IMMITTANCE MEASUREMENT - A PROBE INTO YOUR KNOWLEDGE

REGISTER NO. M 8906

AN INDEPENDENT PROJECT WORK SUBMITTED IN PART FULFILMENT FOR FIRST YEAR M.Sc.,(SPEECH AND HEARING) TO THE

UNIVERSITY OF MYSORE

ALL INDIA INSTITUTE OF SPEECH AND HEARING MYSORE - 570006

MAY 1990

MY
PARENTS AND

TO MY BELOVED

CERTIFICATE

This is to certify that the Independent Project entitled "Immittance Measurement - A Probe Into Your Knowledge" is the bonafide work, done in part fulfilment for First Year M.Sc., (Speech and Hearing) of the student with Register No.M 8906.

Mysore

May:l990

Director
All India Institute of
Speech and Hearing,
Mysore-6

CERTIFICATE

This is to certify that the Independent Project entitled:"Immittance Measurement - A Probe Into Your Knowledge" has been prepared under my supervision and guidance.

Mysore
May 1990

GUIDE

DECLARATION

This Independent Project entitled: "Immittance Measurement - A Probe Into your Knowledge" is the result of my own study undertaken under the guidance of Dr.(Miss) S. Nikam, Professor and Head of the Department of Audiology, All India Institute of Speech and Hearing, Mysore and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore

May:1990 Register No.M8906

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Beauty lies in the hands of this beholder. My special thanks to Ms. Rajalakshmi R Gopal for the finesse to this work.

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INTRODUCTION

One of the most important sense organs of human being is the ear. He can hear most of the sounds produced surrounding his environment through out the day and night.Normally a human being can hear by the mechanism of air conduction as well as bone conduction. But most of the sounds are transmitted through air conduction mechanism only. Because most of the sounds we attend are airborne and the mechanism itself is more sensitive as such.

Sound waves in the air around us are directed by the pinna in the external acoustic meatus, where they impiage on the ear-drum. The ear-drum is than set into vibration by the movement of the air particles. The vibration of the ear-drum then transmitted to the oval window through the movements of the ossicular chain.

As it goes to the oval window the fluids (ecdolymph and perilymph) start moving in direction from oval window to round window, hence the acoustical energy changes into electrical energy and those electrical impules carry by the auditory nerve to auditory cortex. If the middle ear structure would have been absent in ear, then the sound would have been impinged on the oval window from external canal directly. As a result the acoustical energy reaching the inner ear would have been less, because of the high impedance characteristics of the cochlear fluids. As Waver and Lawrence (1954) said the cochlear fluids have an impedance approximately equal to sea-water namely 1.5 x 10^6 m sec/m^3 .Therefore, if the sound met the oval window directly only 0.1% of the incident energy would be transmitted. As a whole, there would have been 35 dB transmission loss (Smith 1968). So the human ear has designed in such a way that this mismatch of impedance is being managed by the structure, namely middle ear and reduces the. transmission loss by 25 dB (Smith, 1968). Sound transmission suffres when the middle ear function abnormally.

Abnormal function of the middle ear is generally a consequence of pathological condition that might have existed In it. An abnormality in middle ear structure results in changes is impedance. Changes may be increase of impedance or decrease in impedance. These changes in impedance in the basis of detecting middle ear pathology.

Impedance is nothing but a measure ef the acceptance or rejection of energy per unit time. Impedance measurements to diagnose pathological conditions of middle ear is done on the plane ef the tympanic membrane. So, here impedence measurement is the acceptance or rejection of sound energy by tympanic membrane per unit time.

Although impedance measurement is used as a basis of diagnosis bat the outcome of impedance measurement improves, if it is used, along with other audiological findings such as, pure tone thresholds.

This project has mainly dealt with the various types of questions and answers of different aspects of impedance audiometry and tried to crystalize the concepts of impedance audiometry.

Objectives of this project:

1. It can be used to get a basic concept about impedance measurement, principles and applications.
2. To get collective information about different aspects of 'Impedance audiometry test', so that this serves as a guide for the trainees and examiners.
3. It can be used to evaluate trainees after training programme.
4. It can be used to monitor student's knowledge in under-Standing the subject.
5. It can be considered as a reference for examiner and interview purposes.

HISTORICAL BACKGROUND OF ELECTROACOUSTIC IMPEDANCE MEASUREMENTS

Test-1: I. Choose the correct answer:

Q.1) Concept of acoustic impedance was given by ..

a) Metz (1920)
b) Anderson (1969)
c) Webster (1919)
d) None of the above.

2) First acoustic impedence bridge was constructed by ..

a) Schuster (1934)
b) Troger (1930)
c) Zwislocki (1957)
d) None of the above.

3) Zwislocki bridge is also called ....

a) Acoustical bridge
b) Electro-acoustic bridge
c) Mechanical bridge.
d) None of the above.

4) First electracoustic impedence bridge was constructed by..

a) Jerger and Jerger (1960)
b) Terkildsen and Scott-Nielsen (1960)
c) Anderson et al. (1960)
d) Nene of the above

5) First study on impedance of the human ear done by .

a) Metz c) Japsen
b) Troger d) None of the above.

0.6) Impedance measurements in neonates was first done by.

a) Keith (1973) c)McCall (1973)

b) Jerger (1973) d) None of the above.

7) The term "tympanometry" was coined by ..

a) Jerger c) Hallen

b) Liden d)Terkildsen

8) Interpretation of tympanogram using gradient value was recommended by

a) Feldman (1976) c) Brooks (1969)

b) Liden (1974) d) Keith (1973)

9) Inflation deflation test was developed by ..

a) Jerger c) Liden

b) Bkuestone (1975) d) Keith

10) Pressure swallow test was developed by

a) Williams c) Hallen

b) Bluestone d) Matz

11) Differential ratio quotient was introduced by ..

a) Fitz Zaland and Balkany

b) Jerger and Jerger

c) Liden et al.

d) Brooks et al.

12) Rsflex relaxation index was contributed by .

a) Jerger (1975) c) Brooks (1974)

b) McCall (1973) d) Norris, et al.(1974)

Test-2:

I. Choose the correct answer:

0.1) First electacoustic impedance bridge was constructed in ..

a) 1959 c) 1961

b) 1960- d) 1962

2) The concept of acoustic impedance was given in ...

a) 1917 c) 1919

b) 1918 d) 1920

3} The first acoustic impedance bridge was constructed in...

a) 1932 c) 1934

b) 1933 d) 1935

4) The first systematic study of theacoustic impedance of the human ear was taken up in ...

a) 1927 c) 1929

b) 1928 d) 1930

5) Impedance measurements in the neonates was first done in . .

a) 1973 c) 1975

b) 1974 d) 1976

6) Reflex decay test was introduced in..

a)1970 c) 1972

b) 1971 d) 1973

7) Reflex relaxation index was contributed in..

a) 1971 c) 1973

b) 1972 d) 1974

8) The inflation-deflation test was developed in ..

a) 1974 c) 1976

b) 1975 d) 1977

9) Pressure- swallow test was developed in ..

a) 1973 c) 1975

b) 1974 d) 1976

10) Dignostic application of reflexes (Box pattern) was given in ..

a) 1975 c) 1977

b) 1976 d) 1978

Test-3:Match the following set ef contemporary workers with their respective field of work.

Part-A	Part-B
1.Fledman	(a)Reflex decay test
2. Liden, et el	(b) Evaluation of eustachian tube
3. Colletti	(c)Reflex measurement and their characteristics
4.Blustone,Molmquist	(d)Multifrequency,tympamo-metry
5. Borg	(e)Non-acoustic reflex
6. Nomeyer and Sesterhenn	(f) Tympanometry and inter-pretation.
7. Norris, et el	(g) Diagnostic application T of reflexes (Box pattern)
8. Djupseland et el	(h) Use of high frequency probe tone in tympanometry
9. Jerger, et el	(i) Thresholds prediction from reflex measurement
10. Anderson, et al.	(j) Reflex relaxation index
11.Northern and Downs	(k) Physical volume test.

PHYSICAL BASES OF IMPEDANCE MEASUREMENTS

Test-1 What, which tad why?

(1) What happens to the value of susceptance and conductance when the pump speed is reduced from 30 mm H_2o/sec. to 1 mm H_2o/sec?

(2) Whsat happens to the conductance and susceptance when the direction of pressure is reversed?

(3) Which component is represented as a function of pressure in a phase angle tympanogram?

(4) Why does a mass dominated system may not being about changes ia tympanogram obtained with a 220 Hz probe tone?

(5) What exactly happens to the resonant frequency of middle ear in case of otosclerosis?

(6) Why is the ossicular chain discontinuity detected better by using 660 Hz rather than 220 Hz probe tone?

(7) State the symbol, unit and computational formula for the following:

(a) Admittance

(b) Conductance

(c) Suspectance

(d) Eqaivalent volume

Test-2 : Fill ia the blaks :

(1) Eletrical impedance is a complex ratio of........to the resulting ....

(2) Mechanical impedance ia the ratio of .... and ....

(3) Acoustical impedance can be represented as the ratio of pressure and ....

(4) Acoustic impedance ia having two components viz. ...... and ....

(5) Acoustic reactance composed of ...... and ....

(6) .... gives rise to negative reactance.

(7) .... gives rise to positive reactance.

(8) .... is the reciprocals of stiffness.

(9) stiffness reactance is determined by ...... of middle … ear.

(10) When the values of reastance aad resistance are given, the complex impedance may be computed using the formula ....

(11) Of the two kinds of acoustic reactance........is predominant at low-frequencies

(13) ......acoustic reactance is predominant at high-frequencies.

(13) Susceptance in oto-admittance measurements is analogues to the....... in impedance measurement.

(14) An otosclerotic ear increases the impedance by increasing the........

(15) Changes in the mechanical properties of cochlea are most likely to change .... component of impedance.

(16) The reciprocal of acoustic impedance is .....

(17)....... the reciprocal of acoustic resistance.

(18) ....is the reciprocal of acoustic reactance.

