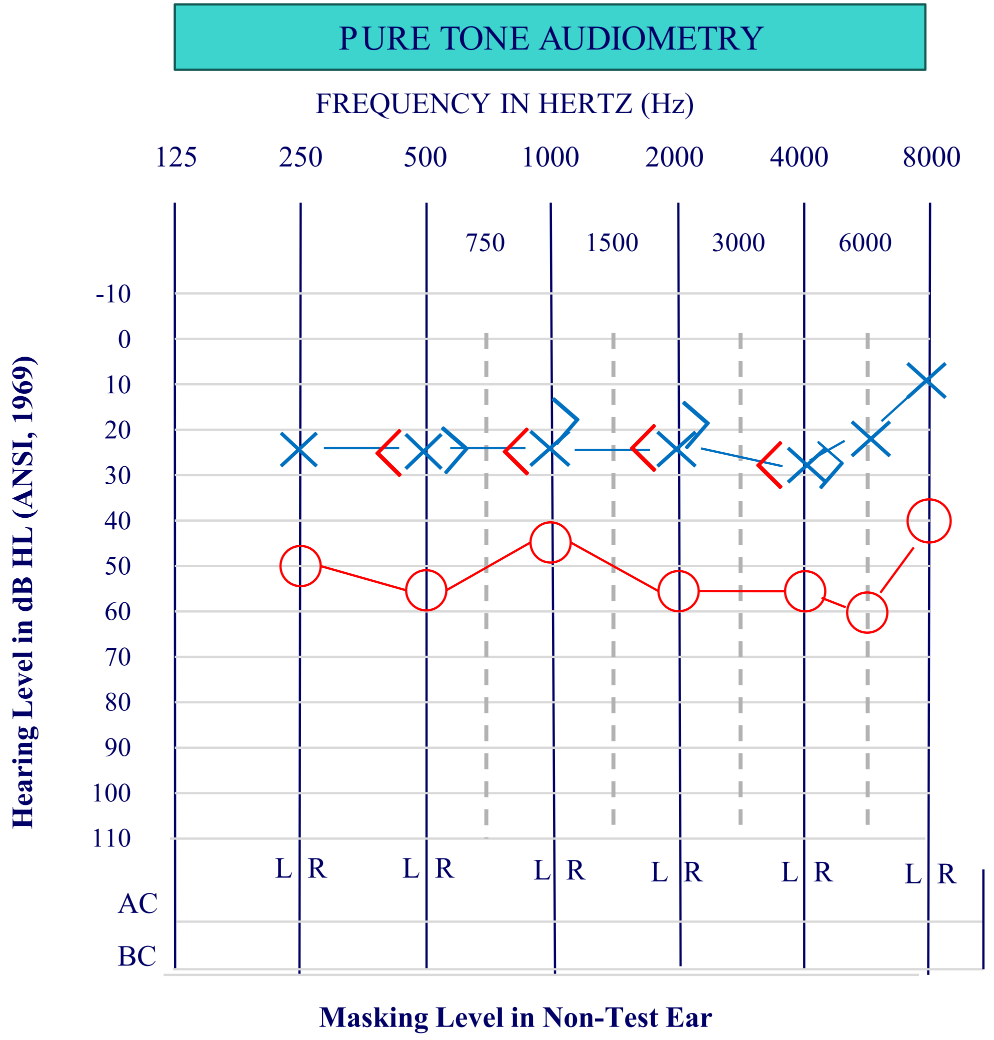
Mine: 40 dB HL

Masked threshold:

