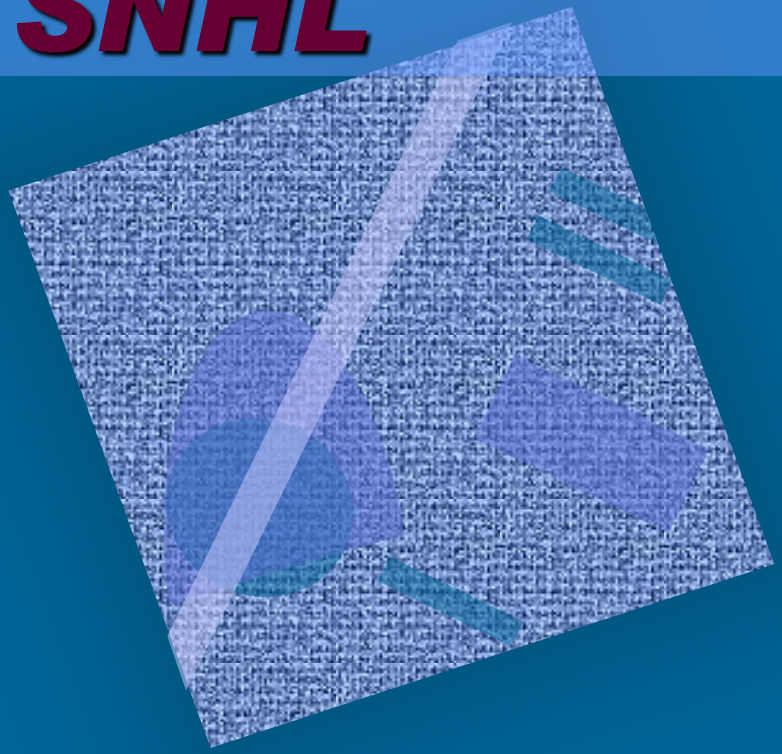
Hearing evaluation for SNHL



Routine test

- Turning fork
  - Weber : lateralize to better ear
  - Rinne : AC > BC
  - Schwabach test : short
- Audiometry
  - Hearing level > 25 dB
  - No air-bone gap
  - Spheech recognition score depend on HL

Special test

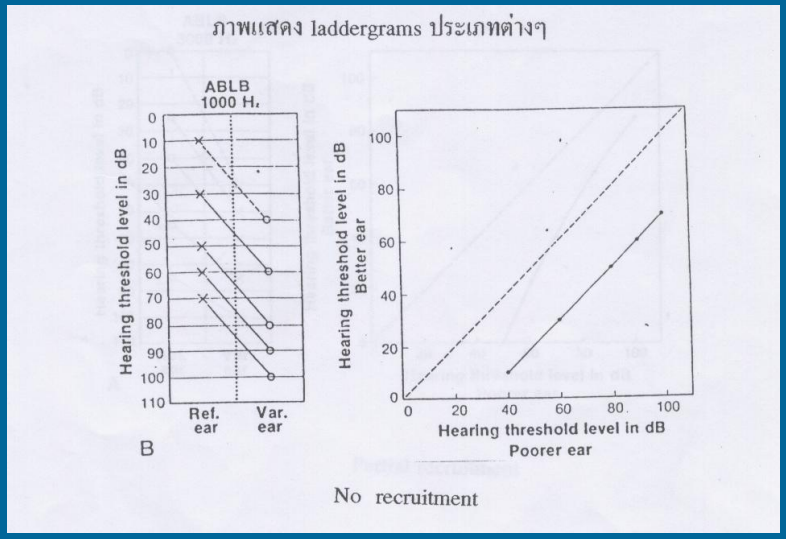
- Subjective test
  - Cochlear
  - ABLB
    - SISI
  - Retrocochlear
  - Tone decay
  - R/O cochlear or retrocochlear
  - Bekesy test
    - PIPB
- Objective test
  - Acoustic immittance audiometry
    - Tympanometry
    - Acoustic stapedial reflex
    - Acoustic stapedial reflex decay
  - OAEs
  - Auditory evoked potentials response
    - ECochG
    - ABR

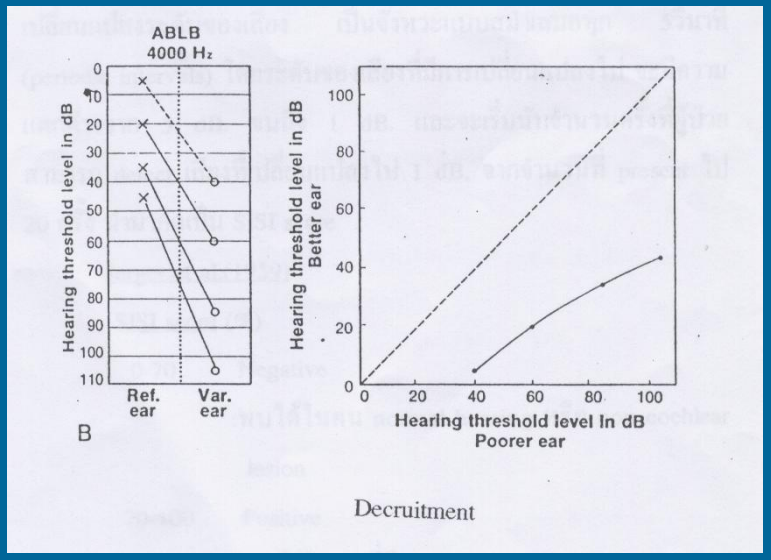
recruitment

- **Recruitment** is a normal loudness response at high intensity
- 1. present in normal ear at high intensity
- 2. present in every ear with cochlear hearing loss
- 3. At high intensity, the growth function of normal and recruit ear are the same
- 4. CN VIII lesion cause neural transmission loss → slow loudness growth

