Speech Audiometry (3)
Performance- Intensity function (PI)

• It is testing speech recognition scores at different intensities at supra-threshold level, it explains the influence of presentation level on performance

• **PB max**: the highest obtainable word recognition score
Normal hearers will get 100% by 30 to 40 dB SL and this should be maintained as the level get louder.

For many people with SNHL, their maximum obtainable scores is below 100 % regardless of presentation level.

If with increasing of the level, the scores deteriorated, this give indication for disorders beyond cochlea (RCP) and the phenomenon called (rollover phenomenon).
Scores interpretation

Interpreting the Results

Speech audiogram:
A. Normal.
B. Conductive deafness.
C. Sensorineural deafness—good discrimination.
D. Sensorineural deafness—severe loss of discrimination.
• A. Normal results

- In normal subjects, as the intensity increases, the scores in % increases (the subject might get 100 % at 30 to 40 dB above PTA or lower)

• B. Conductive heating loss

- Their scores similar to normal hearing subjects (still get high scores), except at slightly elevated intensities

- Same curve except it is shifted to the right
• C. Sensorineural hearing loss

- Word recognition scores varied, good scores at higher intensities or poor scores despite on stimulus presentation level

- Will depend on the extent and shape of the audiogram

- In patient with cochlear pathology, the scores may drop slightly once you go beyond the PB max
• Retrocochlear (Rollover)

➤ Rollover is when speech recognition scores reduced at intensities above the level at which PB max attained

➤ However, mild rollover might not be significant
In order to be significant

✓ Rl : \((\text{score at PB max} - \text{score at PB min}) / \text{PB max}\) > 0.45

❖ **PB max**: level at which highest score achieved

❖ **PB min**: The level higher than the intensity, at which PB max achieved, at which lowest score achieved
Example;
Example answer

RI = (62 - 35) / 62
    = 0.43

❖ Is this significant?

➢ Beware as rollover can occur in elderly with neural presbycusis

➢ But this test is a site of lesion test and not test to determine the etiology
Bone conduction speech recognition testing

- It is used in testing subjects with severe mixed hearing loss as the word recognition scores might not be attainable because the air conduction thresholds are severely affected.
- In this case speech recognition could be tested using the bone conduction threshold and same AC procedure.
• However, Bone conduction speech recognition tastings has never become popular
Masking in speech audiometry

1. masking for Speech- Recognition Threshold (SRT)

- Masking used sometimes in SRT to eliminate the influence of NTE and be ascertain about the true SRT whenever cross hearing is possible
Cross hearing in SRT tests and need for masking

• **Previously**, the notion is that the cross hearing arise and the NTE need to be mask, whenever there is significant difference between both ears SRTs

• However, this notion ignores the existing knowledge that the sound contralaterlize by bone conduction and not by air conduction
• **Nowadays**, cross hearing is a danger when the SRT of the tested ear (TE) minus IA (40 dB for supra-aural headphone and 70 dB for inserts) is greater than or equal to the best bone conduction thresholds of NTE.

• SRT of TE should be compared to best bone conduction threshold of NTE at 500, 1000, 2000 or 4000 Hz

• **SRT (TE) – IA ≥ best BC (NTE)**
Type of noise used

- As speech is a broad-spectrum signal, it needs a noise with a broad band of frequencies.

- White noise (WBN) is available on many diagnostic audiometers and it masks speech satisfactorily. However, it’s less intense at low frequencies.
• Speech noise is white noise that filtered above 1000 Hz by about 12 dB per octave

• Speech noise provides more energy at low frequencies than white noise does

• So, speech noise resembling speech signals more and it’s the preferable one to mask speech signals
Calibration of speech masking noises for effective masking

• If the audiometer calibrated for effective masking, masking for speech could be carried out directly as the way of pure tone masking

• If not, the following psychoacoustic calibration for effective masking should be performed on group of normal hearing subjects
1. Present a group of spondees at 30 dB HL, keep it stable