Mildred's: 55 dB HL

Outside audiologist's: 65 dB HL

Mine: 25 dB HL



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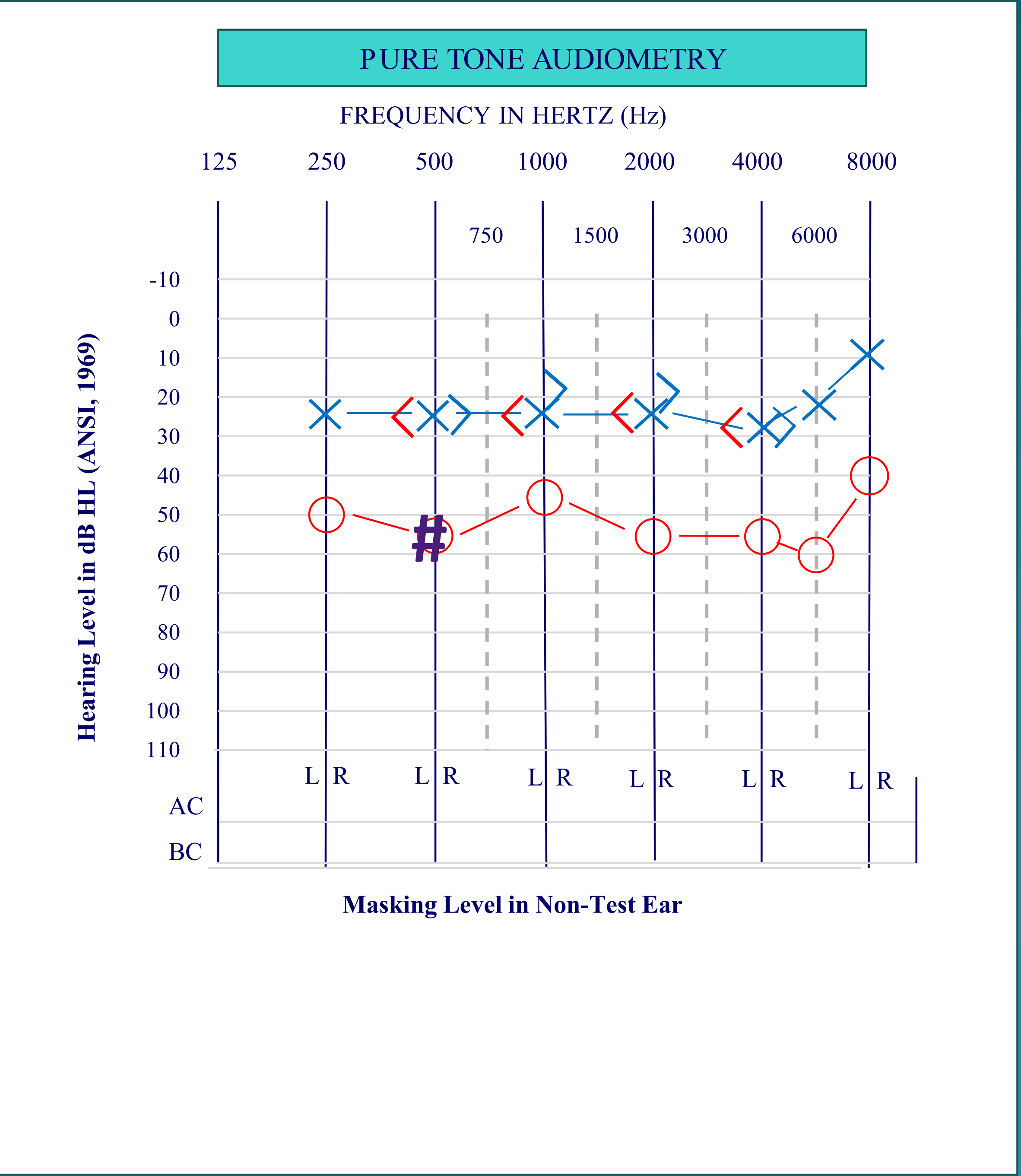

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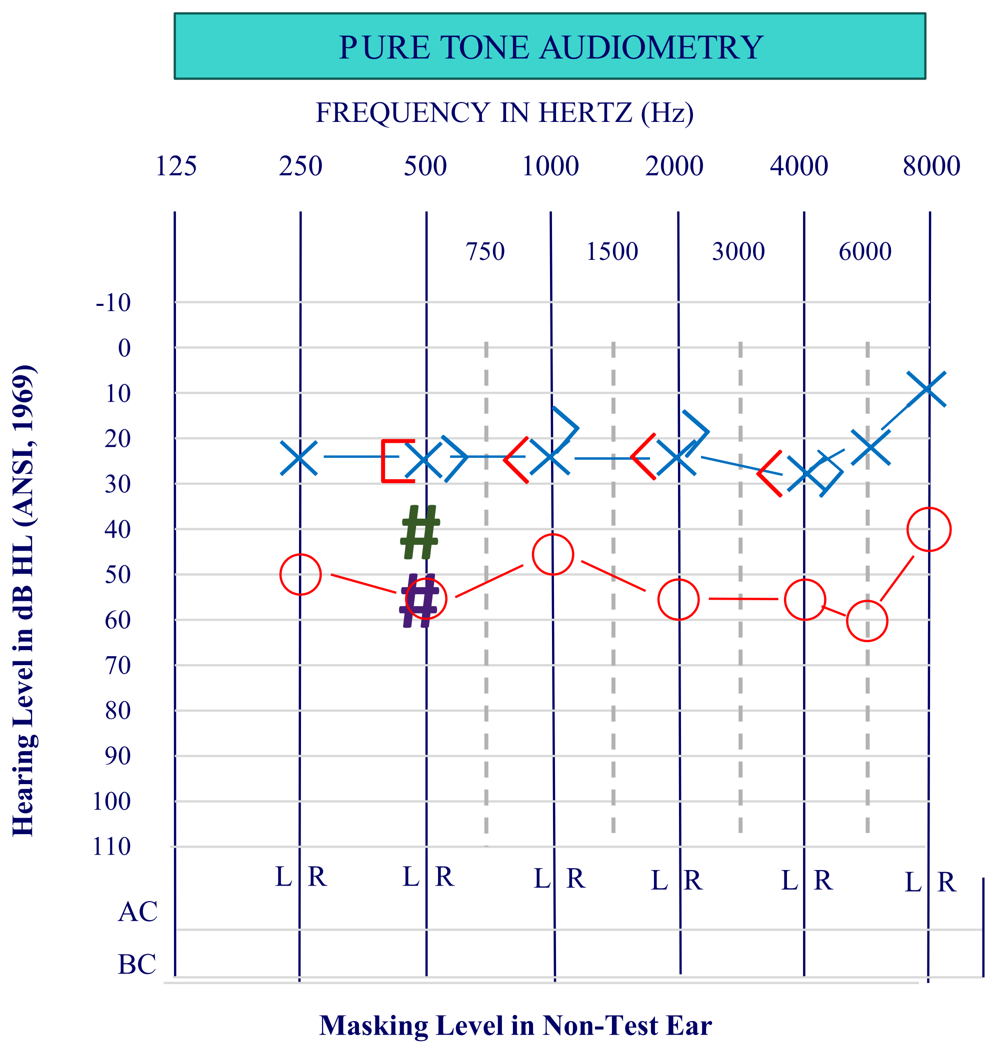