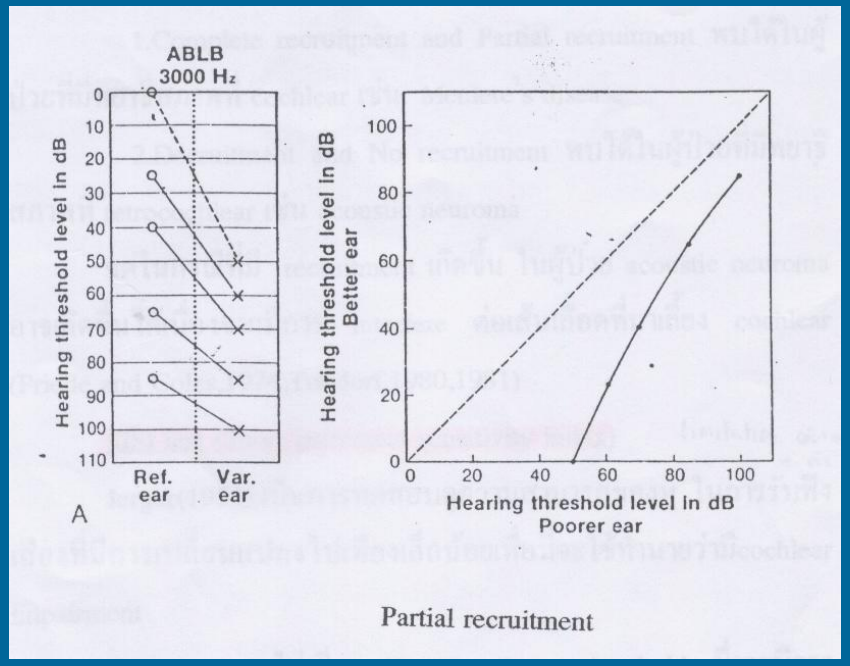
ABLB

- Alternate binaural loudness balance test
- unilateral hearing loss
- growth of loudness
- reference
- ladder gram

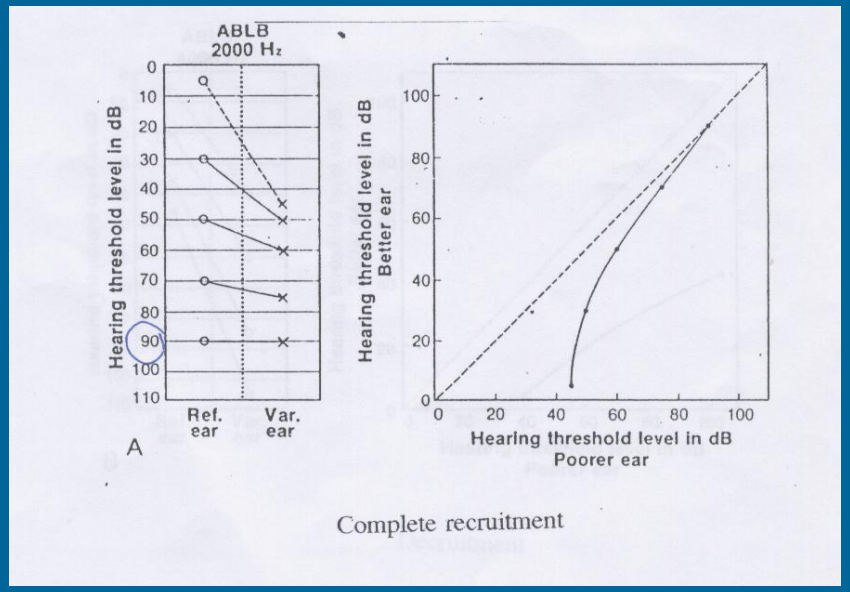




– Decruitment and no recruitment retrocochlear eg. Acoustic neuroma



Partial recruitment



Complete recruitment

- Complete recruitment &partial recruitment cochlear lesion

SISI test

- Short increment sensitivity index
- 20 dB SL or 75 dBHL

Auditory adaptation

- A temporary reduction in hearing sensitivity

-sustained acoustic stimulation at supra-threshold intensity.