TYMPANOMETRY

Test- 1

I. Answer the following questions:

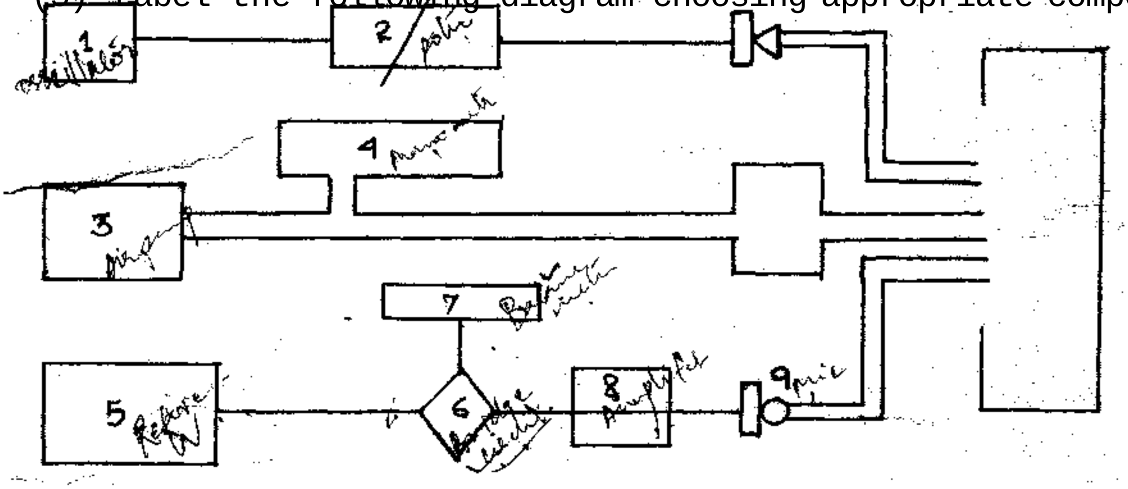
(1) What is tympanometry?

(2) What is the purpose of doing ttympanometry?

(3) What is tympanogram?

(4) What is the utility of the tympanogram?

(5) Label the following diagram choosing appropriate components.



(a) Oscillator
(b) Manometer
(c) OHM-meter
(d) Multi-Meter
(e) Air pump
(f) Potentiometer
(g) Balance meter
(h) Power generator.
(i) Reference voltage
(j) Bridge eiaewit
(k) Amplifier
(1) Microphone
(m) Resistor
(n) Capacitor
(o) Voltmeter
(p) Bridge circuit.

(6) What are the steps involved in obtaining tympanogram?

(7) What are the factors generally considered to interpret tympanograms?

(8) What it the other way of interpreting tympamograms?

(9) Classify the tympanograms according to their morphological characteristics and corresponding clinical implications.

(19) Define probe, probecuff, probe ear and probe signal.

(11) What factors are related to tympanometric result?

(12) What is positive aad negative curve?

(13) How does probe tone frequency affect on the tympanometric pattern?

(14) Why do you get reduced amplitude and flat tympanogram in case of otitis media?

(15) Why do you get reduced amplitude in case of otosclerosis?

(16) Why do you get increased amplitude ia case of ossicular chain discontinuity?

(17) How do you differentiate between tympanic membrane abnormality and ossicular chain discontinuity for low frequency tone?

(18) What ia the synonym used for mm H2o?

(19) What does amplitude of a tympanogram represent?

(20) Define middle ear pressure.

(21) What does the alteration in the shape of tympanogram imply?

(22) When is the flow of energy maximum?

(23) When does the impedance become high?

(24) What do the impedance tympanogram and admittance tympanogram measure as a function of pressure?

(25) What is the amplitude of ia case of tympanosclerosis?

(26) What is the other name of the deeply notched (V-shaped) tympanogram?

(27) What type of tympanogram is an alogous to a tympanogram which shows broad-double peak?

(28) What does a decreased pressure gradient indicate?

(29) What criteria are used for interpreting the tympanogram recorded from ears with middle ear pathologies, when normal middle ear pressure is indicated?

(30) What tympanogram can be expected in a case with history of eardischarge 5 yeara before the present examination and complete absence of diacharge since than?

(31) What type of tympanogram a case with history of severe cold 10 days prior to testing would probably exhibit?

(32) What ia the value of leak of air which does not have a significant effect on impedance measurement?

Test-2: Match the following:

'A'	'B'
1. Glomus Jugultries	1. Decreased elasticity of tympano-ossicular system
2. Middle ear polyp	2. AbnormaL tympanogram tends to be 'A' type.
3. External otitis	3. Notching is 660 Hz.
4. Myasthenia Gravis	4. Negative middle ear pressure
5. Lymphangioma and Von Recklinghausen's disease.	5. 'C' type tympanogram
6. Rheumatoid arthsitis.	6. Normal pressure with reduced mobility.
7. Post neck surgery	7. 'B' type with reduced volume.
8. Divers	8. Shallow tympanogram with rhythmic, pulsating movement of the balance meter needle.

Test-3:Choose the correct answer:

(1) Type 'B' tympanograms may The attributed to any of the follows, except

a) Otitis media

b) Impacted cerumen

c) Interrupted ossicular chain

d) Opening of probe against the canal wall.

(2) Retracted tympanic membrane should yield a tympanogram type

a) 'A' c) 'C'

b) 'B' d) 'B'

(3) A measured increase in compliance of the tympanic membrane may result from

a) Interrupted ossicular chain

b) Middle ear infection

c) Perforated tympanic membrane

d) Ceruminosis

(4) An acoustic reflex indicates

a) Change in middle ear impedence

b) No change in middle ear impedance

c) Increased impedance in middle ear

d) None of the above.

(5) The portion of the ear responsible far stiffness component of impedance in the plane of tympanic membrane is

a) Tympanic membrane

b) Ossicular ligament

c) Ossicular mass

d)Fluid load on the stapes

(6) A tympanogram with no point of maximum compliance indicate the probable presence of

a) Meniere's disease

b) Otitis media

c) Broken incus

d) Otosclerosis

(7) Theoretically, an interrupted ossicular chain shows the tympanogram type

a)'A' (b) A_s

c)A_d (d) C

(8) A tympanogram with maximum compliance at-200mm H_2o suggests

a) Normal middle ear

b) Negative pressure in middle ear

c) Positive pressure in middle ear

d) Fluid in the middle ear.

(9) According to the impedance formula early otosclerosis should result in an audiometric configuration which is

a) Basically flat

b) Worst in high frequencies

c) Worst in mid frequencies

d) Worst in low frequencies

(10) Stapedactomized ear gives rise to tympanogram similar to that ..

a) Reduced amplitude and flatten tympanogram

b) Reduced amplitude

c) Deeply notched tympamogram

d) Normal tympanogram

(11) In case of glomous jugularies, the tympanogram is..

a) Normal

b) Shallow with pulsating movements of balance meter

c) Deep notched with pulsating movement of balance meter.

d) Flat with pulsating movement of balance meter.

(12) At high frequency probe tone, 'D' type tympanogram is observed in ...

a) Otosclerosis

b) Tympanic membrane abnormality

c) Otitis media

d) Ossicular chain discontinuity

(13) At high frequency probe tone, 'E' type tympanogram is observed in ..

a) Tympanic membrane scar

b) Otosclerosis

c) Tympanic membrane perforation

d) Ossicular chain discontinuity

(14) Eustachian tube dysfunction gives rise..

a)'Ad' type tympanogram

b)'Add' type tympanogram

C) 'C type tympanogram

d) 'A' type tympanogram

(15) Early stage of otitis media shows

a) 'A' type tympanogram with positive pressure

b) 'A' type tympanogram

c) 'B' type tympanogram

d) 'C' type tympanogram

Test-4:

What is the tympanometric finding along with probable cause of the following cases?

(A) A 24-year old female comes with a complaint of insidious hearing loss and buzzing tinnitus over 10 years. She has trouble hearing soft voices but understands clearly when voice is loud. She can hear better in cocktail parties and noisy places. Her voice ia soft and clearly audible. Otologic finding reveals normal tympanic membrane. Her puretone average for right ear and left ear are 28 dB and 30 dB; speech reception threshold for the two ears are 30 dB and 35 dB respectively. speech discrimination score is 100% for both the ears. Bone conduction thresholds are aroand 0 dB HL except 2 KHz, which shows a thresholds of 10 dB.

(2) A 8-year old female comes with a complaint of hearing loss in the right ear. She reported of having eardis-charge from right ear since at the age of 6 months. Otologic finding shows right tympanic membrane eroded with purulent discharge in middle ear and ossicles absent during surgery. Puretone average for the affected ear is 58 dB, SRT is 60 dB and SDS 98%; left ear is having normal PTA, SRT and SDS. Bone conduction thresholds as well as masked BC thresholds of right ear are around 0 to 5 dB level.

(3) A case comes with a complaint of hearing loss in the left ear. He is having a history of recurrent fullness in left ear, since past 6 months. Otologic finding shows restriction in mobility of tympanic membrane with air pressure. No fluid level is seen. No history of ear discharge. Audiological findings dhow a PTA of 5 dB and 35 dB, SRT of 10-dB sad 40 dB, SDS of 100% in right and left ear respectively. Bone conduction thresholds show normal level.

(4) A case comes with a complaint of weak voice. His voice is reported to be fatigued easily. Voice is reported to be poorer as the day progresses. He also complains of generalized weakness of the body.

(5) A case comes with a complaint of hearing loss and fullness in right ear for several weeks. Otological findings show poor visibility of the tympanic membrane.. Audiological findings reveal a PTA of 27 dB and 0 dBy SRT of 30 dB and 5 dB; SDS of 98% 100% in the right ear and left ear respectively. Bone conduction thresholds are 5 dB approximately.

(6) A 35 year old man comes with a complaint of hearing loss in the left ear, along with history of exposure to fire craker explosion next to left ear. He also complains of intermittent ringing tinnitus. Otologic findings reveal

a large perforation without visible infection ia left ear. Right ear tympanic membrane is normal. Ossicles are found to be functioning normally. Radiological findings show a PTA of 5 dB and 55 dB, SRT if 5 dB and 60 dB and SDS of 100% and 95% to the right and left ear respectively. Right bone conduction is 0 dB, left bone conduction is 5 dB (masked). A 20 dB dip at 4000 Hz in right ear and 65 dB dip at 4000 Hz in left ear(air conduction threshold).

(7) A 50 year old male had normal hearing, untill an industrial head-injury. He lost consciousness, but there was no fracture of the skull. No tinnitus or vertigo, but a marked right ear hearing loss resulted from the injury, otological findings revealed; Normal eardrums and middle ears, exploration revealed a complete dislocation of the end of the incus from the head of the stapes. Audiological findings revealed: Air conduction thresholds in the right ear revealed a moderately - severe hearing loss. Bone counduction thresholds were normal. Marked air-bone gap was present. Weber lateralized to right ear.