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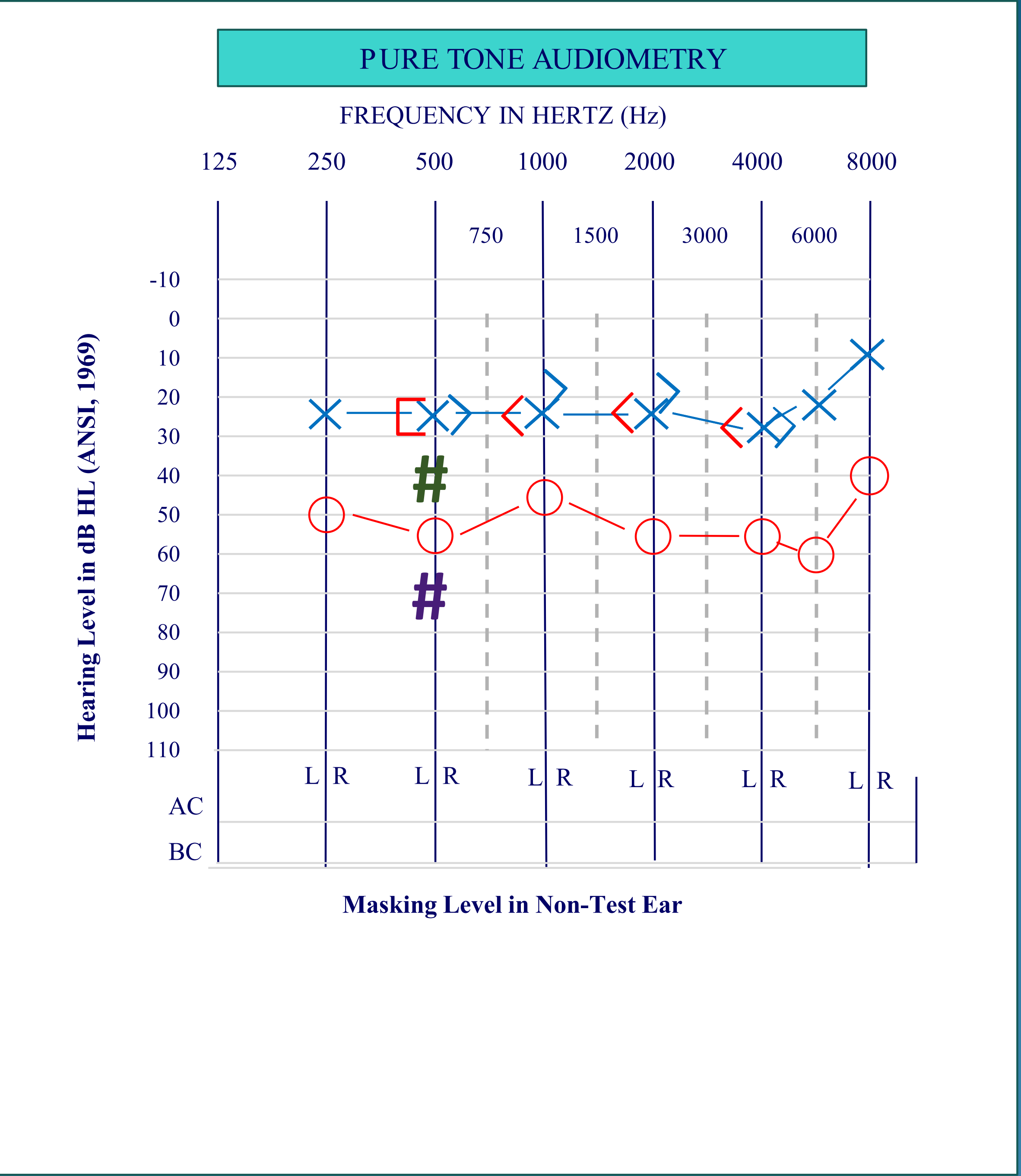