Tone decay

- Indication
  - Asym SNHL
  - Asym speech recognition ability
  - SSNHL
  - Asym tinnitus of recent origin
  - Vestibular symptoms(dizziness,balance disturbance)

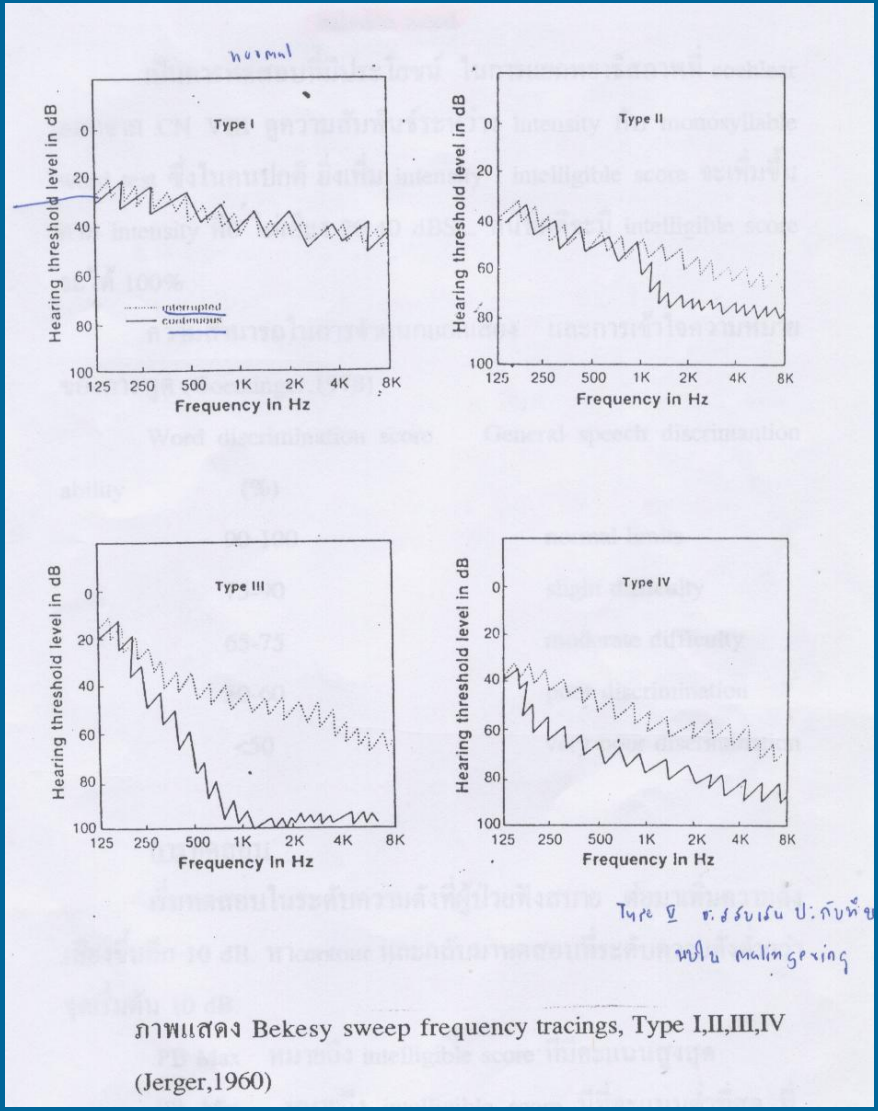
Tone decay

  - TDT:tone decay threshold
  - STAT : supra-threshold adaptation test
- STAT:pure tone
- 105 dBHL
- Abnormal tone decay :retrocochlear lesion

Bekesy test

- continuous tone & interrupted tone , Fq 100-10000 Hz
- โดinterrupted tone

Bekesy test



ภาพแสดง Bekesy sweep frequency tracings, Type I,II,III,IV (Jerger,1960)

- Type I: normal ,CHL,cochlear lesion
- Type II:cochlear lesion
- Type III: retrocochlear
- TypeIV: retrocochlear or cochlear

PIPB function

- Performance intensity function for ponetically balance word
- cochlear &retrocochlear lesion
- intensity
- monosyllable word test , intensity =>intelligible score