(8) A 30 year old female comes with the complaint of bilateral hearing loss. Age of onset of hearing less is reported to be 28 years, at the time of pregnency. The case reports of a negative history of aural symptoms each as eardiacharge, ear ache. Family history of hearing leas is reported.

(9) A 57 year old female with sadden discomfort is left ear 6 months earlier complains of hearing loss in left ear. No complaint of ear pain and no sign of facial paralysis. There is a history of thumping tinnitus for past 5 months, otological findings show no abnormality in right ear, left middle tar is red and inflammed but ear dram moves freely. Needle aspiration produced bleeding. Audiological findings reveal a mild flat hearing loss (air conduction). Bone condaetion thresholds shew as airbone gap at 500 Hz, 1000 Hz and 2000 Hz., Suspected a case of glomous jugularies.

(Indicates the following:

PTA - Pure tone average

SRT - Speech reception thresholds

SDS - Speech discrimination score.)

Test-1: Answer the following questions.

(1) What is the principle of measurement of static compliance?

(2) When compliance is maximum?

(3) How volume and pressure are related to compliance?

(4) What is the ambient pressure for normal ear?

(5) What is drum tight condition?

(6) What is drum free condition?

(7) What is the normal compliance value?

Test-2: Fill in the blanks:

(1) Compliance reduces with .....age

(2) Admittance .... with increasing age.

(3) females have a .... compliance than males do

(4) Compliance is measured in a 5 year old boy and a 5 year old girl. Compliance value in the boy would be .... the compliance value in girl.

(5) Compliance value does not vary When frequency of probe tone is within the range of .... and ..... Hz.

Test-3: Match the following:

'A'	'B'
a) Otosclerosis	1) increased compliance
b) Post stapedectomy ears	2) falls below the normal range (.30 - 1.60 ec)
c) Ossicular chain discontinuity	3) more than normal
d) Otitis media	4) reduced or some times overlap with normal compliance
e) Meniere's disease	5) Normal compliance
f) Acoustic neuroma.	6) low input impedance of the cochlea.

ASSESSMENT OF EUSTACHIAN TUBE FUNCTION

TesST-1: Answer the following questions.

(1) What are the physiological functions of eustachian tube with respect to the middle ear?

(2) When does the eustachian tube open and Why?

(3) What muscle activates the tubal opening?

(4) What are the instruments used to assess the ventilation, protection and clearance functions of the eustachian tube?

(5) What abnormal functions of the eustachian tube can cause a middle ear effusion?

(6) What is the normal resting middle ear pressure?

(7) What are the tests that can be performed to assess the eustachian tabe ventilatory function with the electro-acoustic impedance bridge?

(8) Why is pressare swallow test preferred with children in the evaluation of eastachian tube function?

(19) Why does an infant have a higher change of developing negative middle ear pressare?

(10) What should be the head position of an infast during bottle feeding?

Test-2: Fill in the blanks:

(1) The eustachian tube connects the middle ear cavity to the ....

(3) In adults anterior two-third is........ and the posterior one-third is........

(3) The angle of the tube with horizontal plane is .... to .... in adult and in infant........

(4) The aural orifice of the tabe is........ shape and .... ana High and........mm wide in adult.

(5) The diameter of autral orifice........mm to ....mm in adult and .... to ....mm in infant.

(6) The middle portion of eustachian tabe is called ....

(7) Middle ear with negative pressure and retracted tympanic membrane is teased as ....

(8) Due to abnormal patency, the eastachian tabe is open even at rest and it is called ....

(9) When the tympanic membrane is intact, the tympanometry will show .... type tympanogram for obstruction of eustachian tube.

(10) A rhythmic movement of the balance meter needle during tympanometry is indicative of ....

Test-1 :Answer the following questions.

(1) Draw a schematic diagram of the ipsilateral and contralateral stapedius reflex pathways, based on the following parts of auditory system.

a) Spiral ganglion

b) Ventral cochlear nucleus

e) Trapezoid body

d) Medial superior olive.

e) Facial nerve and facial motor nucleus

f) Stapedius muscle

g) stapes.

(2) What is reflex?

(3) What are the stimuli that can bring about the contraction of the middle ear muscles?

(4) What is the principle behind measuring reflex?

(5) What is an acoustic reflex threshold?

(6) What is ipsilateral reflex measurement?

(f) What is contralateral reflex measurement?

(8) What is the minimum intensity required to elicit the ipsilateral and contralateral reflexes?

(9) What are the frequencies that we take into consideration for measuremeat of ipsilateral and eeatralateral reflexes?

(10) What is negative reflex?

(11) What is diphasic reflex?

(12) What are the factors which are of significance in the acoustic reflex measurements?

(13) How is handedness related to acoustic reflex measurement?

(14) How are frequency and intensity parameters related to reflex measurement?

(15) How does stimulus type affect the reflex observed?

(16) Haw does the mode of stimulation determine reflex measurements?

(17) What are the prerequisites for eliciting a reflex?

(18) What is D.R.O?

(19) What is reflex relaxation index (RRI)?

(20) What are the temporal parameters of acoustic reflex?

(21) What is acoustic reflex decay?

(22) What is sensitivity prediction from acoustic reflex?

(23) Why is there little difference between the reflex thresholds for noise and tone? in S.N. loss cases.

(24) Whet are the different procedures employed for sensitivity prediction?

(25) What is an artefact in ipsilateral and contralateral reflex measurements?

(26) How does Acoustic Reflex measurement help in hearing aid fittin?

Test-2: State whether the following statements are 'true' or 'false':

(1) There is no difference in the threshold obtained through contralateral and ipsilateral stimulation.

(2) Reflex thresholds cannot be elicited in the presence of eustachian tube dysfunction.

(3) The significance of 'negative on-off' reflex reduces as frequency of eliciting tone increases.

(4) Reflex threshold may be elevated despite normal puretone thresholds in diabetis mellits.

(5) Reflex findings in osteogenesis imperfecta is similar to that in otosclerosis.

(6) A reflex threshold of 10 dB at 500 Hz if observed in a boy aged 11 years, is abnormal.

(7) Females have lower reflex thresholds than males.

(g) Right ear seems to give reflex response at lower levels than does the left

(9) Acoustic reflex threshold for speech may be at a level above that or pure tones.

l0) Intercepted and continuous tones elicit reflex response at the same level.

Test-3: Fill in the blanks:

(1) The middle ear muscle involved in acoustic reflex activity is........

(2) The motor serve that plays aa important role in acoustic reflex activity is ....

(3) Negative 'on-off effect' is usually observed in ....

(4) When DRO is computed for am ear with hyper - recruitment, the value would be ....

(5) In ease of cochlear pathology, when temporal characteristics are analysed .....is observed to be normal while, ...shows a delay.

(6) In case of an ear with retrocochlear pathology the most commonly observed abnormality in reflex response is .... or ......

(7) A recruiting ear with a pure tone threshold of 60 dB at 1000 Hz will show a reflex threshold leas than ....

(8) In a case, if the reflex response is observed to decay by 50% wtthia 5 seconds for a 2000 Hz then it ia ....

(9) A cupula like pattern observed when graphically recorded is indicative of ....

(10) Amplitude of reflex response is .... in cases of multiple sclerosis.

(11) Reflex thresholds at low sensation levels are observed in cases of .... and ....

(12) Aging may have pronounced effect on reflex threshold when ...... is the eliciting stimulus.

(13) As frequency increases........ of reflex response decreases and its ....increases.

(14) The effect of anesthesia on acoustic reflex response depends upon its ....

(15) The latency of reflex response depends to a greater extent, on .... than on ....

(16) When the duration of a reflex eliciting stimulus is varied from 200 to 20 msec. the acoustic reflex threshold .... by 22 dB.

(17) The duration- intensity trade-off .... with increasing intensity.

(18) The slope of the temporal integration function is more at .... levels.

(19) Reflex decay is more at........"frequencies.

(20) As bandwidth decreases, the intensity required to elicit reflex .....

(21) When Niemeyer and Sesterhann's formala haa to be applied for an Indian population a 'K' factor of........should be used at 4000 Hz.

(22) Accuracy of prediction in........than .... (with reference to age).

23) An acoustic reflex response seems to be responsible for the lower TTS at .... frequency.

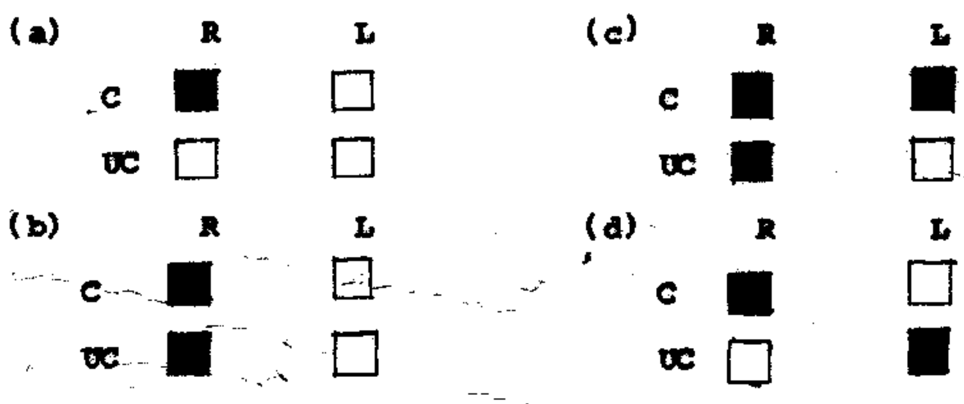
(24) Middle ear muscle activity. . . . . . . .the onset of speech.

(25) The artefacts in ipsilateral measurement are less likely to occur ....frequencies.

Test-4: Choose the correct answer:

1. A 38 year old male with an acoustic swanoma occupying the right posterior fossa space. Surgical findings noted that a small portion of the tumor extended into the right internal auditory canal.