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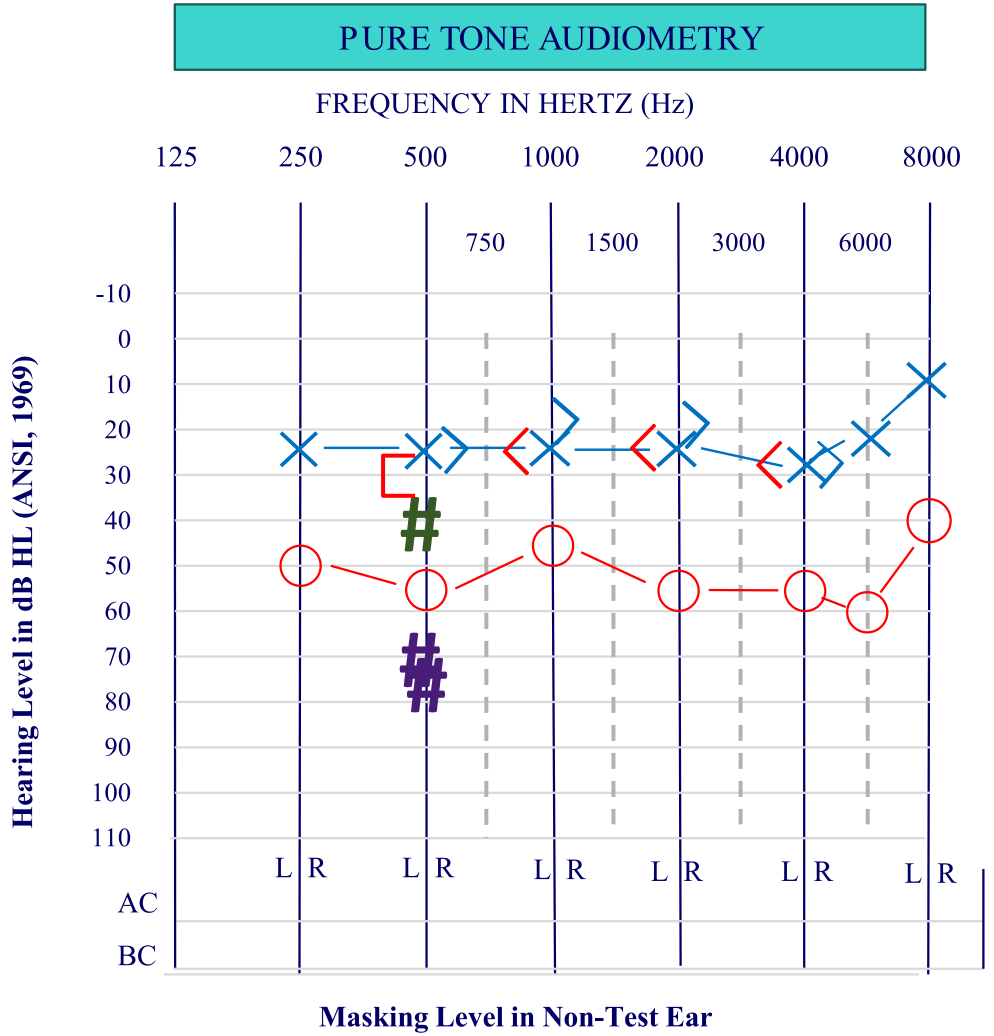

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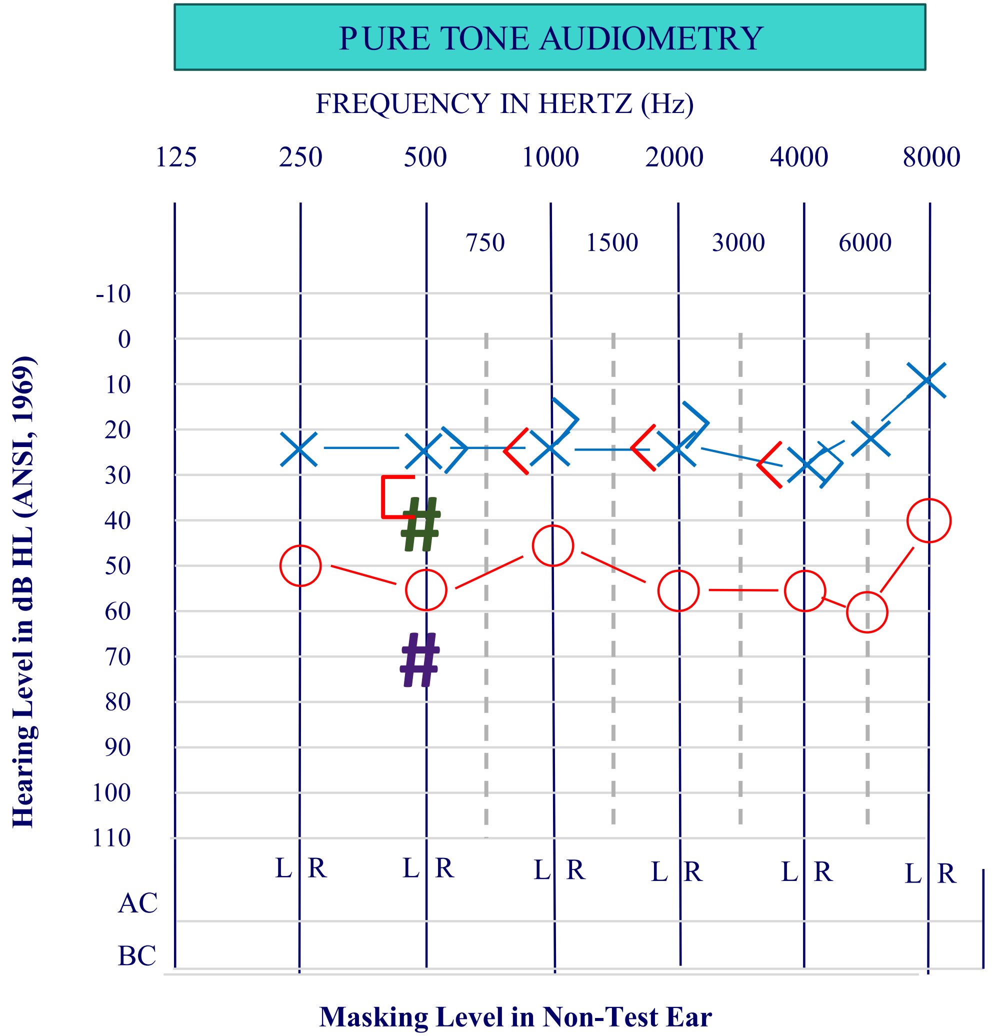

