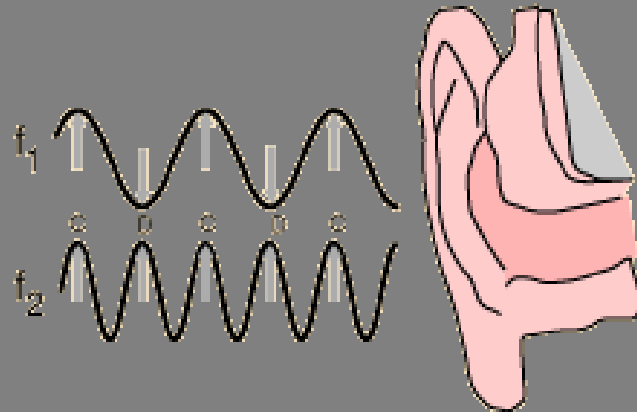


# AUDIOLOGY

## The Secrets Behind the Squiggles



Dave Pothier  
St Mary's

# Ear examination

- Make sure ear is not occluded
- No other physical abnormalities
- Put audiological tests into context



'Interesting' technique

# Tuning fork tests

- Rinne's test
- Weber's test



# Striking the fork

- On bony prominence
- Not on hard surface
- Gives better single tone without overtones



# Rinne's Test

## Purpose

- Compare AC to BC

## How

- Strike tuning fork
- Place TF alternately on mastoid process and EAM



# Rinne interpretation

- Normal

Positive Rinne – louder at EAM

AC > BC

- Abnormal

Negative Rinne – louder on mastoid process

Positive Rinne – Bilateral SNHL

# Rinne interpretation

## True Negative Rinne

- Conductive Hearing loss
- $BC > AC$

## False Negative Rinne

- Severe S/N loss on test side = tone heard on contralateral side



# Rinne interpretation

If Rinne Negative, masking is essential

Types:

Tragal Rub

Baranay Noise Box



# Weber

Purpose:

Conductive vs. SNHL in  
unilateral losses

How:

Strike fork

Place midline of head

Incisors > Vertex > Forehead



# Weber - interpretation

Normal - Midline sensation of hearing

= equal hearing both sides of same type

= equal loss of same type

Abnormal – Tone louder in on one side

=Conductive loss – tone louder on affected side

=SNHL – tone louder on contralateral side

# Simple free field testing

- By 'bedside'
- Good adjunct to PTA
- Helpful with children too young for PTA
- Fairly sensitive
- Give some idea of significance of hearing loss

# Concepts

- Turn patients head to side (so cannot see examiner's mouth)
- Apply tragal rub masking to non-test ear (furthest away)
- Whisper at arms length, then increase loudness of voice in increments
- Patient to repeat numbers/words

# What this tells you

Can hear whisper at arm's length

- Normal hearing

Can hear normal voice at arm's length

- mild / moderate loss

Can hear loud voice at arm's length

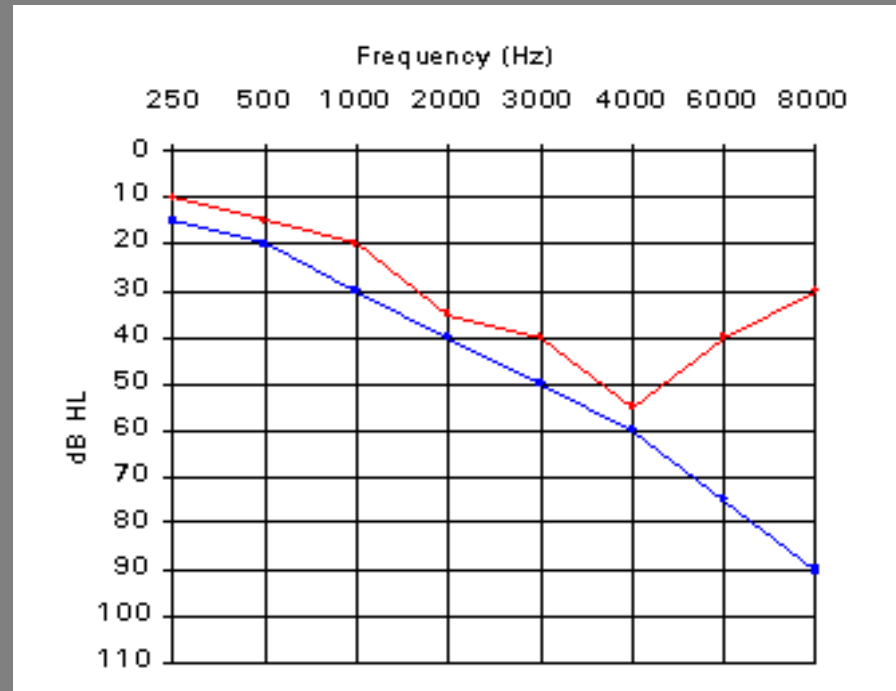
- moderate / severe loss

Can only hear loud voice close up

- profound loss

# Pure Tone Audiometry

- Setup/physics
- AC
- BC
- Masking

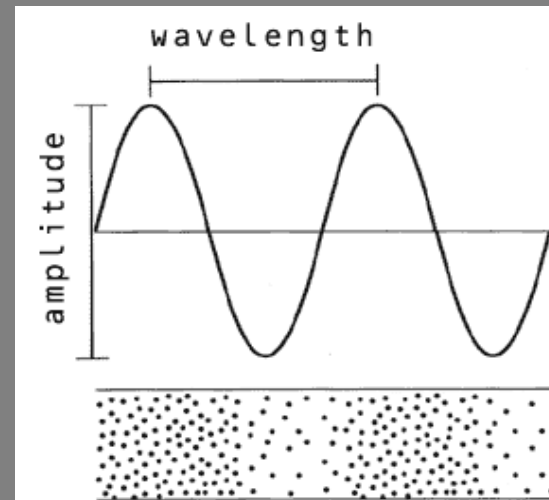


# Pure Tone Audiometry

## Setup/physics

Sound has 2 components:

- Frequency (pitch) cf. wavelength  
Hz / kHz
- Intensity (loudness) cf. amplitude  
dB





# Pure Tone Audiometry

Setup/physics

## The Decibel

Sound intensity SPL measured in decibels

- log of intensity of sound
- NB.. A logarithmic scale
- 20dB is 10 times 0dB, 40dB is 10 times 20dB, 60dB is 1000 times louder than 0dB

# Pure Tone Audiometry

Setup/physics

Very confusing...

dB used as measures of SPL are different to  
dB's used as measure of hearing level

# Important concept...

A hearing level of 0 dB is an arbitrary level of hearing of a given SPL

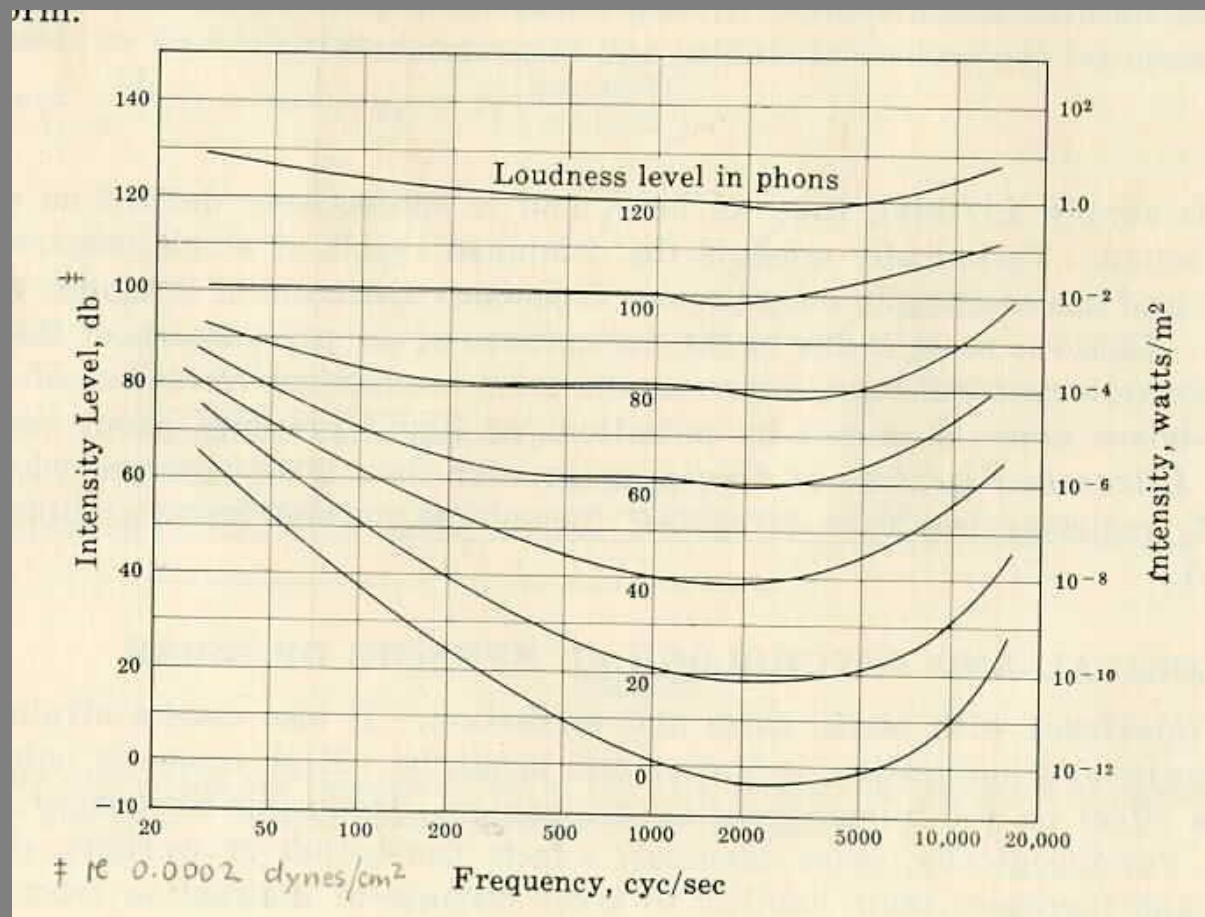
Iowa State Fair (allegedly) in 1935, 10 000 young women had their hearing measured

This established the normal hearing levels for pure tone Audiometry (0 db Threshold)