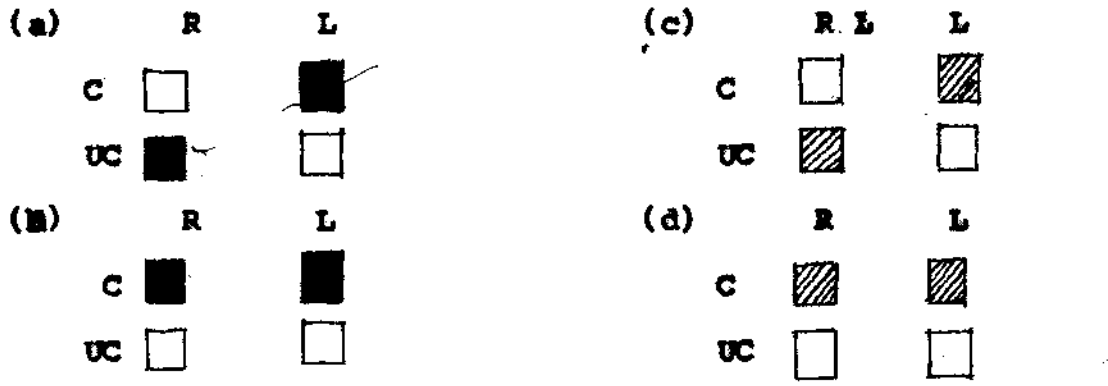
The audiogram of the right ear shows a mild sensori-neural hearing loss through 2000 Hz and a profound sensori-neural loss above 2000 Hz. On the left ear the audiogram shows normal sensitivity upto 3000 Hz and a severe sensori-neural loss above 3000 Hz. Acousic reflex pattern should be as follows:



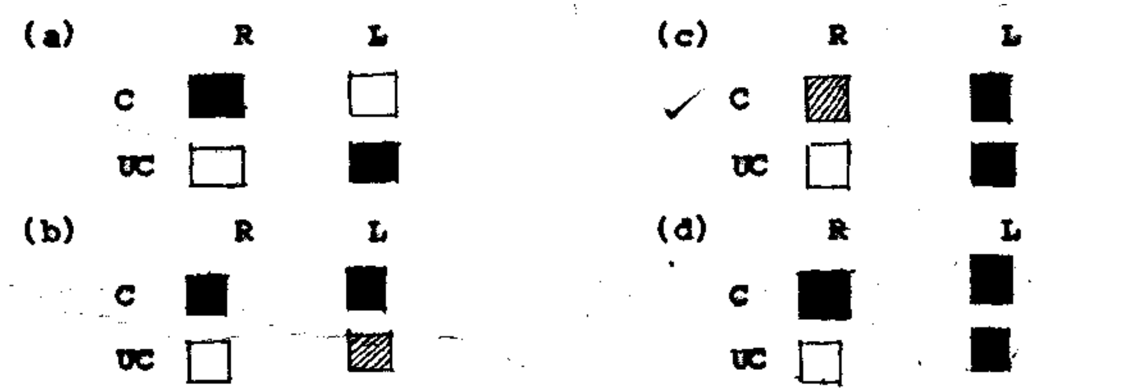
(Justify your answer)

(2) A 23 years old female with as acoustic schwanoma on the right, near internal acoustic meatus. The audiogram shows normal sensitivity except for a mild senaorineural

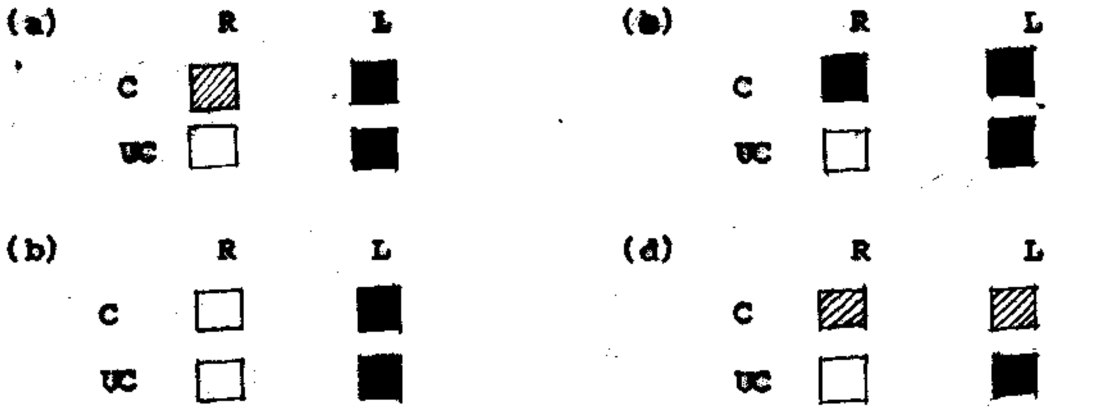
loss at. 2000 Hz, on the right ear and on the left ear, sensitivity is within normal limits at all frequencies. PTA in right ear is 13 dB HL and in left ear is 4 dB HL. An acoustic reflex pattern should be as follows:



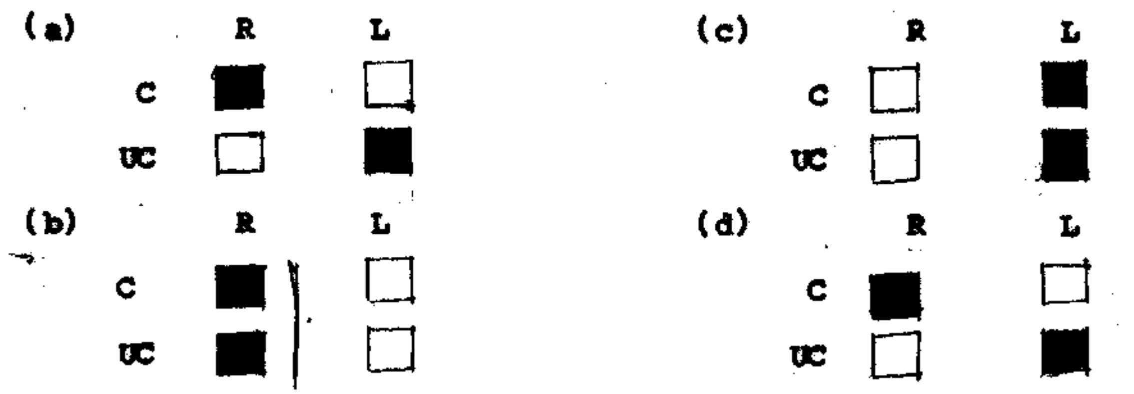
(3) A 41 year old male with bilateral cholestatoma and the audiogram shows hearing sensitivity within normal limits in the right ear and a moderate conductive loss in the left ear. An acoustic reflex pattern should be as follows:



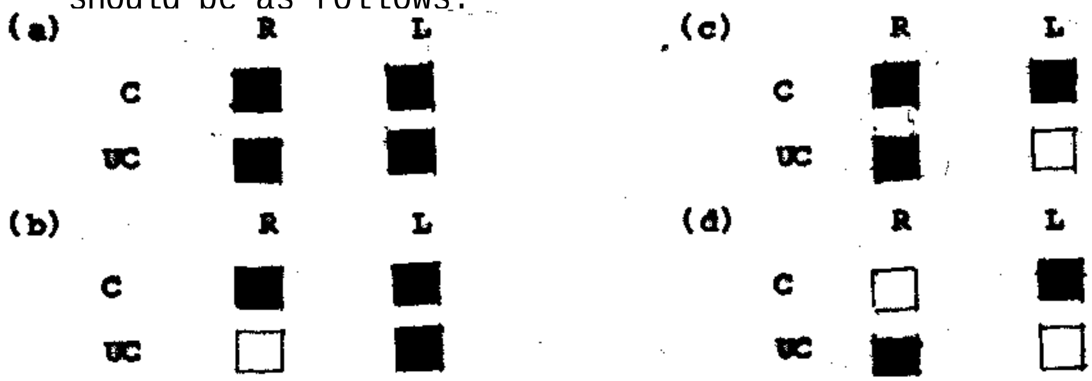
(4). A 15 year old female with ossicular chain discontinuity on the left ear. The audiogram shows normal senaitivity on the right aad a mild conductive loss in the left ear. Acoustic reflex pattern should be as follows:



(5) A 25 year old female with facial paralysis of unknown etiology on the right side. The audiogram shows normal puretone sensitivity bilaterally. The acoustic reflex pattern should be as follows;



(6) A 23 year eld female with otesclerosis shews a moderate conductive loss in the right ear and a mild sensori-neural less in the left ear. The acoustic reflex pattern should be as follows:



(7) An absence of an acoustic reflex is probable

a) in conductive hearing loss

b) in profound sensorineural hearing loss

c) in facial nerve palsy

d) in all of the above.

(8) Using an impedance meter with proble in the right ear and phone over left ear, the contralateral acoustic reflex is designed to measure.

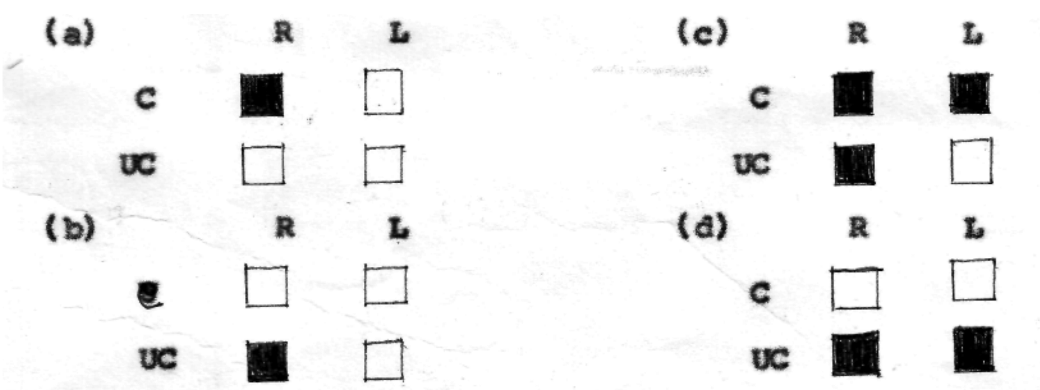
a)Vth nerve left, reflex SL right

b) recruitment right, decruitment left.

c) facial nerve left, reflex SL right

d) facial nerve right and reflex SL left

(9) Your patient has an intraxial brainstem lesion on the right side but normal hearing for puretone in both ears Acoustic reflex results should be as follows:



(10) Acoustic reflex at 5 dB SL sugests

a)retrocochlear lesion

b)cochlear lesion

c)conductive lesion

d)pseudohypacusis.