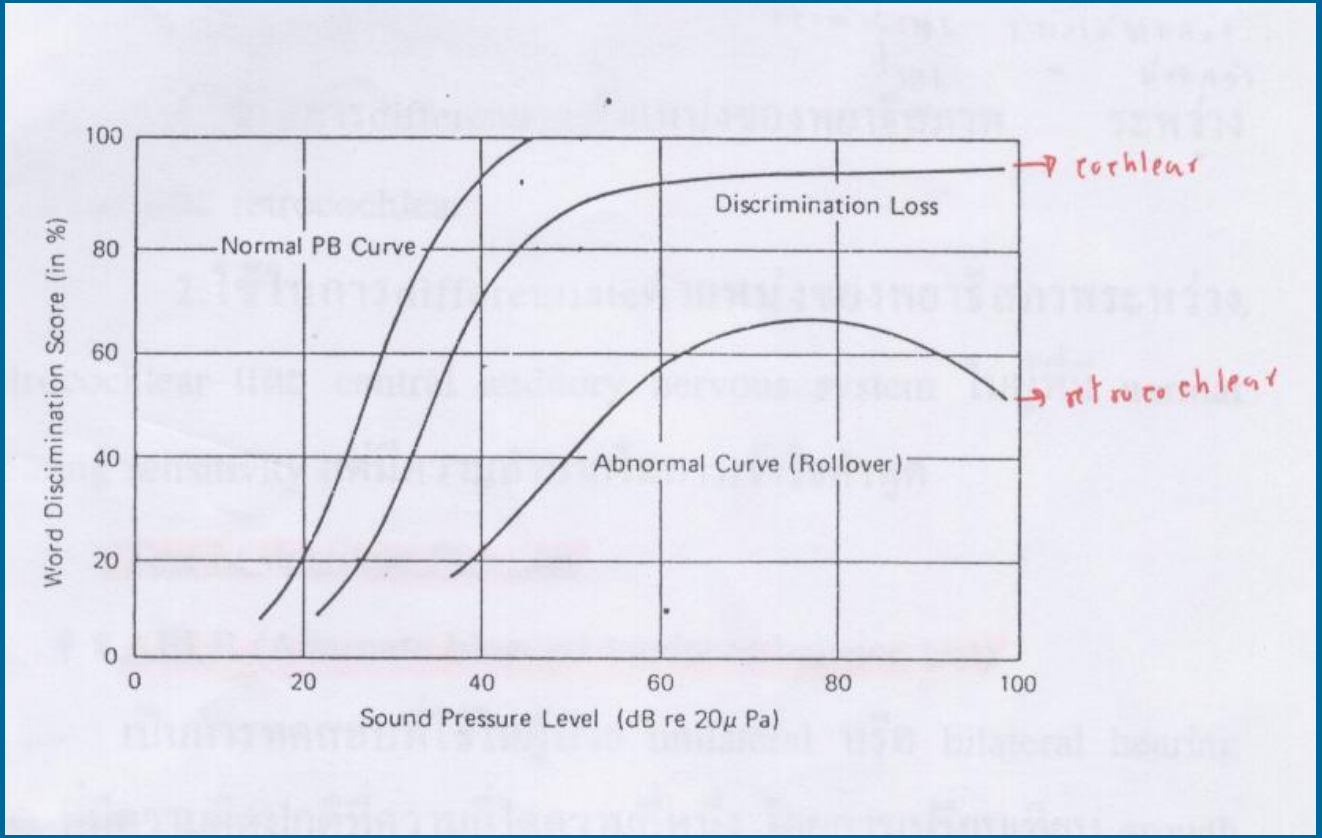
PIPB function

- PB Max : Max intelligible score
- PB Min : Min intelligible score after PB Max
- Roll over :percent of intelligible score
- Roll over index = $\frac{\text{PB Max-PB Min}}{\text{PB Max}}$