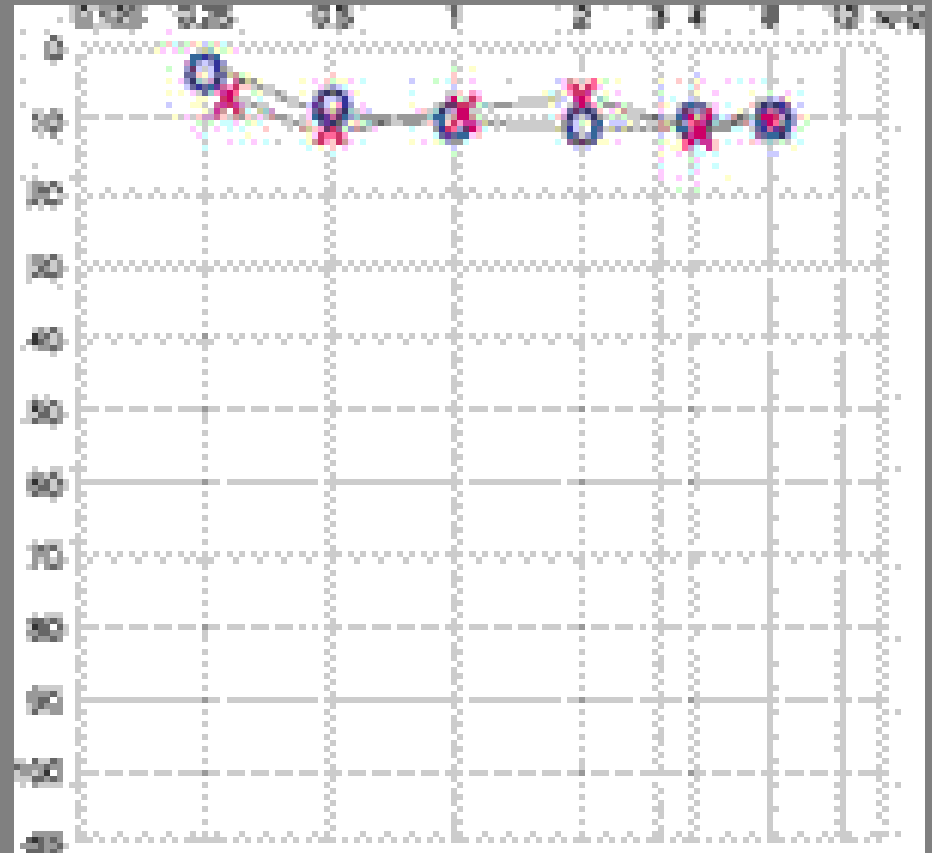


# But, to confuse even more...

The cochlear does not hear all sounds equally at all frequencies



And, we all know BC is not as good as AC, don't we?



So, why does a normal PTA look like this?

# Calibration!

The audiometer accounts for the different hearing levels at different frequencies as well as the 'natural' reverse A/B gap.



Clever thing

# Those mysterious markings



# Legends for PTA's

Legend	Right	Left
Air Conduction	O	X
•with masking	Δ	□
Bone Conduction	<	>
•with masking	┌	┐
No Response	↙	↘



Air conduction



Bone conduction

# How they do it (briefly)

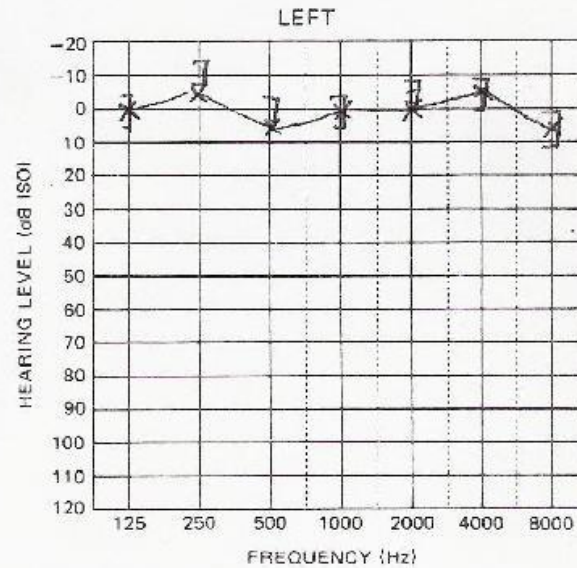
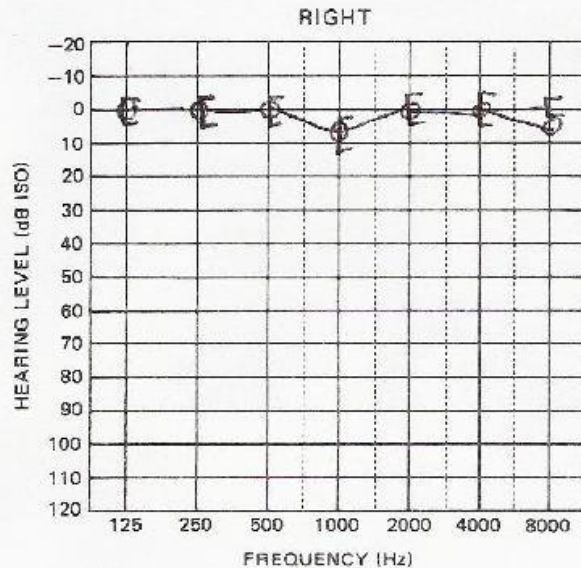
1. Otoscopy + explanation
2. Best ear?
3. Start with AC on best ear
4. Start at 1000Hz at 60dB
5. Down by 10dB until no response
6. Then up by 5dB until response (3 out of 5)
7. Up and down frequencies
8. Same for bone

# Normal PTA

HEARING ASSESSMENT CENTRE - BCH

AUDIOGRAM OF ..... DATE .....

DATE OF BIRTH .....



REMARKS: ..... RECORDED BY: .....