(11) SPAR results for a normal hearing person (N) and a patient with sensori-neural hearing loss (SN) would be expected aa follows:

PTA = pnretone average

BBN = Broad-band noise

a) N : PTA - BBN - 5 dB

SN : PTA - BBN - 5 dB

b) N: PTA - BBN - 20 dB

NH: PTA - BBN - 25 dB

c) N : PTA - BBN = 25 dB

SN : PTA - BBN = 5 dB

d) N : PTA - BBN = 5 dB

SN : PTA - BBN = 20 dB

(12) Reflex decay at 500 Hz to half amplitude within 10 secs. suggest.

a) pseudohypacusis

b) conductive loss

c) cochlear loss

d) retroeochlear lesion

(13) When Niemeyer and Sesterhenn's formula has to be applied for an Indian population, a'K' factor at 4000 Hz should be

a) 2.8 (b) 3.6 (c) 3.3 (d) 3.9

(14) Cases with Myasthenia Gravia were observed to give

a) normal reflex threaholds

b)elevated reflex thresholds

e) absent reflex thresholds

d) in all of the above.

(15) Cases of osteogenisis imperfecta, reflexes recorded were

a) normal

b) elevated

c) absent

d) in all of the above.

(The following indicates:

R = right

L = left

C = crossed

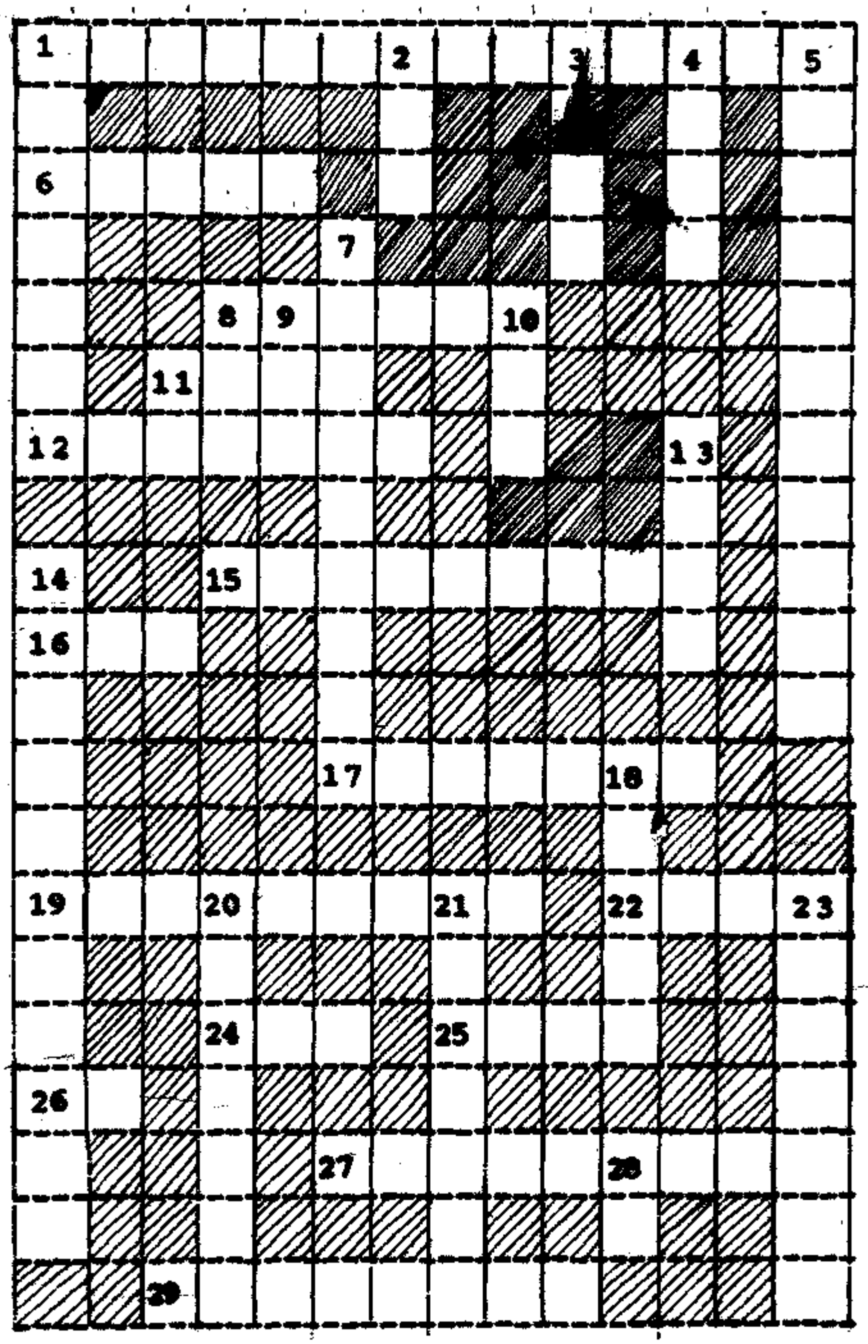
UC = uncrossed

PTA = puretone average

BBN = Broad-band noise

SL - Sensation level

CROSS-WORD



CLUES

ACROSS:

1. The tunnel of the "Extra Terrestrial"(14)
6. The hidden window (5)
8. Last but not the least ia the group (6)
11. Leg - , off - , Bowl then out with this test (1, 1, 1, 1)
12. First on the charts among the Trio (7)
15. The taut and concave part (9)
16. A threshold of talent (1, 1, 1)
17. Radar of the outer plane (7)
19. Suspenders fastening them together (9)
22. Strong bony arm of an "ear body" (4)
24. It's just a matter of time after the decay starts (1, 1, 1)
25. The huge leaning tower of Piza tilts and also the tiny audiogram pattern tilts both are .... tilts (4)
26. Rise thou tone for a period (1,1)
27. Born tough, no not the ceat tyres (9)
29. It-is lax hence named Pars ... (8)

DOWN

1. Can't bang hard on this dram (7)
2. Hear well (1, 1, 1)
3. Testing period for Jamesband to detect these two in a test (1, 1, 1, 1)
4. Get together at a junction (4)
5. Room at the roof top (11)
7. Handle with care (9)
8. The reference of the sound at this level (1,1,1)
9. The first step in Audio testing but the clue here .... in the ear (1, 1, 1)
10. Receive the speech at this level (1+ 1+ 1)
11. Sensational moments (1, 1)
13. Peep internally through the ....window (4)
14. The seventh member of the series (11)
18. It's easier to trace it with its nick name Anvil t5)
20. The honeycomb of air space (7)
21. Work out for fitness hence long and slender,tensor ...(7)
23. Inner spaces are empty(7)
28. Time of falling down (1, 1)

SUMMARY

The project encompasses a wide range of information made to easy and interesting access via multiple choice, matching, fill in the blanks, answer the following questions true or false, and cross word puzzles etc.

It is hoped that the information covered will serve the primary objectives such as in crystalizing the concepts in impedance audiometry and in providing practical base for the clinically oriented personnel.

ANSWERS

CHAPTER-2:

TESt-1: 1. (c); 2. (a);9 3.(c); 4.(b); 5,(b);
6.(a); 7. (d); 8. (c); 9. (b)y 10. (a)
11. (a); 12 (d)

Test-2: 1. (b); 2. (c); 3. (c); 4. (d); 5. (A);
6. (a); 7. (d); P 8. (b); 9. (c); 10 (a)

Test-3: 1 - f; 2 - h; 3 - d; 4 - b; 5 - C; 6 - 1;
7 - j; 8 - C; 9 - g; 10 - a; 11 - k.

CHAPTER-3:

Test-1: (1) The value of susceptance and conductance may be decreased by as much as 50% when the pump speed is reduced from 30 mm H_2o/sec. to 1 mm H_2O./sec

(2) When the direction of pressure is sverered from positive to negative, the value of susceptance and conductance becomes maximum.

13) In a phase and tympanogram, phase angle is represented as a function of pressure.

(4) Because the system is mass-dominated only at higher frequencies and at the low-frequencies such as 220Hz stiffness controls the system. There-fore, mass dominated system does not alter the tympanogram at 220Hz.

(5) It gets reduced.

(6) Because ossicalar discontinuity gives rise to mass dominated system which is predominant at high-frequencies. Therefore 660Hz is preferred to 220 Hz.

Pathological conditions of the middle ear shows better at or near resonant frequency, 660 Hz is closer to the resonant frequency that is 220 Hz.

In ease of ossicular discontinuity, there is a change of resonance in the system. Change of resonance is well detected at or near the resonant frequency. Hence ossicular chain discontinuity is better detected at 660 Hz rather then 220 Hz.

(7)

	Symbol	Unit	Cemputational formula
a)	Y_a	Acoustic mho	Y_a=/G_a^2 + B_a^2
b)	G_a	Acoustic mho	
c)	B_a	Acoustic mho	
d)	EV_a (V_e)	c.c/ml	1 c.c. - 1 ml
e)	mm dapa?	H_2o/mmH_2O/dapa (decapascal)	1 dapa = 1.02 mm H_2o 1 mm H_2O = .98 dapa

Teat-2: 1) Voltage to current

2) Force/velocity

3) sound pressure and volume velocity

4) Acoustic reactance acoustic resistance

5) Stiffness, inertia

6) stiffness

7) inertia

8) compliance

9) tympanic membrane

10) $Z_A = x_A^2 + R_A^2$ Where Z_A - Acoustic impedance

x_A = Acoustical reactance

R_A = Acoustical resistance

11) Stiffness reactance

12) Mass reactance

13) Reactance.

14) Stiffness reactance

15) Resistance

16) Acoustic admittance

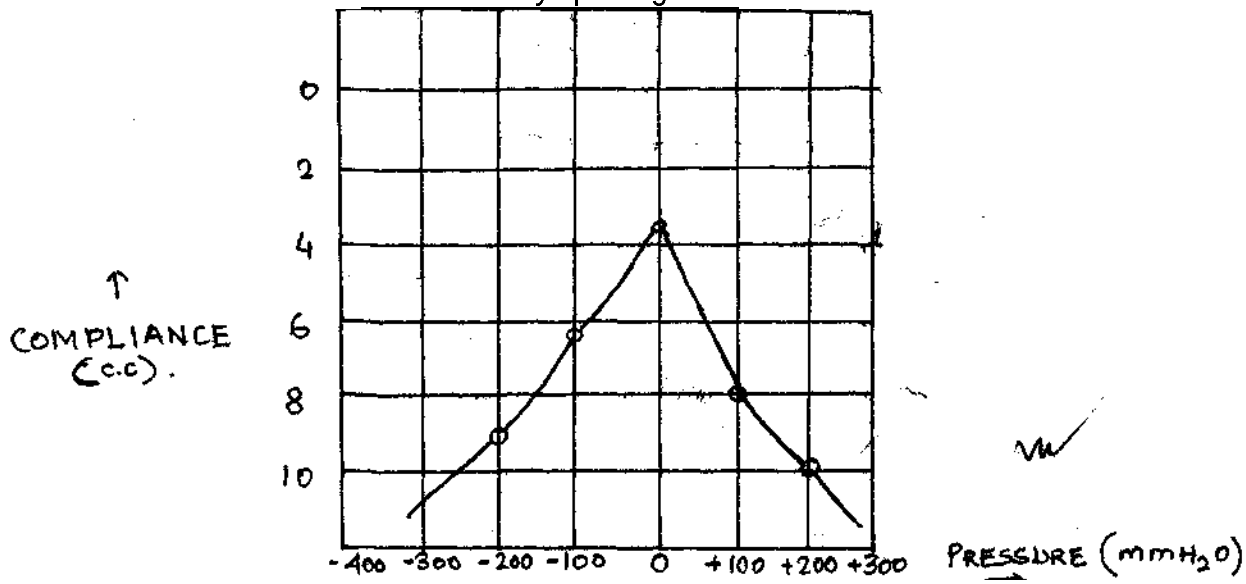
17) Acoustic conductance

16) Acoustic susceptance

Test-3: 1) Tympanometry is the measurement of eardrum compliance change as air pressure is varied in the external ear canal."