< 0.4 cochlear lesion

> 0.45 CN VIII lesion

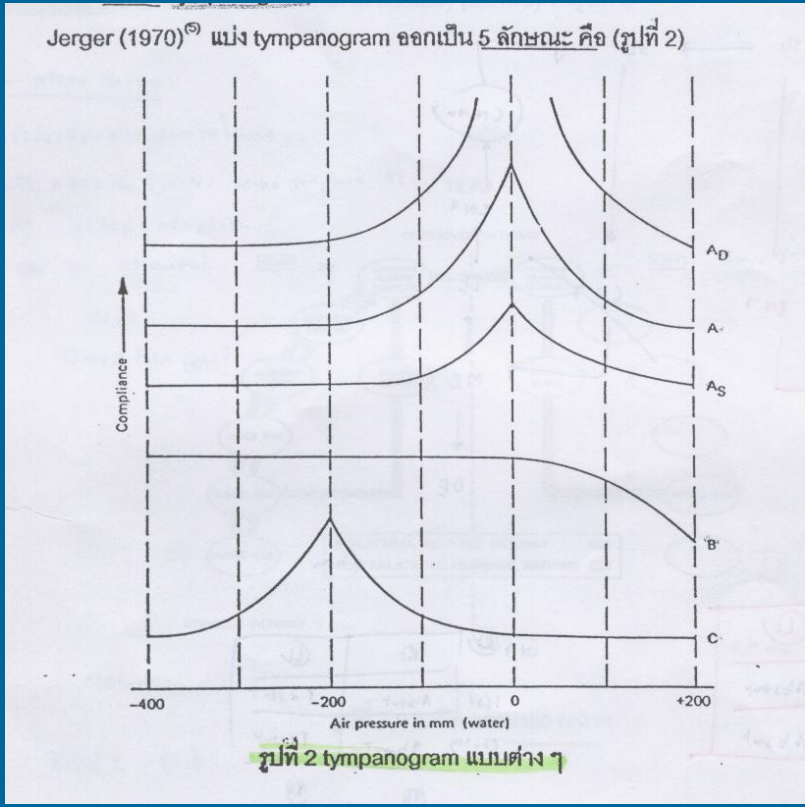
PIPB function



Limitation of subjective

- hearing loss > 90 dB

tympanometry

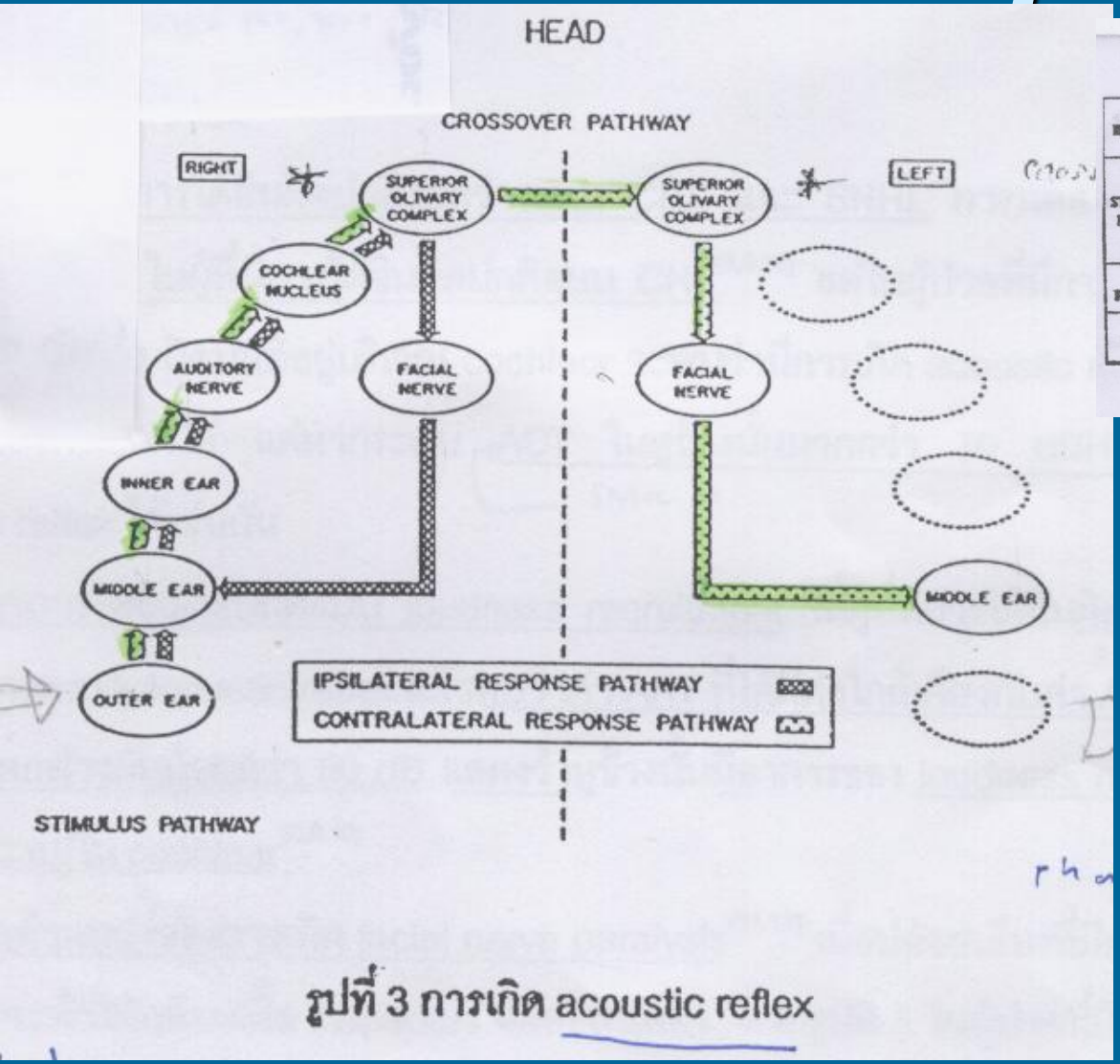


- SNHL=> type A
- Normal static compliance

Acoustic stapedial reflex

- Stimulation:ipsilateral ,contralateral
- reflex=>acoustic reflex threshold(ART)or stapedius reflex threshold (SRT)
  normal 70-110 dBSPL(pure tone),
  90-95 dBSPL (broad band noise)

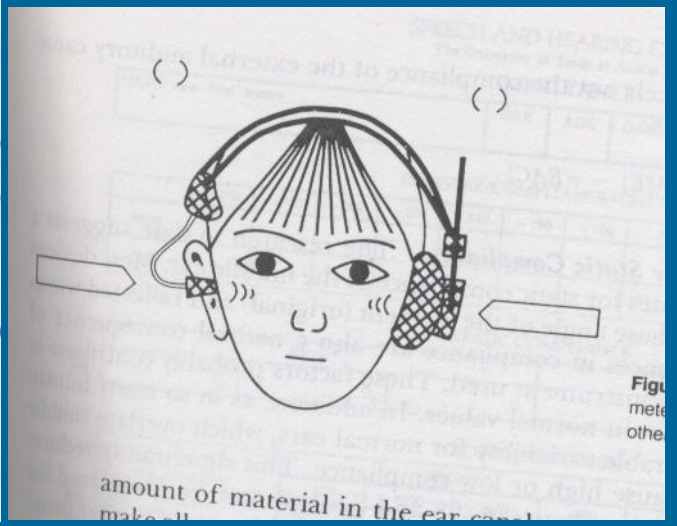
Acoustic stapedial reflex



รูปที่ 3 การเกิด acoustic reflex

EAR	MODE	FREQUENCY (Hz) .5K	1K	2K	4K
STIM. RE	ipsi	90	95	95	
	contra	85	85	90	90
PTT.	LE	15	10	5	0
Difference		70	75	85	90

EAR	MODE	FREQUENCY (Hz) .5K	1K	2K	4K
STIM. LE	ipsi	80	90	90	
	contra	80	85	85	80
PTT.	RE	60	60	40	30
Difference		20	25	45	50



amount of material in the ear

Acoustic stapedial reflex

- Cochlear
  - Normal
  - elevated
  - Absent if HL > 70 dB
  - Recruitment:
    ART-ACT < 60
    dB:positive Metz test
- retrocochlear :
  - Absent
  - Elevate reflex:
  - retrocochlear lesion