AIR CONDUCTION  
RIGHT O      LEFT X

MASKED AIR CONDUCTION  
RIGHT O      LEFT X

BONE CONDUCTION  
UNMASKED (RIGHT OR LEFT)    Δ  
MASKED                      RIGHT (      LEFT )

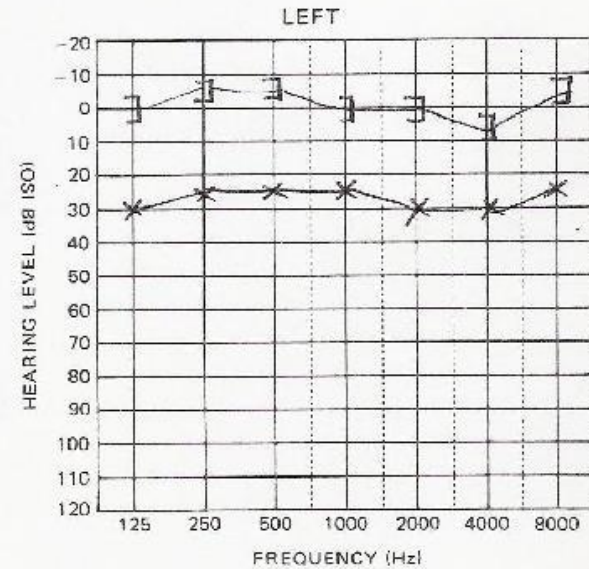
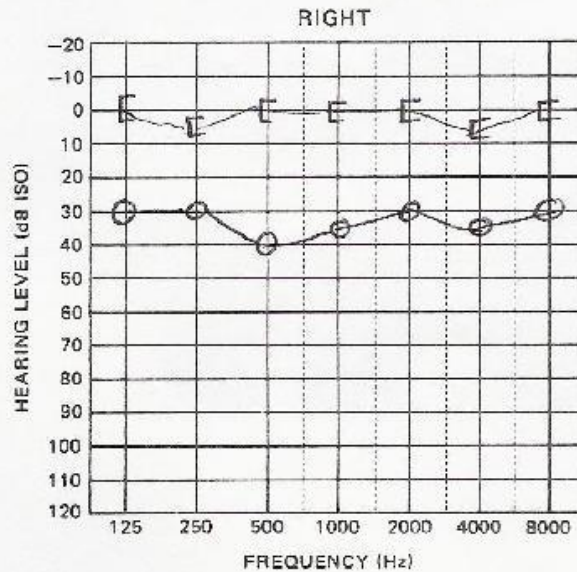
DATE ..... PURE TONE AUDIOGRAM

# Conductive Loss

HEARING ASSESSMENT CENTRE - BCH

AUDIOGRAM OF ..... DATE .....

DATE OF BIRTH .....



REMARKS: .....

RECORDED BY: .....

AIR CONDUCTION  
RIGHT O      LEFT X

MASKED AIR CONDUCTION  
RIGHT O      LEFT X

BONE CONDUCTION  
UNMASKED (RIGHT OR LEFT) Δ  
MASKED                      RIGHT (      LEFT )

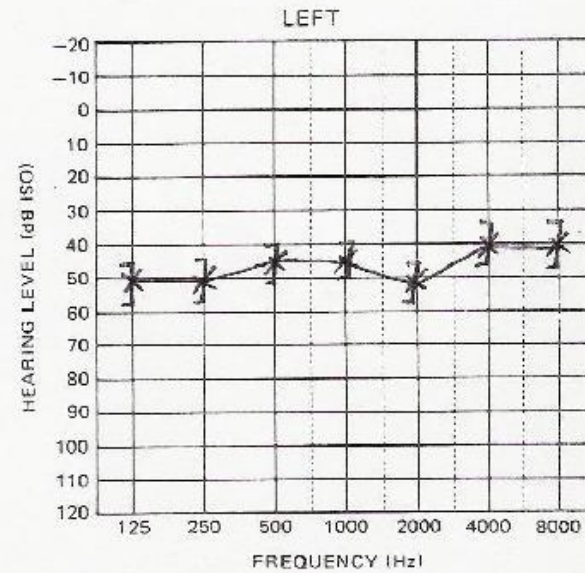
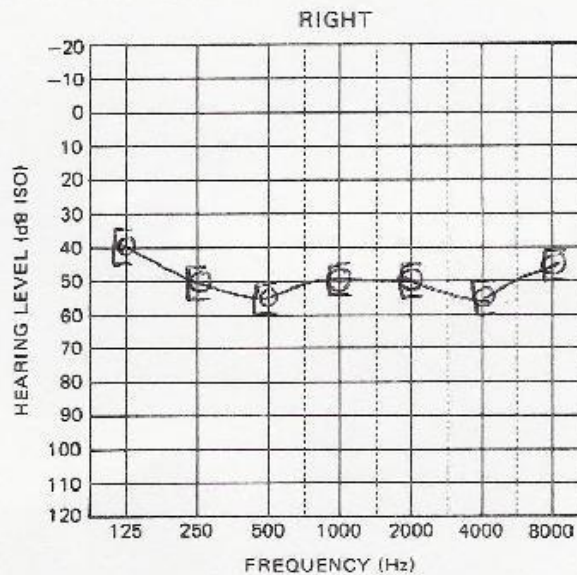
DATE ..... PURE TONE AUDIOGRAM

# Sensorineural Loss

HEARING ASSESSMENT CENTRE - BCH

AUDIOGRAM OF ..... DATE .....

DATE OF BIRTH .....



REMARKS: .....

RECORDED BY: .....