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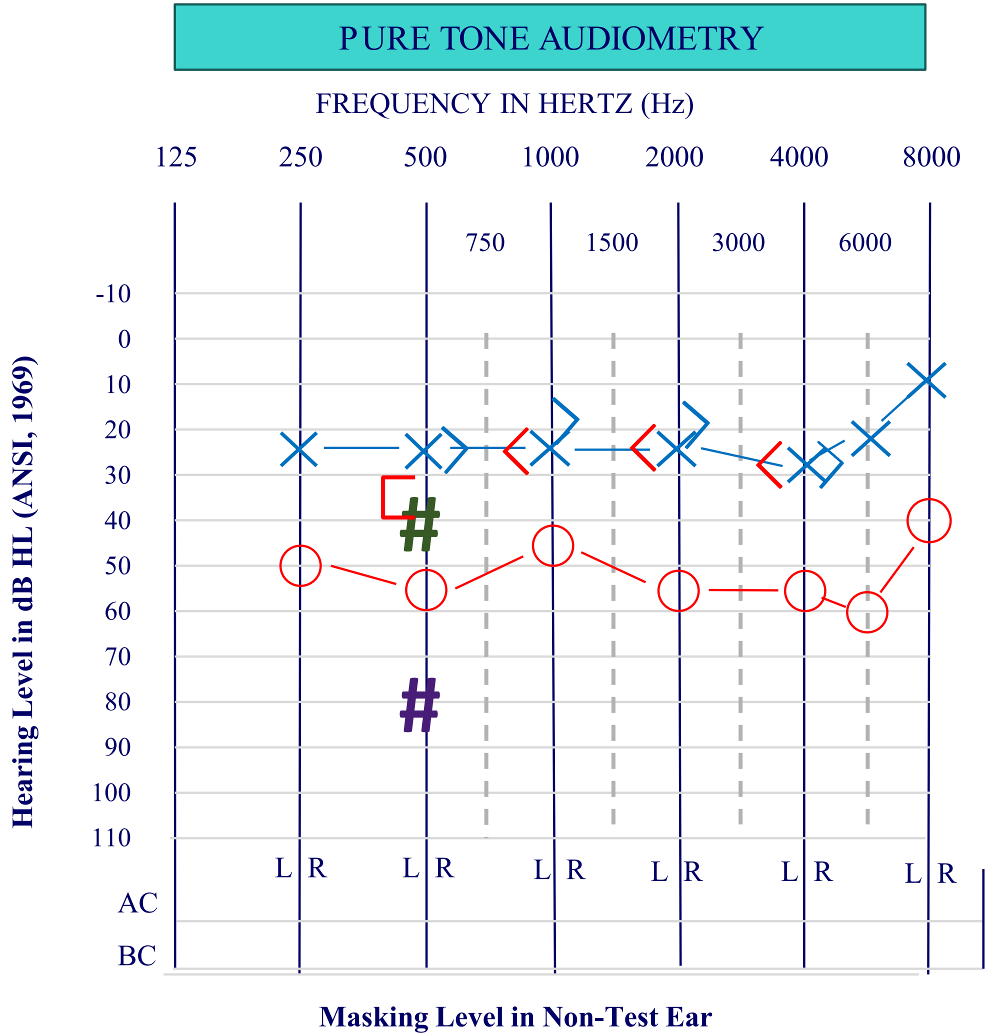