Acoustic stapedial reflex decay

- auditory adaptation
- > ART 10 dB , 10 sec , Fq 500,1000 Hz
- 2000 , 4000 Hz adaptation
- 3-5 sec : abnormal auditory adaptation

OAEs

- Otoacoustic emissions
- sound reflection from the cochlear with and without stimulation
- Represent OHCs function
- Absent : HL > 40 dB in DPOAEs
- HL > 30 dB in TEOAEs

Classification of OAEs

- 1.spontaneous OAEs(SOAEs):50 %
- 2.stimulated or evoke OAEs(EOAEs)
  - 2.1 delayed or transient evoke OAE (TEOAEs): brief acoustic stimulus
  - 2.2 stimulus Fq evoke OAEs(SFOAEs):single continuous puretone
  - 2.3 distortion product (DPOAEs): 2 continuous pure tone ,diff Fq

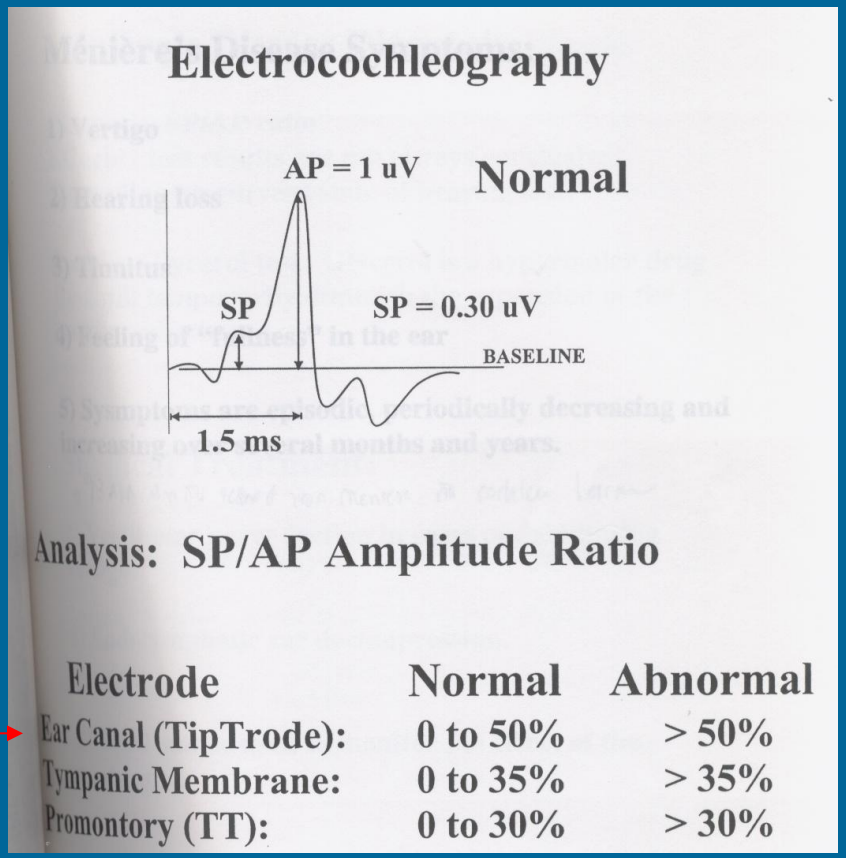
ประโยชน์ของ OAE

- 1.identify subtle cochlear pathology pure tone normal complain (auditory neuropathy: normal OAEs ,absent ABR)

OAE

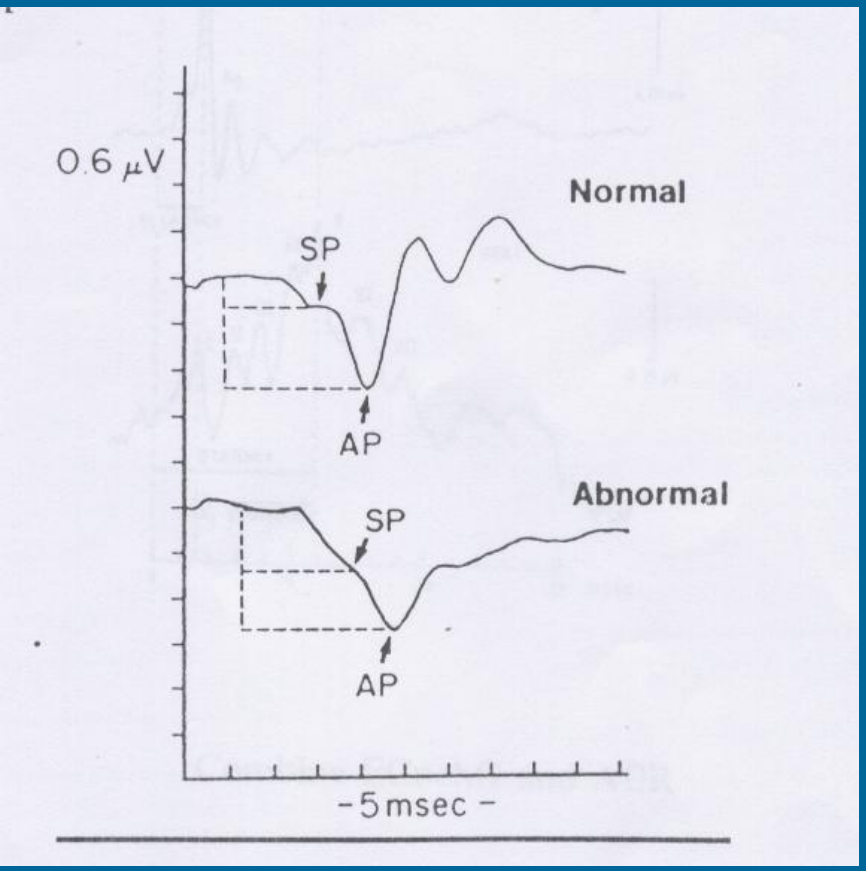
- 2.differentiate cochlear&retrocochlear
- 3.monitoring
  - Ototoxic drug
  - Intraoperative:acoustic neuroma
  - Meningitis
  - Progressive Dz=>heridity hearing loss
  - Glyceral test in Meniere's Dz