AIR CONDUCTION  
RIGHT O      LEFT X

MASKED AIR CONDUCTION  
RIGHT O      LEFT X

BONE CONDUCTION  
UNMASKED (RIGHT OR LEFT) △  
MASKED                      RIGHT (      LEFT )

DATE ..... PURE TONE AUDIOGRAM

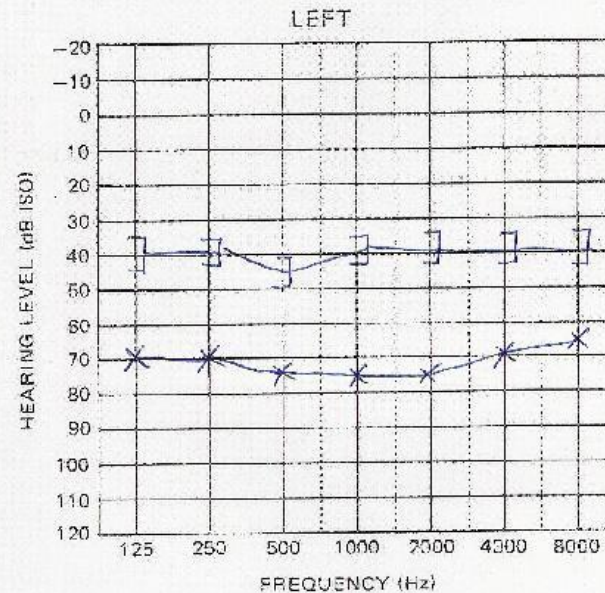
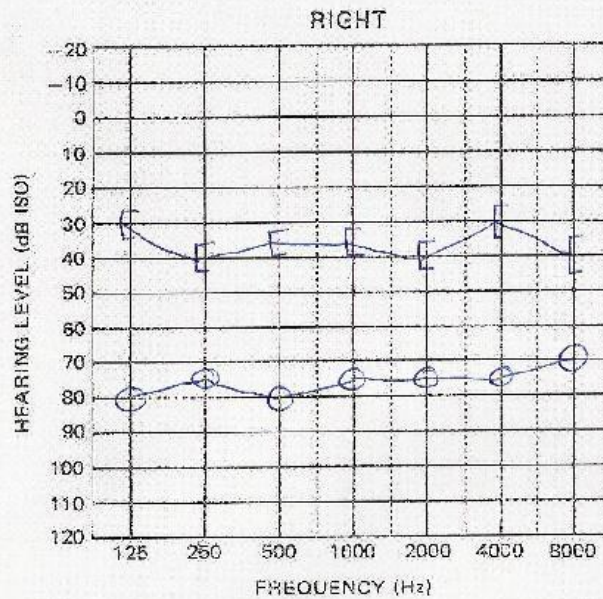


# Mixed Loss

HEARING ASSESSMENT CENTRE - BCH

AUDIOGRAM OF ..... DATE .....

DATE OF BIRTH .....



REMARKS: .....

RECORDED BY: .....

AIR CONDUCTION  
RIGHT O      LEFT X

MASKED AIR CONDUCTION  
RIGHT O      LEFT X

BONE CONDUCTION  
UNMASKED (RIGHT OR LEFT) Δ  
MASKED                      RIGHT (      LEFT )

DATE ..... PURE TONE AUDIOGRAM

# Masking

Used to prevent non-test ear hearing stimulus presented to test ear



# Interaural attenuation

- Bone

Assumed to be 0dB, but probably nearer 4-6dB

- Air

Assumed to be greater than 40dB, but varies between patients

- Masking used to eliminate this confounding factor



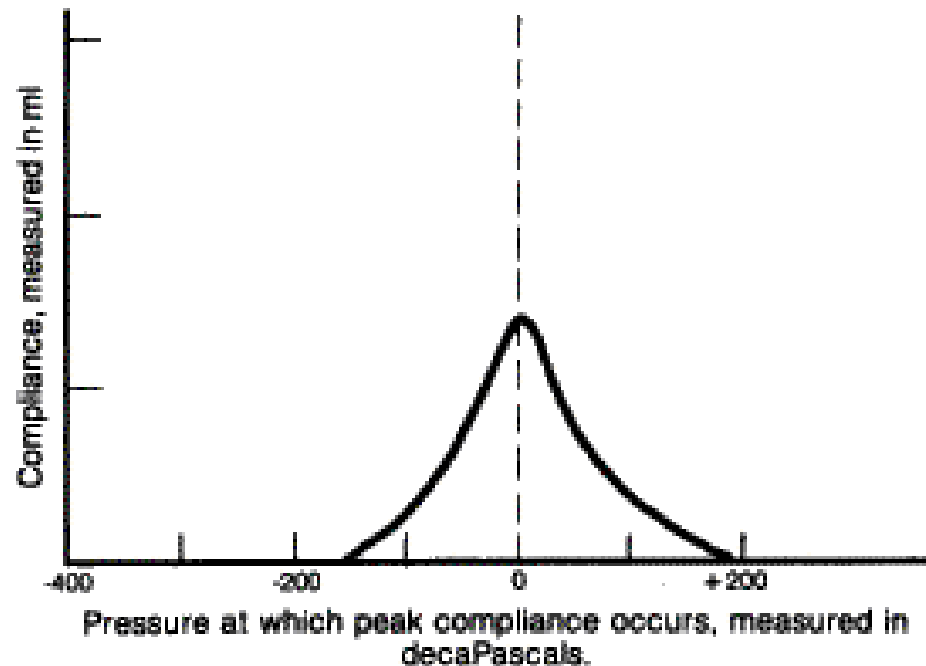
# PTA limitations

- PTA is NOT always a 'Gold Standard' and infallible
- Limited by : patient, audiologist and equipment
- Beware on NOHL
- Try to supplement other simple tests