2. Present speech noise (or equivalent) to the same ear

3. Raise the level of noise in 5 dB steps, until the person misses 50% of the presented words, recheck this level
4. Obtain the average of noise that masks 30 dB speech signal

5. Subtract 30 dB from the obtained noise level

6. Add a safety factor of 10 dB to ensure the masking effectiveness for most cases

7. This considered as 0 dB EM for speech
• So, as the cross hearing has been proved masking with speech noise will be applied to the non tested ear (NTE), and the testing words presented to the TE and plateau method like pure tone masking will be conducted
Central masking

• It’s the same as pure tone one

• It’s a brain phenomenon at which slight shift happened (5 dB) to TE SRT when the masking applied to the NTE

• The shift is not corresponding to the presence of noise
Demonstration Example for masking

**FIGURE 6.9** Possible cross hearing during SRT testing. Both A and B show that the difference between the SRT of the test ear and the lowest bone-conduction threshold of the non-test ear exceed the minimum interaural attenuation found when speech sounds contralateralize (40 dB). Note that the SRT of the non-test ear in A is 0 dB HL and in B it is 30 dB HL. The SRTs of the non-test ears are unrelated to the danger of cross hearing for speech. The SRT of the test ear must be compared to the lowest bone-conduction threshold of the non-test ear. The initial effective masking level for the SRT is equal to the SRT of the non-test ear (i.e., 0 dB EM for A, 30 dB EM for B).
Masking procedure

• Find out if the masking needed for both ears

\[ \text{SRT (TE)} - \text{IA} \geq \text{best BC (NTE)} \]

• If yes, specify tested ear (spondee to be presented) and Non-tested ear (noise to be applied)

• Masking level \( = \) (NTE) SRT EM, for the above example, (A, 0 dB EM and B, 30 dB EM)
• Present 4 to 6 spondees to the TE (at its threshold level) while rushing noise applied to the NTE

• If the patient repeat 50% or more of the words ¾ or 4/6, increase the noise level in 5 dB steps for three times

• If the SRT does not change or just 5 dB difference happened, just change the symbol
• If the patient shows no response or less than 50% of the words repeated, increase the presentation level in 5 dB and decrease in 10 until the patient repeat 50% of the words, at that level manipulate plateau
2. Cross hearing and masking in SRS testing

- As the SRS testing are done at supra-threshold level, the danger of cross hearing is of greater possibilities.

- Masking judged to be needed for SRS whenever the stimulus level minus the IA is equal to or greater than the lowest BC threshold of NTE

\[ \text{SRSHL (TE)} - \text{IA} \geq \text{best BC (NTE)} \]
• IA considered as 40 dB for supra-aural earphone and 70 dB for inserts

• Whenever masking needed for SRT testing, it will always needed for SRS

• Masking noise available to be used for SRT same as the one for SRS
• The noise should be calibrated for effective masking level

• EML is equal to hearing level at which the SRS test is performed plus correction factor minus IA plus the largest ABG in the masked ear

\[
\text{EML} = \text{HL (TE)} + \text{CF (10)} - \text{IA (40 or 70)} + \text{ABG (NTE)}
\]

• so, the EM is just sufficient to mask speech at NTE
• If larger values of IA could be used, EM will be lowered and the probability of over masking will be diminish

• Using Inserts has advantages over supra-aural earphone as

✓ It has IA values which eliminates the need for masking for many patients
✓ Also, the probability of over-masking will be reduced due to large IA values

✓ Inserts reduced the effect of background noise

• The used EM level better to be recorded on the audiometeric worksheet
MaxML and overmasking

- MaxML for Speech audiometry (SRT and SRS) is the same as pure tone one

\[ \text{MaxML} = \text{IA} + \text{BC (TE)} \]

- Overmasking (OM) is possible when EM minus the IA is equal to or above the best BC threshold of the TE

\[ \text{OM} = \text{EM(NTE)} - \text{IA} \geq \text{best BC (TE)} \]