2) The puropse of tympanometry is to observe the variation in the impedance of the tympano-ossicular system, as a consequence of change in pressure intr duced in ear-canal.

3) The graph depicting in the pressure compliance function is known tympanogram.



4) Tympanograms are useful in the clinical diagnosis of middle ear pathologies. Different pathological conditions in the middle ear alter either its pressure status or the mobility of the ossicular chain or both, thus altering the configurations of tympanogram. Eg. Eustachian tube malfunction alters the pressure peak. Otosclerosis alters the amplitude.

In conjunction with reflex measurements and puretone audiometry, tympanometry provides valuable information for detection, identification and differential diagnosis of middle ear disorder.

5. 1 - a; 7 - g;

2 - f; 8 - k;

3 -e; 9 - 1 .

3 — e;

4 - b;

5 - i;

6 - p;

(6) The steps involved in obtaining a tympanogram may be considered under following heads.

1) Calibration

2)- Preliminaries(a) Examination of the ear

(b) Instructions to the patient's

3) Measurement procedure

(7) Three factors are generally considred to interpret tympanograms.

1) Amplitude

2) Pressure peak } Laden, et al. 1977

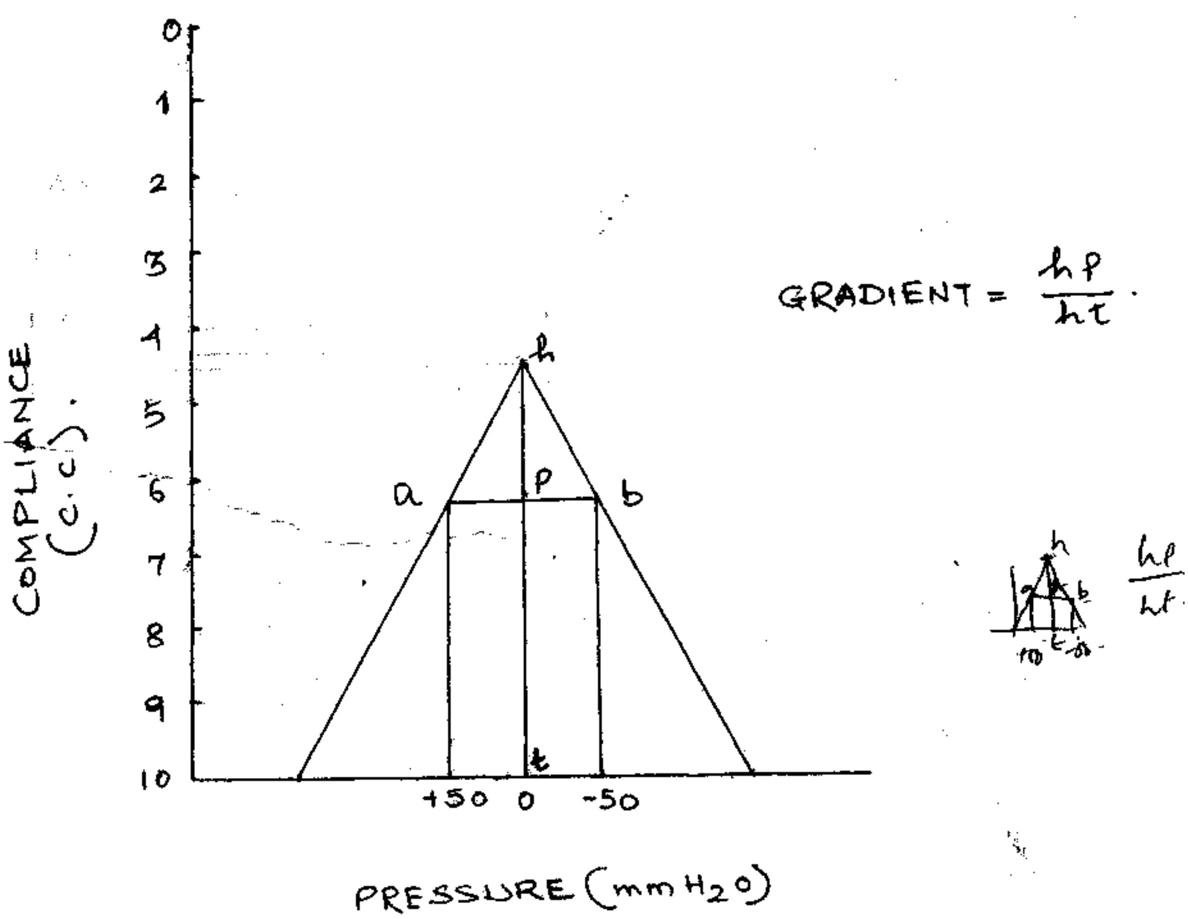
3) Shape

Amplitude of the tympanogram represent the compliance, admittance or impedance, in relation to pressure.

The normal middle ear pressure is equal to ambient pressure. Normally tympanogram are smooth.

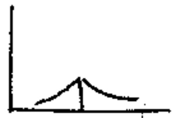
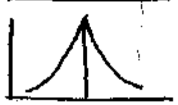
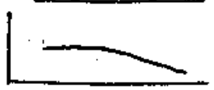
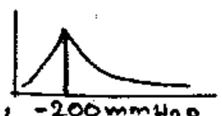
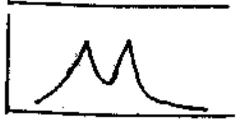
6) Brooks (1969) considered a measure of stiffness near the peaks to determine the shape of the curve. The change in compliance for a pressure difference of 50 mm H_2o from the peak value is computed. This represents what he calls the 'Gradient'.

According to Brooks, the gradient value is about 40% of the compliance in normal ears, while it is reduced to 10% in an ear with fluid and is as high as 80% in ears with scarred tympanic membrane.



9)

MORPHOLOGICAL CHARACTERISTICS

Type of tympanogram		Pressure	Amplitude	Shape	Clinical implication
A		Normal	Normal	Smooth	- Normal -- Sensorineural hearing loss - Early stage of otosclerosis
A_s		Normal	Reduced	Decreased in slope	- Otosclerosis - Tympanosclerosis
A_d		Normal	Increased	Smooth	- Ossicular chain disconti-nuity.
A_{dd}		Normal	Increased (undulating)	Increase in slope	- Necrosis of ossicular chain.
B		Negative pressure	Decreased (±)	Flat	- Serous otitis media - Wax
C		Negative pressure	Normal	Smooth	- Eustachian tube dysfunction
D		Normal	Flaccid	Notched	- Tympanic membrane ABN
E		Normal	Flaccid	Deep, Broad Notched	- Ossicular chain disconti-nuity

Jerger (1970); Fiden et. al (1974); Feldman (1975)

10) Probe is a coupling device that is inserted into the external acoustic meatus to connect the instrument to the ear.

Probecuff is a deviee which provide a seal between the probe and the external acoustic meatus.

Probe ear is the ear into which the probe is inserted.

Probe signal is the acoustical stimulus which comes from the oscillater of the probe.

11) The pathology or the condition of the middle ear is the prime determiner of the type and configuration of the tympanogram obtained. However, certain other factors also appear to affect the tyapanogram.

a) Rate of pressure change
b) Direction of pressure change
e) Airtight sealing in the ear canal
d) Eartip
e) Manual v/s automatic recording
f) Componental analysis v/s complex analysis
g) Phase angle tympanometry
h) Probe frequency

12) In tympanometry, the pressure la changed usually from positive to negative pressure. When a tympanogram is obtained by change pressure from - 400 to +400 mm H_2o it is called positive carve.

Those tympanogram which are obtained by changing the pressure from +400 to -400 mm H_2o are called negative curves.

13) It has been observed that the frequency of the probe tone has an effect en the tympanometric pattern. Certain disorders like ossicular discontinuity, tympanic membrane abnormality give rise to different pattern, depending upon probe tone frequency. The commonly used probe tones are 220 Hz, 660 Hz and 800 Hz. Each of these frequencies have their own advantages and disadvantages. However, the selection of a low-frequency probe tone has some advantages.

i) Many of the earlier microphones did not have linear response at high frequencies.

ii) It is easier to control the phase angle because low-frequency is predominant to stiffness reactance.

iii) Reflex thresholds for low-frequency sounds is at a higher intensity than for higher frequency tone. Thus, the unwanted contraction of the stapedius muscle could be avoided.

iv) At low-frequencies, the wave length is long enough to avoid resonance.

Frequencies such as 200 Hz or 250 Hz were not used because they are harmonic of 50 Hz which is the frequency of air conduction conmonly used.

(Terkildsen and Scott-Neilson,1960).

The high frequency probe tones too have some advantages.

i) Changes in the middle ear resonance do not affect the tympanogram obtained with a 220 Hz, probe tone, while they have a clear influence on the tympanogram obtained with a 660 Hz probe tone. Their influence is more at 800 Hz. (Liden, et al. 1974).

ii) High frequencies probe tone depicts changes in both reactance and resistance components of impedance. (Moller, 1965).

iii) Another reason of using high frequencies probe tone is that probe which employs low frequencies have narrow opening. They can easily be blocked by wax etc. Larger diameter is therefore preferred. But probe with low frequency generator and large diameter cannot maintain a constant SPL. With 800 Hz, a probe with relatively large opening can be used to maintain constant SPL, as they have sufficient high impedance.