ECochG



- bioelectric response cochlear&auditory n.
- SP:summating potential
- AP:whole nerve action potential
- CM: cochlear microphonic

Clinical application of ECochG



- 1. lesion in auditory system
  - cochlear lesion AP ≤ 2 msec
- 2.enlarge SP =>Dx Meniere symtomatic sens >90%
- 3. ABR , AP =wave I

ABR

- Auditory brainstem response
- ABR is one component of AEPs
- Others terms
  - BAER:brainstem auditory evoked response
  - BSER:brainstem evoked response
  - BAEP:brainstem auditory evoked potential

Indication ABR

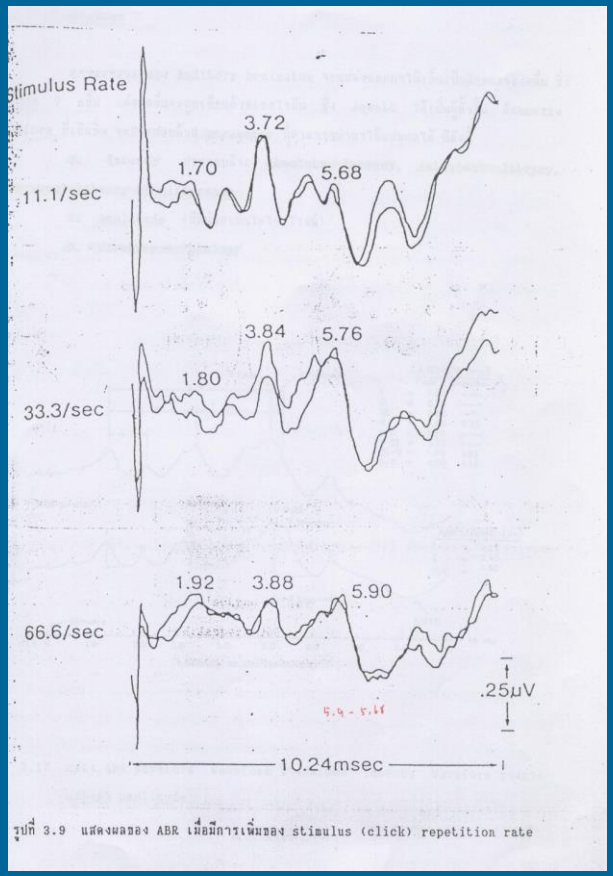
- 1.unilateral hearing loss
- 2.asymmetrical hearing loss
- 3.symmetrical hearing loss underlying
- 4.inappropiate SDS & PTA
- 5.pt. vertigo or tinnitus R/O peripheral or central lesion

ปัจจัยที่มีผลต่อ ABR

- 1.Stimulus
  - intensity ใช้เสียง > 60 dBSL จึงจะทำให้เกิด good waveform morphology
    - **เพิ่มขึ้น =>** amplitude เพิ่มขึ้น , morphology good, latency ลดลง
    - **ลดลง** => amplitude ลดลง , morphology poor, latency เพิ่มขึ้น
  - rate :
    - ปกติใช้ ≤ 20/sec
    - Rate เพิ่มขึ้น => latency เพิ่มขึ้น , amplitude ลดลง, morphology poor
  - type of stimulus
    - Click:broad band spectrum ,Fq 1-4 KHz
    - Click จะพบ wave form 7 wave
    - Tone burst , specific Fq ม waveform จะขึ้นอยู่กับ Fq ที่ใช้กระตุ้น

ABR

- 2.audiometry:
  - Hearing level
  - Type of hearing loss



รูปที่ 3.9 แสดงผลของ ABR เมื่อมีการเพิ่มของ stimulus (click) repetition rate

Origin ABR

- Wave I :distal portion of the VIII n.
- Wave II:proximal portion of the VIII n.
- Wave III:cochlear nucleus
- Wave IV:superior olivary complex
- Wave V:lateral lemniscus
- Wave VI-VII: inferior colliculus