# Tympanometry

# Tympanometry

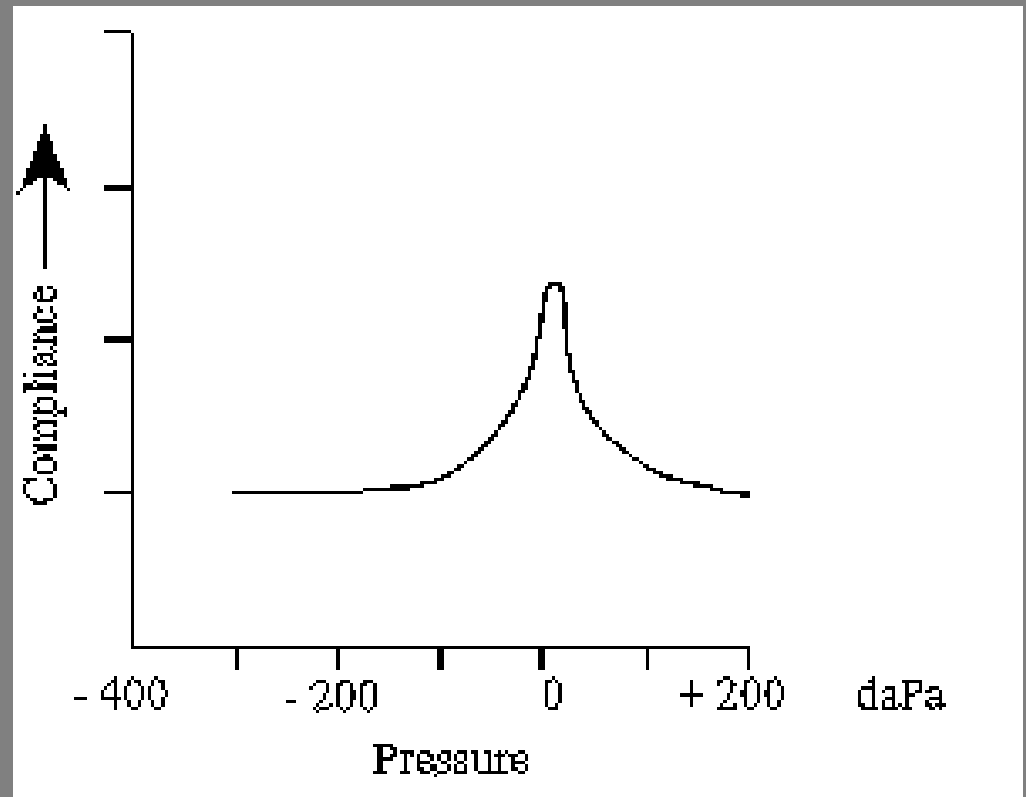
Measure of compliance  
of TM at varying  
pressures in EAM



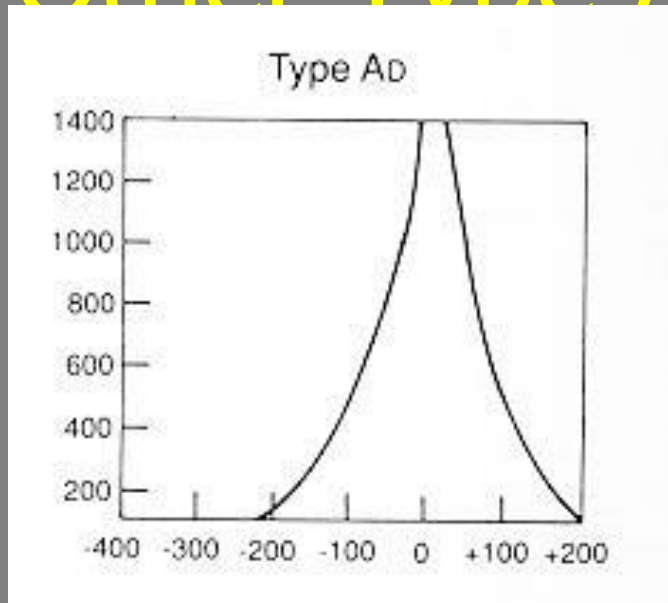
# Normal tympanogram (Type A)