It may be concluded that both low and high frequencies have their own advantages. However, the Advantages of high frequencies especially in diagnosis, seen to make their choice more preferable. Although in most eases low frequency probe tone is adequate.

14) Otitis media is a condition which decreases the mobility of the ossicular chain and Which reduces the middle ear space. As a result it reduces the amplitude and flattens the tympanogram.

15) Otosclerosis is a condition that does not usually alter middle ear pressure. In otoaclerosis, the mobility of the ossicular chain is decreased because of stapes fixation. The stiffness of the system increased due to the decreased mobility of the ossicular chain, as a result amplitude of the tympanogram reduced.

16) This is a condition where in the ossicular chain interrupted at some point. The common site is the incudo-stapedial joint Ossicular chain discontinuity gives rise to a highly flaccid system. Therefore the impedance offered the system is very low. Thus ossicular chain discontinuity manifest itself as tympanograms with exaggerated amplitude.

17. Abnormally deep, tympanograms are common to both tympanic membrane abnormality and ossicular chain discontinuity, when low frequency probe tones are used. In these cases, one may consider the AB gap in conjunction with the tympanogram. An AB gap of 30-50 dB in addition to an A_d type tympanogram is indicative of ossicular chain discontinuity. (Jerger, 1975 b).

18. mm H_2o is also denoted as mm

19. It represents the compliance, admittance or impedance, in relation to pressure.
20. The pressure at which the maximum amplitude occurs.
21. It implies the alternation in resonance.
22. When the ear canal volume is equal to that of middle ear pressure.
23. When the pressure difference on the two sides of the tympanic membrane is large.
24. Impedance tympanogram - the obstruction of flow of energy.

    Admittance tympsnogram- the flow of energy.
25. Reduced
26. A_d type
27. E type
28. Otitis media

29. Amplitude
30. A_d or hiden type 'D'
31. 'C' type
32. 20 mm H_2o/10 sec. or 2 mm H_2O)/sec.

Test-2: 1 - B; 2-7; 3-6; 4-4; 5-2; 6-3;
7 - 5; 8 - 1.

Test-3: -1-C; 2 - c; 3- a; 4 -a; 5- d; 6- b;
7 -c: 8 -b; 9- d; 10- C; 11- b; 12-b;
13-a; 14- c; 15 - a.

Test-4: 1) 'A_S' type tympanogram both ears; otosclerosis.
2) 'B' type tympanogram/chronic otitis media
3) 'B' type tympanogram (220 Hz probe tone) 'W shape (660 Hz probe tone); tympanic membrane abnormality (Scarr?)
4) 'C' type tympanogram (because of inadequate function of tensor-velli palatini muscle),Myasthenia Gravis
5) 'B' type tympanogram with reduced physical volume cerumen in ear canal.
6) Probe pressure will not build up because of perforation. Physical volume test will show a large value around 4-5 c.c, acoustic trauma with rupture ear
7)'A_d'type tympanogram; ossicular chain discontinuity.
8) 'A' type tympanogram; otosclerosis.
9) Tympanogram with normal pressure peak a pulsating movements of compliance meter needle.

CHAPTER-5:

Test-1: 1) Consider a cyclinder, which is closed at one end by a piston, when a force is applied and withdrawn, the piston moves inwards and outwards. If the volume with in the cyclinder is small, the movement of the piston is restricted. When the volume is more the piston can move more freely. In other words, when the volume is small, the elasticity is less and therefore the compliance is low. Conversely, larger the volume, lesser the stiffness and higher the compliance. (Terkildsen, 1972).

The above physical explanation could be applied to the ear. In the ear, the middle ear acts as a cylinder, tympanic membrane acts as a piston, though it has been proved that tympanic membrane does not really act as a piston (Tonndrof and Khanna, 1977). When a high pressure is induced in the ear canal, the membrane has to stress when the membrane streches elasticity decreases. This reduces the compliance of the membrane.

2) When the middle ear ait pressure and the external ear air pressure become equal, the maximum compliance occur. This pressure point is called ambient pressure

3) Compliance is dependent upon the volume displacement and it is directly related to volume i.e. compliance varies directly with variations in the volume.

Compliance also depends upon pressure. As pressure increases compliance decreases. Thus compliance varies inversely as pressure is varied.

4) Usually for normal ear, ambient pressure is 0 mm H_2o

5) 'Drum tight' condition can be defined aa the pressure point at which tympanic membrane is maximally strech i.e. maximally stiff to say maximally tight. In this condition compliance is less. Compliance in the drum tight condition is computed.by

a) compliance reading at +200 mm H_2o

b) Compliance reading at -200 mm H_2O

Compliance daring drum tight condition can be denoted as C_1.

6) 'Drgm free' condition is defined at the pressure point at which tympanic membrane ia maximally mobile i.e. leas stiff i.e. to say 'free'. In this condition compliance is more. Usually compliance in drumfree condition/is computed at the ambient pressure level (mostly 0 mm H_2O) and can be denoted as C_2.

7) 0.30 c.c to 1.60 c.c (Jerger, 1975 b).

Teat-2: 1) increasing
2) decreases
3) low
4) same
5) 125 Hz to 250 Hz

Teat-3: 1a - 4; b - 3; c - 1; d - 2; e - 5; f - 6

CHAPTER-6:

Test-1: 1) The eustachian tube has atleast three physiological function with respect to the middle ear.

a) Ventilations of the middle ear to equilibrate air pressure in the middle ear with atmospheric pressure aad to replenish O_2 which has been absorbed.

b) Protection from nasopharyngeal sound pressure and secretion.

c) Clearance into the nasopharynx of secretions produced within the middle ear.

2) Usually the eustachian tube is closed, but it opens during swallowing, yawning and sneezing. It permits the air pressure in the middle ear to equalize with atmospheric pressure.

3) The tensor veli palatini is the only muscle to activate tubal opening (Contenkin, et at. 1978)

4) Manometry, sonometry and tympanometry can be used to assess ventilation function, whereas radiographic technique can be used to assess the protective and clearance function of eustachian tube.

5) Basically two major types of abnormal function of the eastachian tabe can cause middle ear effusion, obstruction or abnormal patency or both Nasal obstruction may also be involved in middle ear effusion.

6) Brooks (1969) determined the resting middle ear pressure by tympanometry in a large group of apparently normal children as being from 0 to -175 mm H_2O. Alberti and Kristensen (1970) obtained resting middle ear pressure between + 50 and! -50 mm H_2O in adults.

7) The tests of eustachian tube ventilatory function which can be performed with the electro-acoustic impedance bridge are.

(1) Resting middle ear pressure

(2) Inflation deflation

(3) Toynbee's

(4) Valsalva's

8) The test is voluntary. Activities that are involved in other tests are not necessary. The child need not follow instructions for swallowing may be made to drink something.

9) An infant has a high chance of developing negative middle ear pressure because the eustachian tube is placed more, horizontally.

10) His/her head should be positioned slightly obliquely with respect to the rest of the body. Because when the head is kept inclined the eustachian tube is no longer horizontal. This prevents the entry of fluid or milk into the middle ear through the eustachian tube.

Test-2: 1) Nasopharynx

2) Cartilaginous, bony

3) 30^0 to 40^0; 10^0

4) Oval, 5 mm, 2mm.

5) 8 to 9 mm 4 to 5 mm

6) Isthmus

7) atelectasis

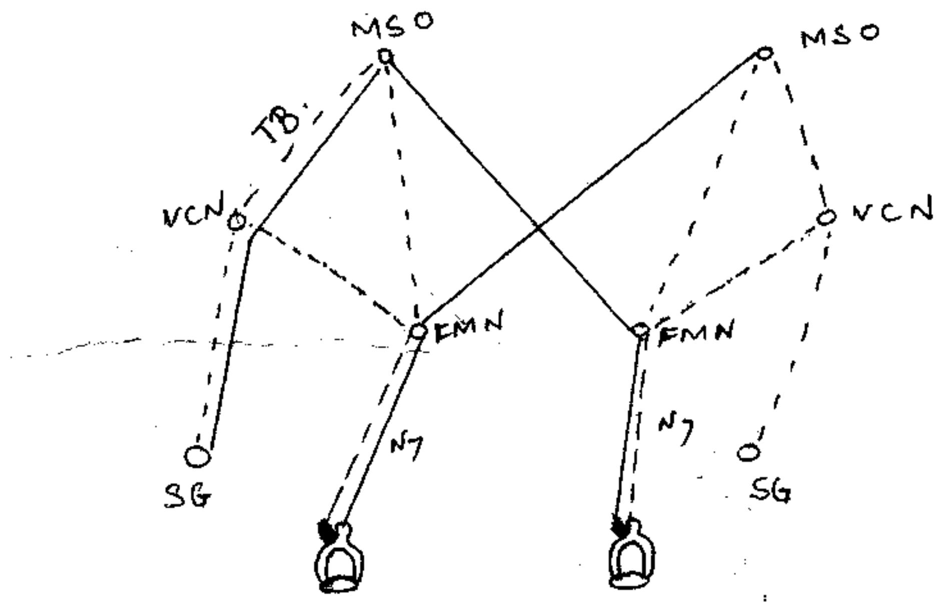
8) patulous

9) 'C' type

10) Patulous eustachian tube.

CHAPTER-7:

Test-1: 1) SG = Spiral ganglion; VCN = Ventral Cochlear Nucleus.
MSO = Medial Superior olive; FMN = Facio-motor nucleus.
N_7 = Facial nerve. TB = Trapezoid Body.



- - - -> IPSILATERAL, ⟶ CONTRALATERAL.

2) The contraction of teaser tympani and stapedius muscles because of acoustic stimulus influence to a large extent the mobility of the ossicular chain which in tarn determine the impedance change at plane of the tympanic membrane. This change in impedance is termed as reflex.

3) The contraction of the middle ear muscles may be brought about either by aa acoustic stimulus such as a loud tone or a nonacoustic stimulus such as current.

4) When a loud sound is presented, the tympanic muscles contract, which influence the mobility of the ossicular chain. As a result there is an impedance change observed on/the plane of the tympanic membrane. This observation was first made by Metz (1946) and cited in Jepsen, (1963). He suggested that this method of examination allows aa evaluation of the middle ear muscle function.

5) The lowest level at which, a change in impedance occurs consequently to stimulation is considered as the acoustic reflex threshold.

6) When a stimulus is presented to one ear sad the reflex is measured in the same ear, it is called ipsilateral reflex measurement.