- Wave I : **c**ochlear nerve
- Wave II: **c**ochlear nucleus
- Wave III: **s**uperior olivary complex
- Wave IV: **l**ateral lemniscus
- Wave V: **i**nferior colliculus
- Wave VI: **m**edial geniculate
- Wave VII: **a**uditory(cortical) radiation

ABR

- Clinical applications
  - Newborn,infant auditory screening
  - Estimation of auditory sensitivity (1-4KHz)
  - Neurodiagnosis of VIII or auditory brainstem dysfunction
  - Monitoring VIII &auditory brainstem intraoperative (posterior fossa Sx)

ABR

- 1.waveform morphology
  - Normal=>clearly wave I –V
  - Wave V : hearing threshold
  - Wave VI-VII :
  - Poorly form

การอ่าน ABR

2.latency

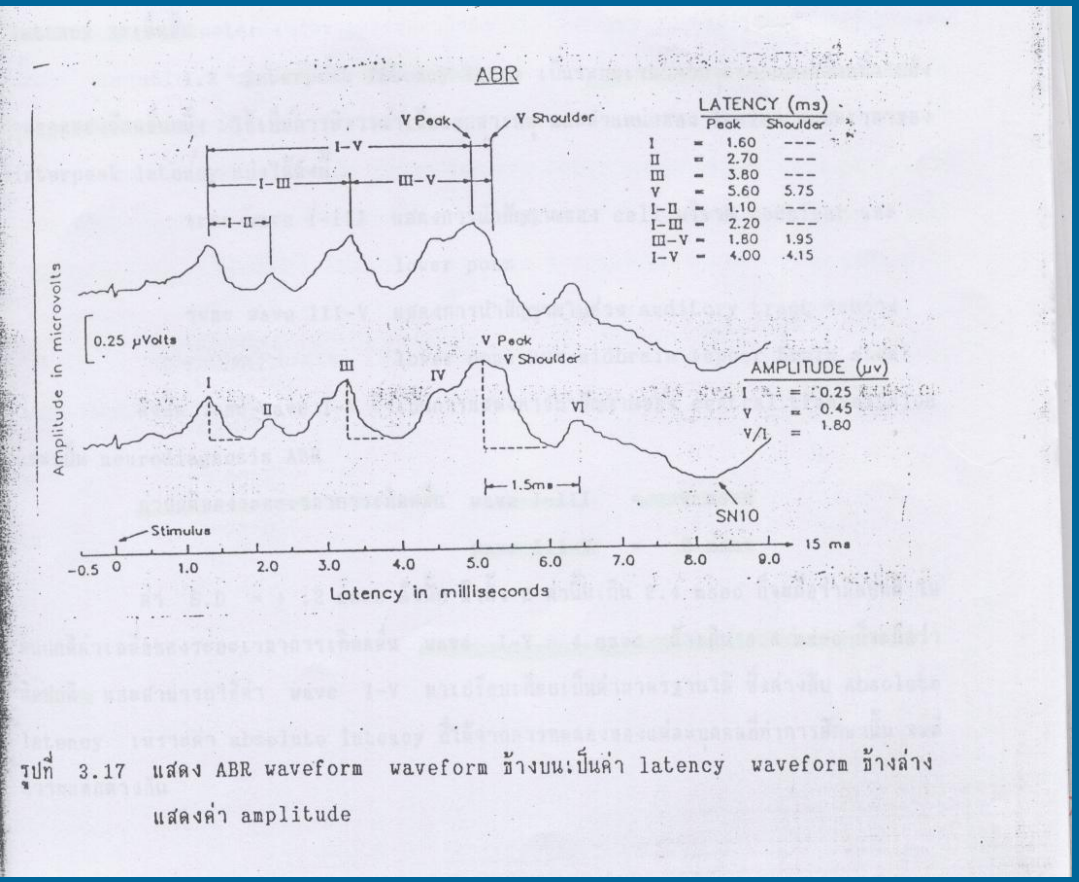
- Absolute latency : ≤ wave n+1
  - Wave I ≥ 1.5 msec
  - Later wave + 1 msec
- Interpeak latency : I-III = 2msec, III-V= 2msec, I-V = 4 msec S.D= 0.2 msec

  normal ≤ + 2 S.D
- Interaural latency difference ≤ 0.4 msec
  - Wave V
  - I-V

ABR

- 3.amplitude:
- 0.1-1 µvolt
  - Amplitude ratio wave V:I
    - Normal >1
    - Retrocochlear < 1

ABR



รูปที่ 3.17 แสดง ABR waveform waveform ข้างบนเป็นค่า latency waveform ข้างล่าง แสดงค่า amplitude

- I-III : cochlear & lower pons =>lower brain stem
- III-V: lower pons & midbrain => upper brain stem

interpretation

- Cochlear lesion
  - Absolute latency: normal or delayed
  - Interpeak latency: normal or reduced
  - Good/clear morphology
  - unclear wave I or absent wave I ขึ้นกับ hearing level
  - if severe HL =>absent
  - interaural difference: normal

interpretation

- Retrocochlear lesion
  - Absolute Latency : delayed
  - Interpeak latency : delayed
  - Present wave I ,absent later wave
  - Interaural latency wave V diff > o.4
    - asym
    - Interaural IPL I-V diff > 0.4
  - Absent or poor morphology