Peak at 0dPa

Best movement of drum when no extra pressure on either side of TM

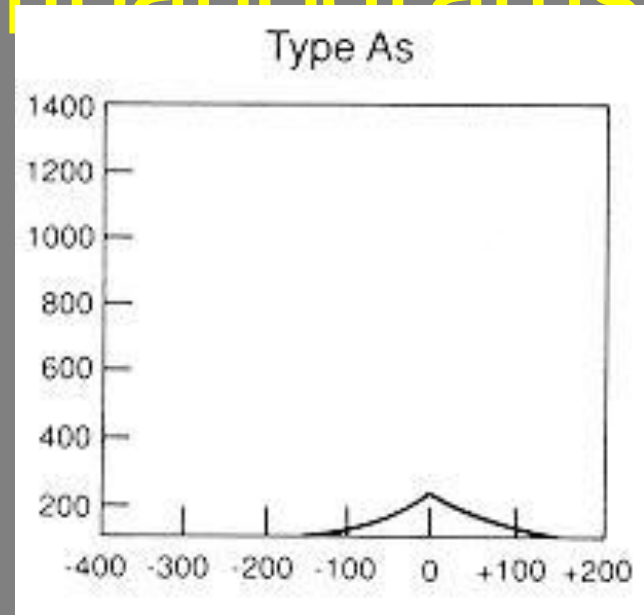


# Other Type A tympanograms



Peak at 0dPa, but  
unusually high  
amplitude

? Ossicular disruption



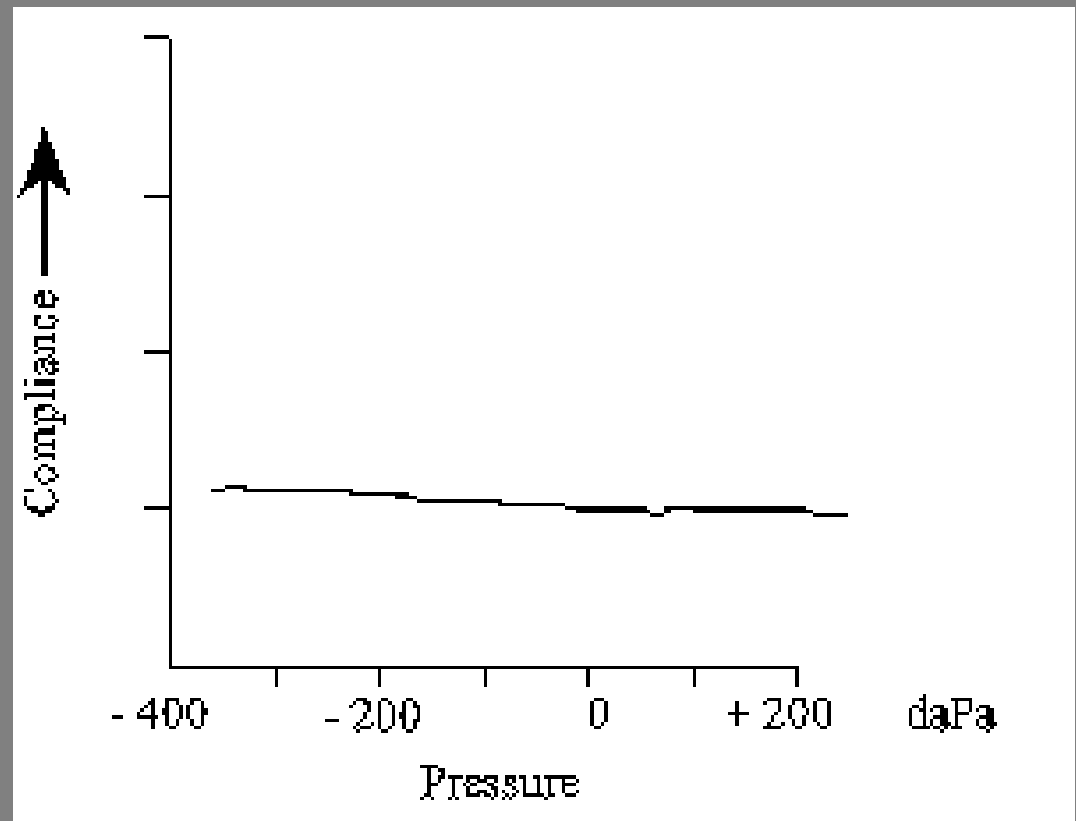
Peak at 0dPa, but  
unusually low  
amplitude

? Stapes fixation

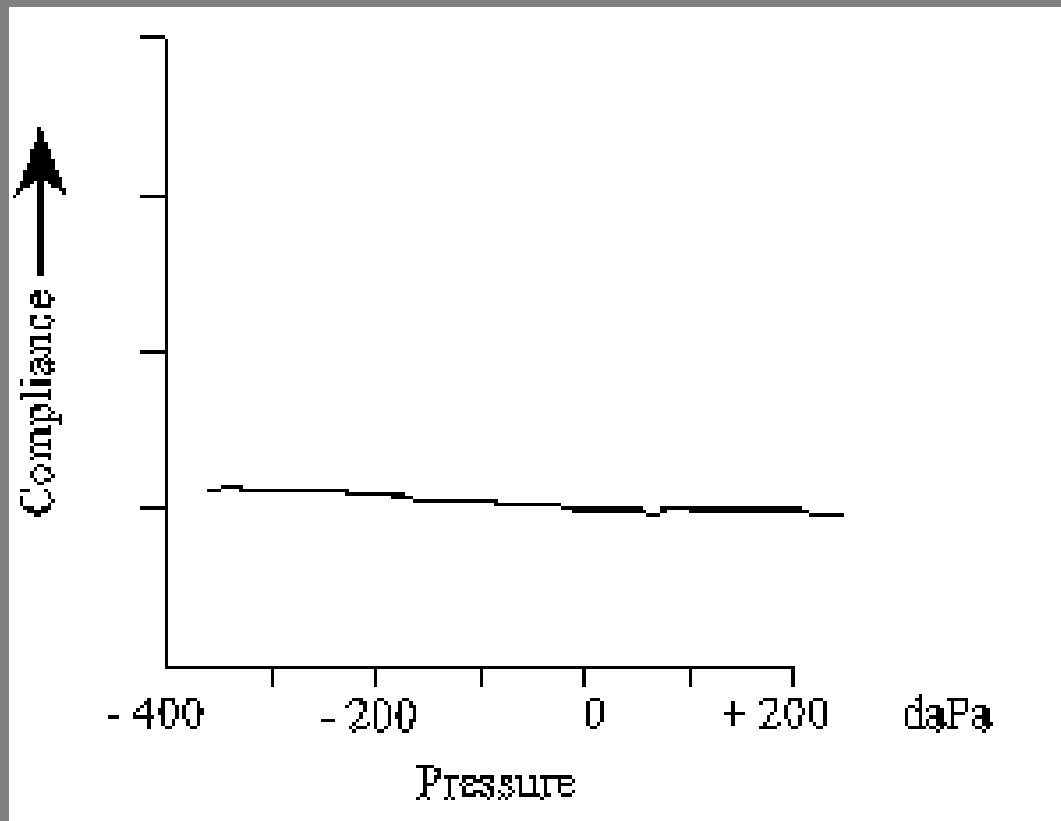
# Flat tympanogram (Type B)

No Peak

No best TM  
movement at any  
pressure



# Flat tympanogram (Type B)



When tymp is flat,  
usually means 1 of 3  
things:

1. Artefact
2. Fluid in ME
3. Perforation

Look at EAM vol.