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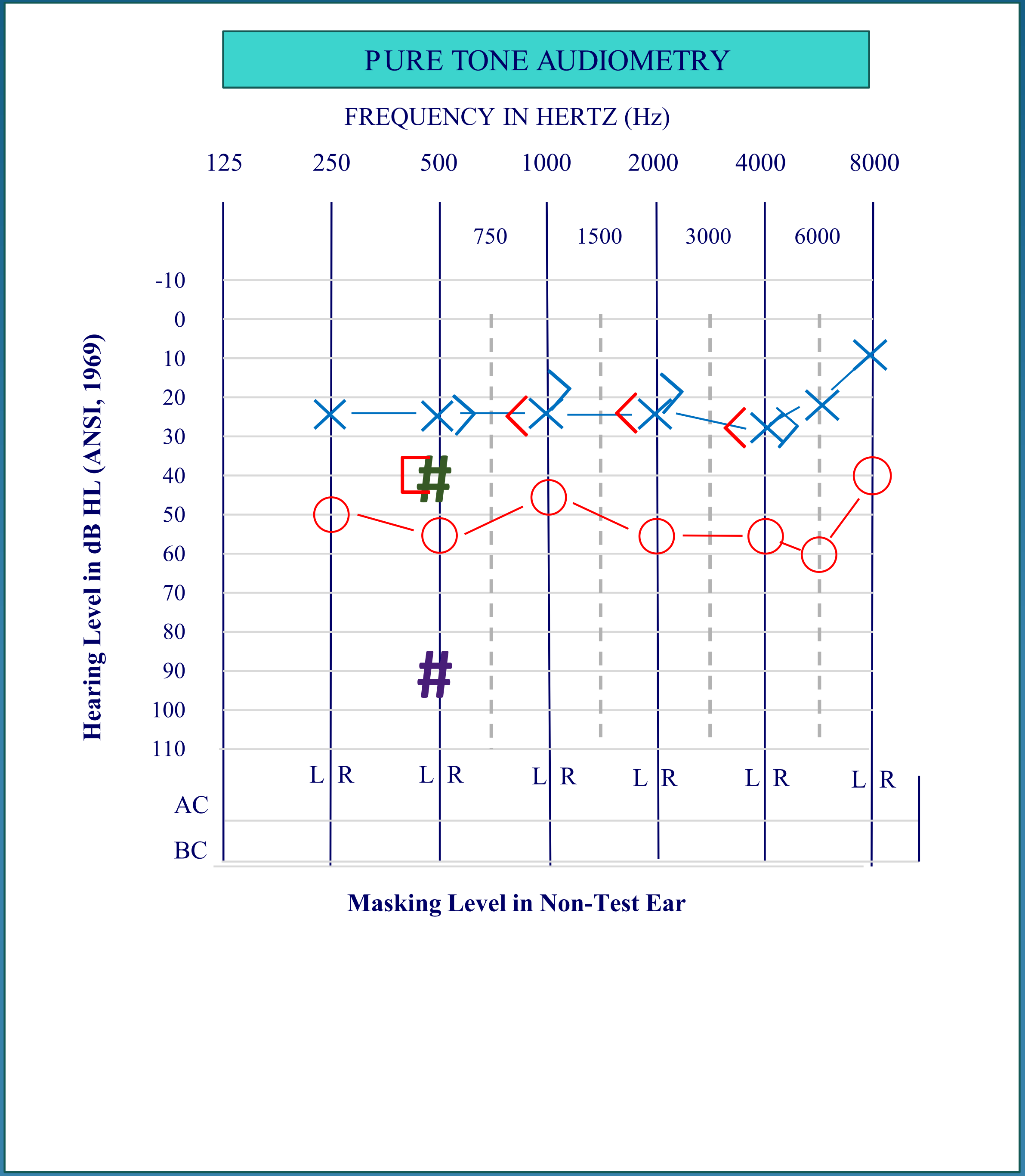

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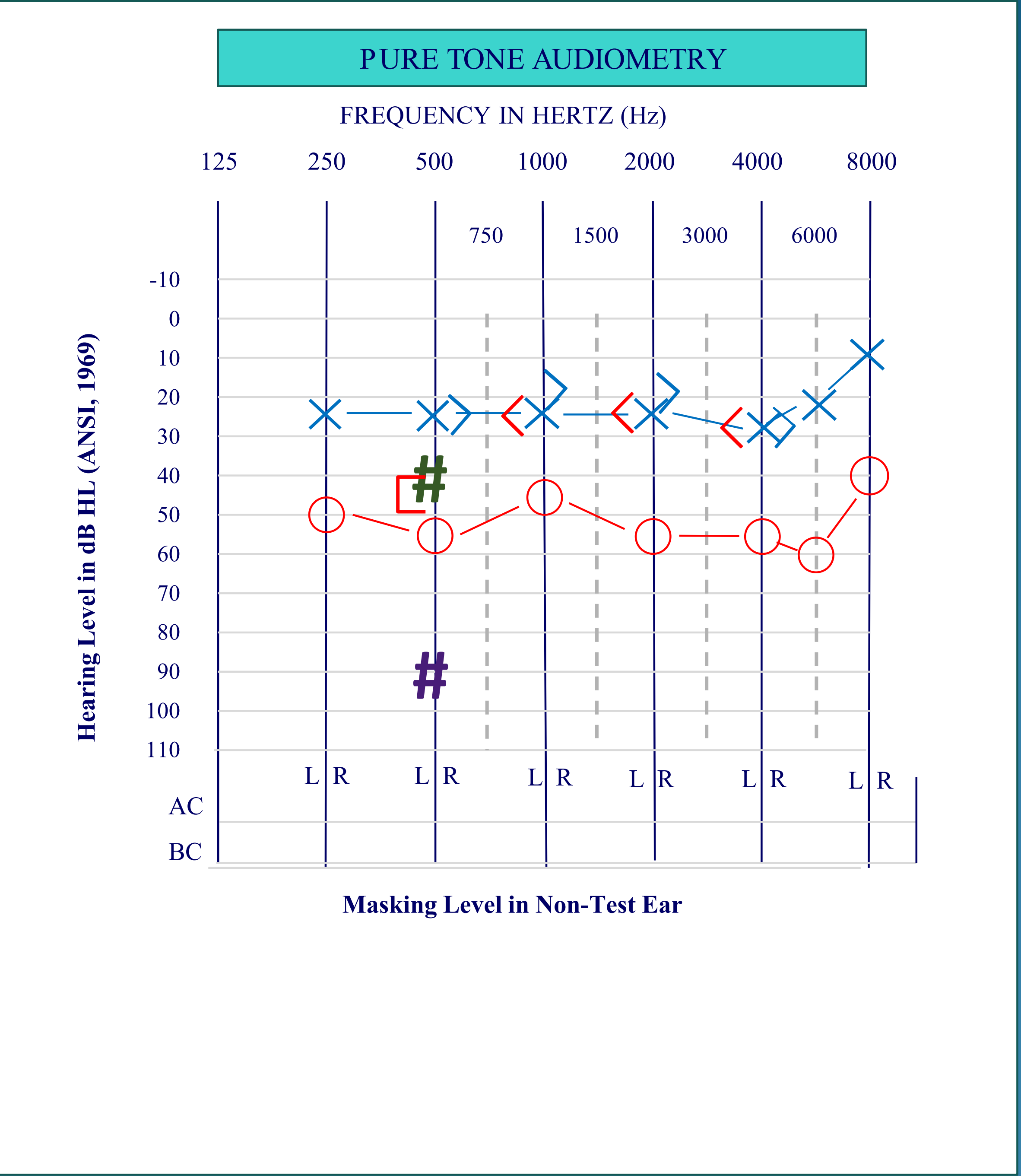