7) When a stimulus is presented in one ear and the reflex is measured in the opposite ear, it is called contra-lateral reflex measurement.

8) 70 - 90 dB SPL

9) 500 Hz, 1000 Hz, 2000 Hz, and 4000 Hz.

10) If on stimulus presentation the balance meter needle consistently deflects to the left at the onset of the stimulus, then it is negative reflex.

11) Consequent to stimulus presentation, if the balance meter needle consistently deflects towards the left at the onset as well as the offset of the stimulus then it is diphasic reflex.

12) Acoustic reflex measurements are affected to a significant extent by many factors which can be grouped under four categories. Factors related to the subject, stimulus parameters, factors related to mode of stimulation and other factors.

A. Factors related to the subject:

1. Age 2. Sex 3. Handedness.

B. Stimulus related-factors

1. Frequency; 2. Intensity; 3.Type of stimulus

C. Mode of stimulation.
1. Ipsilateral v/s contralateral
2. Bilateral stimulation

3. Air conduction v/s bone conduction
4. ascending v/s descending
5. Continuous v/s interrupted presentation

d. Other factors:

1. Eartip
2. Air tight seal in the ear canal
3. Collapsed ear
4. Bar canal pressure
5. Probe tone frequency
6. Eye closure
7. Attention
8. Drugs
9. Number of trials.

13. Johnson (1919) reported that left handed children were significantly slower than the right handed in terms of development or maturation of acoustic reflex threshold sensitivity. Right ears, in general gave reflex thresholds at about 3.8 dB lower than the left ear.

14. Frequency of the puretone seems to influence the measurement of reflex. Tsukanona et al. (1977) observed that in increase in frequency brought about a redaction in the amplitude and increase in the instability of the recorded reflex response. They reported to be the best to elicit reflex.

Acoustic reflex also varies with intensity. As intensity of the puretone stimulus increases, amplitude of response also increases (Bang and Dalles, 1972).

15. Noise is more effective than puretones in eliciting a reflex (Goodman, et al. 1977). Reflex thresholds obtained for narrow-band noise is lower than that for puretones. Reflex thresholds for White noise is even lower than that for narrow band noise.

    Reflex threshold for White noise was at 66.7 dB SPL.

    Acoustic reflex thresholds for clicks occured at lower levels than that for puretones. (Lutman, 1976)

    Acoustic reflex thresholds for speech is lower than that for puretonea (Olsen and Hipakind, 1973).

    Reflex thresholds for speech was found to be around 97 dB SPL. Borg and Zakrisson, 1975).

16. Reker (l977) observed that reflex thresholds were about 15 dB lower When stimulated ipsilaterally than when contralaterally stimulated.

    Bilateral stimulation elicits the reflexes at lower levels than does ipsilateral stimulation. (Moller, 1972).

Djupesland, et al (1973) noted that reflex threshold is lower when the reflex eliciting stimulus is presented through bone conduction than when presented through air conduction. They observed differences of 5 to 25 dB between the two modes of presentation.

No differences are observed when the stimulus is presented in an ascending or descending and continuous or interrupted mode.

17. For an acoustic reflex to be present, certain conditions must be met. They are:
    1) There must be sufficient zesidual hearing to induce a reflex
    2) Cranial nerve VII must be functional on the monitored ear.
    3) The stapedial tendon must be intact and properly attached to the head of the stapes.
    4) The ossicular chain must be continuous through the point of stapedial tendon insertion and sufficiently mobile to allow for stapedial contraction to change the impedance characteristics at the tympanic membrane.

18. Fitzzel and and Bakeny (1974)suggested a formula for the purpose of determining the amount of recruitment. They termed it as "Differential Ratio Quotient" as DRQ.

$$DRQ . \frac{(A - X) - (B - Y)}{X-Y}$$

Where A = Acoustic Reflex Threshold of better ear.

B = Acoustic Reflex Threshold of poorer ear

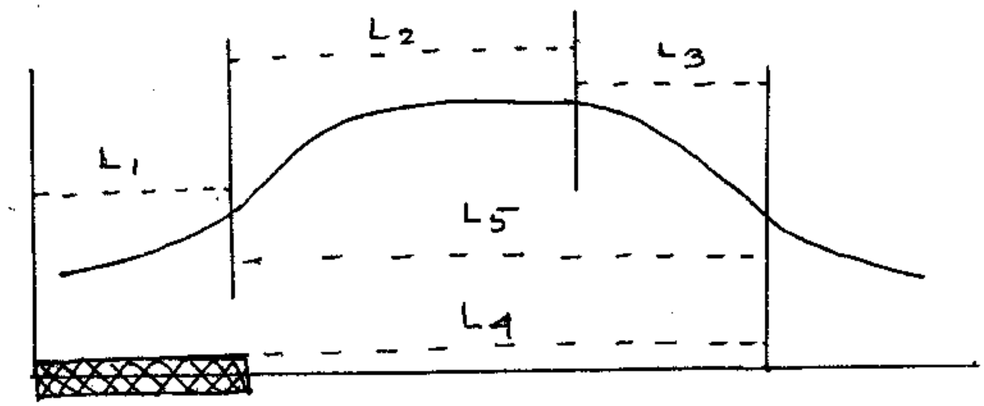
X = Puretone thresholds of better ear.

Y = Puretone threshold of poorer ear.

DRQ of 0 - 1 = partial recruitment.

DRQ > 1 = Complete recruitment.

19. Norris, et al (1974) compared the temporal characteristics of reflex in ears with sensorineural hearing loss with that of normal ears at 1000 Hz.



L_1 = Latency from the onset of stimulus to initial reflex

L_2 = Latency from the initial response to the peak of response.

L_3 = Latency from the peak of response to the point ehere reflex reaches a 95% return to baseline.

L_4 - Latency from the cessation of the stimulus to a 95% return to baseline.

L_5 - Total reflex/response time (L_2+L_3)

It was noted that L_1 and L_2 were not significantly different in the two groups. L_3 which represents the relaxation time was considerably longer in sensori-neural group. Similarly L_4 and L_5 also showed delayed. Thus abnormality was observed in the relaxation of the reflex response in cochlear pathology. To measure RRI, a pulsed tone of 500, 1000 or 2000 Hz at 10 dB above ART is presented.

20. The temporal parameters of acoustic reflex are -

 1) Latency
 2) Risetime
 3) Recovery time
 4) Temporal integration of acoustic reflex
 5) Acoustic reflex decay.

21. Borg and Odman (1979) defined acoustic reflex decay as "any decline of the reflex response during ongoing stimulation".

The amount of decay in reflex response that occurs within 10 sec. of the stimulation could aid in detection of retrocochlear pathology. This is more significant at low frequency, Even some amount of reflex decay occurs in normal also.

Basically it is done with puretones of 500 and 1000 Hz at 10 dB above ART.

22. Some estimation of an individual's hearing sensitivity is possible by measuring the acoustic reflex is called sensitivity prediction from acoustic reflex or SPAR.

SPAR is mainly based on the critical band width concept and its relationship with loudness and acoustic reflex.

23. It is hypothesized that there is widening of critical bands in cases of ears with sensorineural hearing loss. Such a widening is expected to reduce the scope for loudness summation. In addition, the characteristic high frequency sensorineural loss, reduces the contribution of the high frequency region to the total loudness. The net outcome is that in cases of Sensori nearal hearing loss, the differences between the reflex thresholds for noise and tone is reduced.

24. The different methods of sensitivity prediction are-

1) Niemyer and Sesterhenn'a Method.
2) Baker and Lilly method.
3) Sesterhenn and Brsuninger's method.
4) The Bivariate-plot method.

25. Artefacts daring ipsilateral reflex measurement are more common.

Fria, et al (l975) suggested three possible explanations for the presence of artefacts in ipsilateral reflex measurements.

1. It could be an instrumentation artefact.
2. It could be a phenomenon produced by the physiological system by itself or
3. It could be the result of interaction of the physiological system with the measuring device.

In ease of contralateral reflex measurement, when sound is presented at about 80 dB SPL it may cress over to the other ear and interact with the probe tone. As a result there is a sound pressure change in the ear canal. Such a change in sound pressure level is picked up by the microphone resulting in appearance of an artefact. Danaher, and Pickett (1974).

26. Acoustic reflex measurements have been found useful in hearing aid selection in determining the gain and maximum power output especially for pediatric, geriatric cases or in diffcult to teat cases.

McCandless wad Miller tl972) recommended just uncomfortable level. This data can be used to fix up maximum power output of the hearing aid or SSPL. They hypothesized that loudness dis-comfortable level occurs at the same level as the acoustic reflex threshold in persons with cochlear pathology and normals. ART can be used as an indicator of LDL ± 10 dB. A ± 10 dB difference can be accepted.

Test-2! 1. False; 2. False; 3. True; 4. True; 5. False; 6. False; 7. False; 8. True; 9. True; 10. true.

Test-3: 1) Stapedius
2) Facial nerve
3) Otosclerosis
4) 1
5) Rise time; relaxation
6) Elevated reflex threshold or absence of reflex response
7) 120 dB HL
8) Pathological
9) Brainstem disorder
10) Reduced
11) cochlear pathology and non-organic hearing loss.
12) Noise
13) Amplitude; instability
14) Anesthetic power

15. Frequency; intensity
16. Increases
17. Becomes more rapid
18. Suprathreshold
19. Higher
20. Increases.
21. 3.8
22. Children and aged.
23. Low
24. Precedes

25 High.

Test-4: 1. c; 2 - c; 3 - d; 4 - a; 5 - b; 6 - c;
7.-d; 8.-d; 9 - a; 10 - d; 11 - c; 12 - d;
13.-c; 14.-b; 15. - a;

CROSS-WORD

E	U	S	T	A	C	H	I	A	N	T	U	B	E
A						T			T		M		P
R	O	U	N	D		L			D		B		I
D					M				T		O		T
R			S	T	A	P	E	S					Y
U		S	P	I	N			R					M
M	A	L	L	E	U	S		T			O		P
					B						V		A
P			P	A	R	S	T	E	N	S	A		N
A	R	T			I						L		U
C					U								M
I					M	A	S	T	O	I	D		
A										N			
L	I	G	A	M	E	N	T	S		C	R	U	S
N			I				Y			U			I
E			R	D	T		M	A	S	S			N
R	T		C				P						U
V			E		S	T	A	P	E	D	I	U	S
E			L				N			T			E
		F	L	A	C	C	I	D	A				S

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