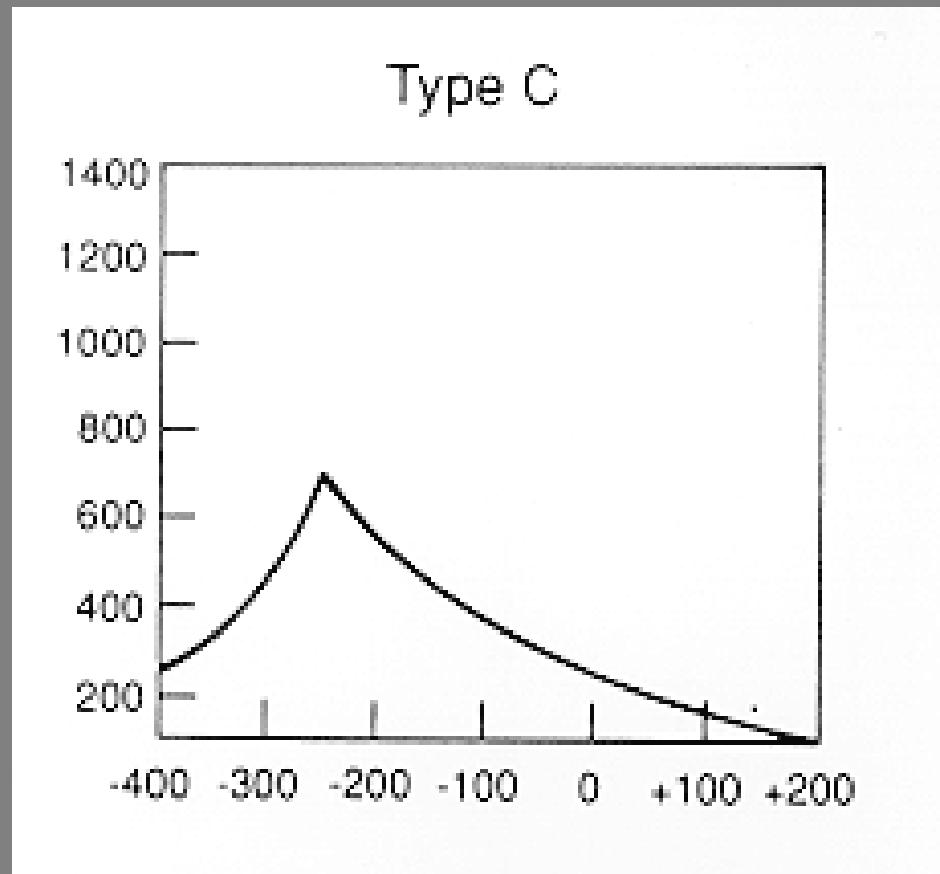
If large = perf

If normal = fluid

# Negative tympanogram (Type C)

Peak at  $< 0$ dPa

Best movement of drum when no negative pressure in EAM thus middle ear pressure must be  $<$  atmospheric



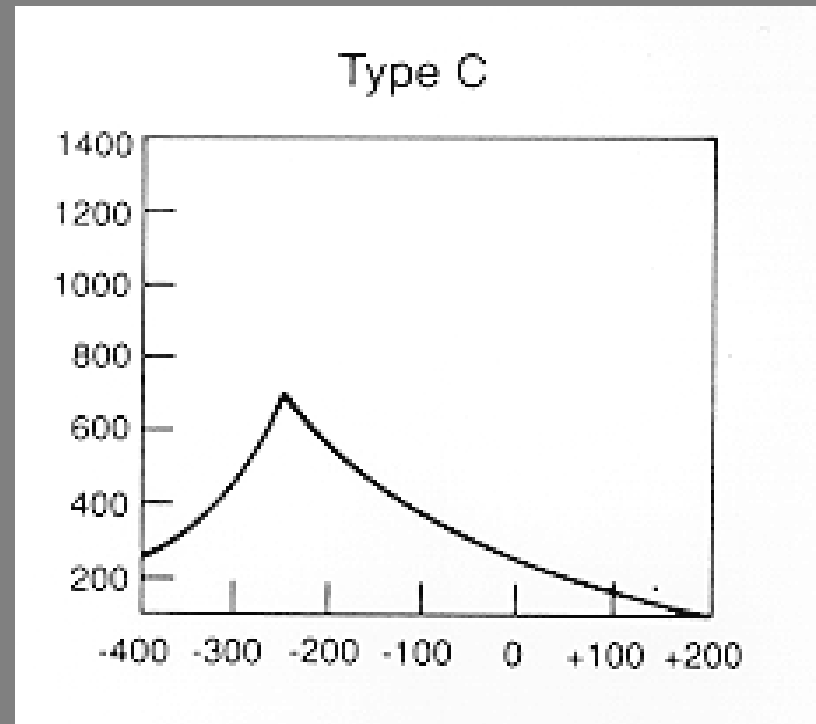


# Negative tympanogram (Type C)

Can be further divided into:

C1 – peak between 0 and -200 daPa

C2 – peak less than -200daPa



# Final Thought

Tests are not infallible, they are only as good as those taking, administering and interpreting them...