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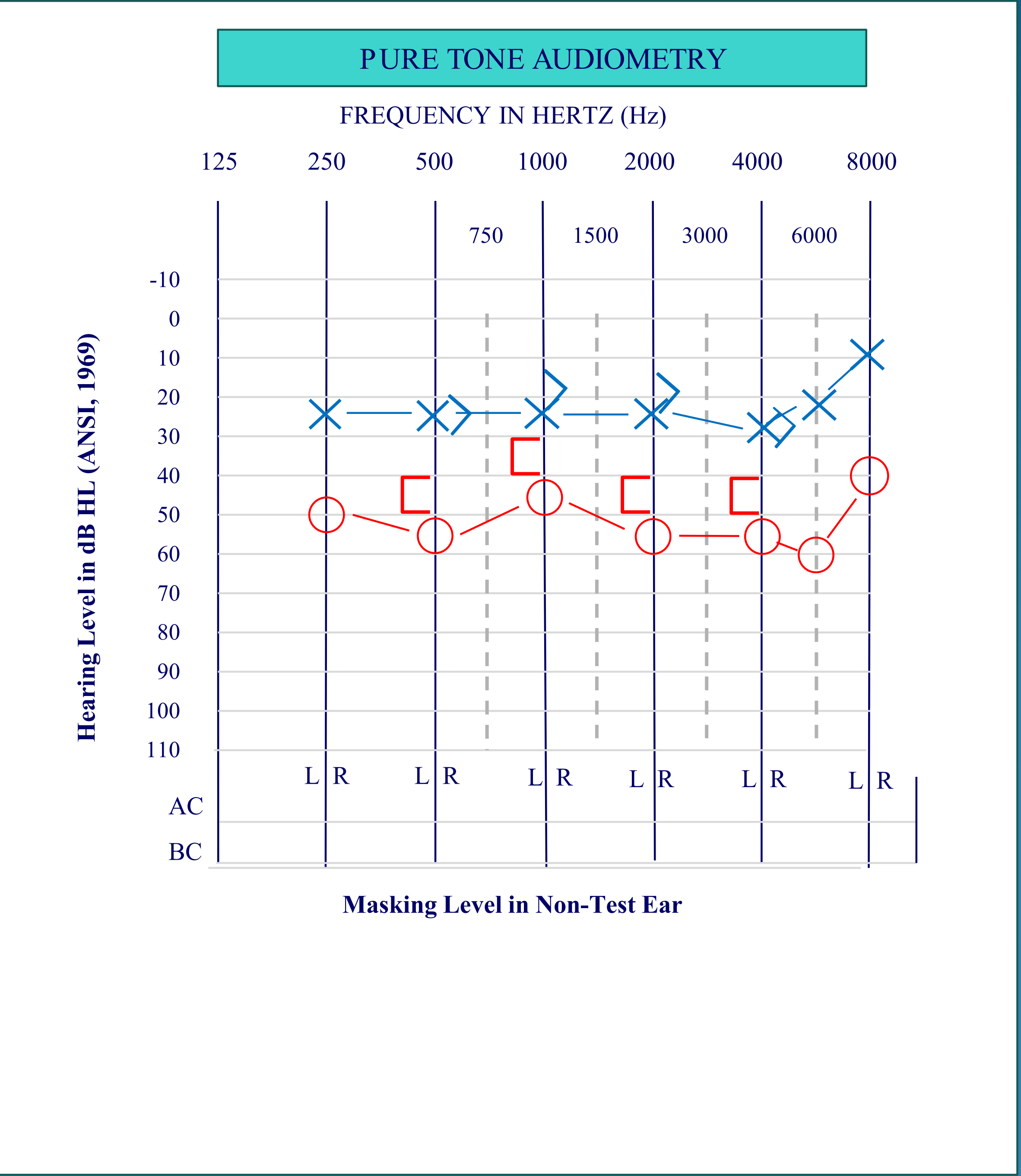

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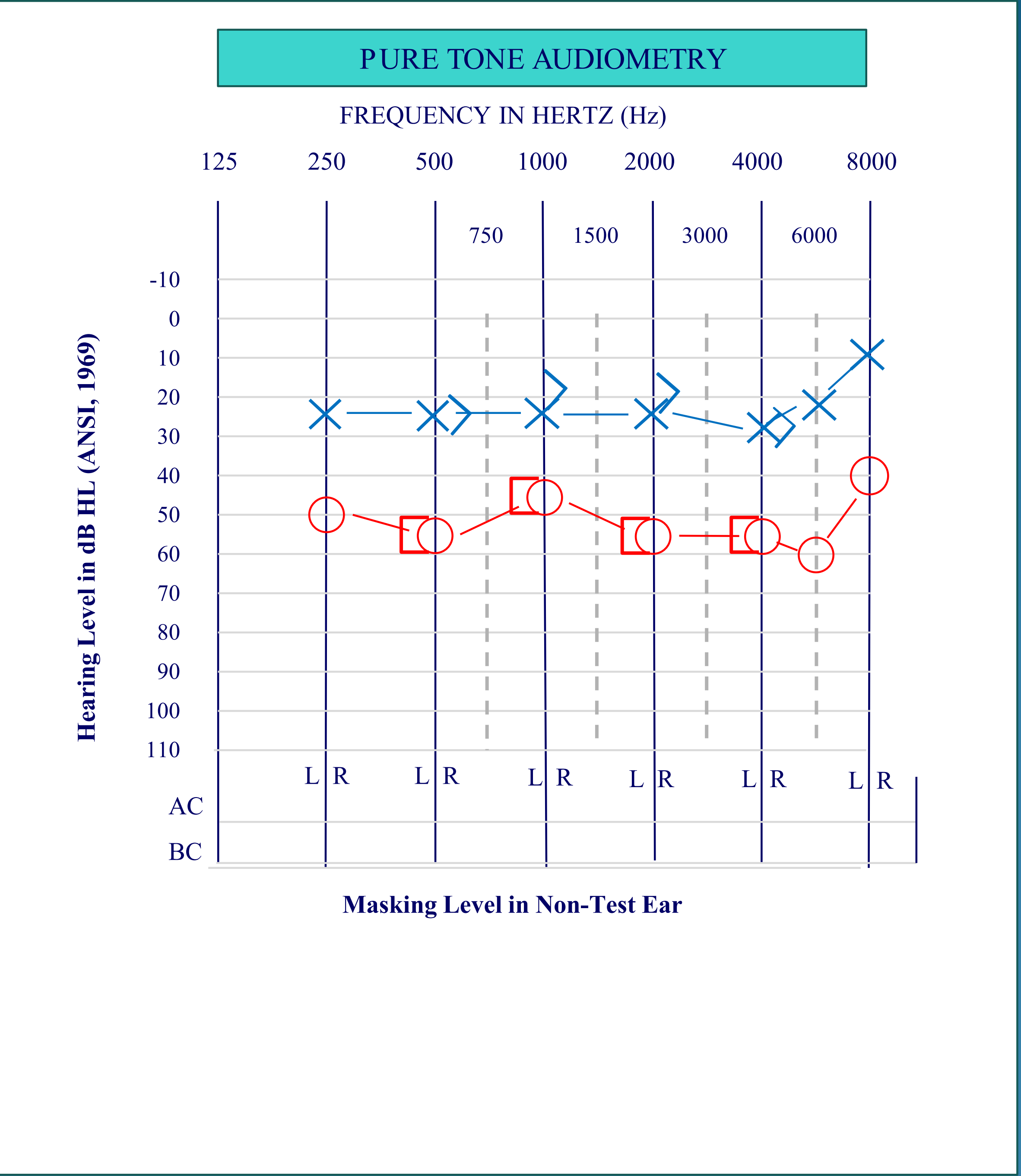

Thoughts for the Inquisitive

- The AS Feldman study had potential
- More data are needed on minimum, average, and maximum interaural attenuation
- Are we teaching our students appropriate masking?

Key Takeaways

- Maximum conductive hearing loss is inextricably linked to interaural attenuation and can feasibly be as great, even exceeding 105 dB assuming a 0 dB IA for bone conduction
- Audiometric findings can be tainted by an audiologist's bias that an air-bone gap cannot be greater than 60 dB
- Likewise, an otolaryngologist who believes maximum conductive hearing loss to be about 60 dB will question audiometric results that do not reflect that limitation

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