A QUIZ ON CALIBRATION OF IMMITTANCE AUDIOMETER - A VIDEO FILM

REG. NO.M9514

THIS INDEPENDENT PROJECT SUBMITTED AS PART FULFILMENT OF FIRST YEAR M.Sc. (SPEECH AND HEARING) TO THE UNIVRESITY OF MYSORE, MYSORE

ALL INDIA INSTITUTE OF SPEECH AND HEARING
MYSORE 570 006

MAY 1996

DEDICATED TO

GRAND PARENTS

CERTIFICATE

This is to certify that the Independent Project entitled "A Quiz on calibration of Immittance Audiometer - A Video Film" is a bonafide work done in part fulfilment for first year degree of Master of Science (Speech and Hearing) of the candidate with register number M 9514.

Mysore
1996.

Dr. (Miss) S. Nikam
Director
All India Institute of
Speech and Hearing
Mysore - 570 006.

CERTIFICATE

This is to certify that the Independent Project entitled "A Quiz on calibration of Immittance Audiometer - A Video Film" has been prepared under my supervision and guidance.

Mysore
1996.

Guide
Dr (Miss) S. Nikam
All India Institute of
Speech and Hearing
Mysore-570 006.

DECLARATION

I, hereby declare that this Independent Project entitled, "A Quiz on calibration of Immittance Audiometer A Video Film" is the result of my own study under the guidance of Dr.(Miss) S. Nikam, Professor and Head of the Department of Audiology, All India Institute of Speech and Hearning, Mysore and has not been submitted earliar at any University for any other diploma or degree.

Mysore
1996.

Reg. No. M 9514

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INTRODUCTION

The key to the successful use of hearing tests in otologic diagnosis seems to be in the employment of multiple tests, rather than single tests alone. While individual test results are often capricious and unreliable, the overall pattern of results obtained from a suitable two or three test battery appears to be stable and more meaningful. (Jerger, 1962).

Each persons threshold of hearing can be tested by means of puretone audiometry. Speech reception threshold can be found using speech audiometry. To find whether a person has got middle ear pathology or not immittance audiometry can be done. Hence for evaluation of hearing at various levels of auditory system, different instruments are used.

Acoustic immittance testing represents a powerful tool in the clinicians armanentarium. Its not a behavioural test, less time consuming, non-invasive, easy to administer and relatively low cost screening device to identify person with conductive pathology. The instrument used for the

acoustic immittance testing is the immittance audiometer (Silman and Silverman, 1987).

An understanding of the instrumentation and physical parameter used in auditory investigation not only provides the knowledge that the results are accurate and free from artifacts, but also by knowing the limitations and procedures utilized more accurate interpretation of the results are got. The knowledge of calibration and specification of the auditory stimuli permits classification of the results and allow other investigators or clinicians to duplicate the results.

Checking calibration is necessary to be sure that an audiometer produces a puretone at the specified level and frequency that the signal is present only in the transducer to which it is directed and that the signal is free from distortion or unwanted noise interferences. Once calibrated the results can be reported with confidence. Calibration check can determine whether the instrument measurement has changed over time.

The parameter to be checked in immittance audiometer calibration are:

1. Probe signal
2. Manometer system
3. Monitoring system.
4. Reflex activating system.

Here is a quiz on calibration of immittance audiometer. This quiz is prepared for students who are already familiar with the calibration procedure and who want to put their knowledge, in this topic to test. This quiz also helps students to be familiar with the instruments used for calibration. This video film was prepared with the intention that along with theoretical knowledge, visuals also help in learning the procedure for immittance calibration easily and quickly.

METHODOLOGY

This project aims at conducting a quiz on calibration of immittance audiometer.

The methodology of the present study is described under the following sections:

I Subjects

II Selection of questions and round

III Scoring

IV Questions.

I. Subjects:

Four graduates and four post graduates of speech and hearing were selected as participants for the quiz programme. The participants were divided into four groups with two members representing each group being selected by lots.

II. Selection of questions and rounds:

The questions for the quiz were prepared from literature (Silman and Silverman 1987; Reetha, 1995, Katz, 1994).

Questions were classified into 4 rounds.

A) Historical background
   - Multiple choice questions
B) Instrumentation
   - Anagrams
   - Symbols.
C) Visuals
   - Testing procedure
   - Wrong connections.
D) Rapid fire questions.

A) HISTORICAL BACKGROUND

Questions regarding the dates of discovery and discoverers were asked and the choices were displayed on the monitor.

B) INSTRUMENTATION

Here the questions on concepts and instruments for immittance calibration were put-forth.

C) VISUALS

Different instruments and the testing procedure are displayed on the monitor and the subjects were expected to answer.

D) RAPID FIRE QUESTIONS

Five questions were presented to all the teams and the subjects were expected to answer the question within 20 sees.

III. Scoring:

For the found A and B the points awarded for a correct answer was ten points. If the answers was incorrect it did not carry any point. For round C, the visuals were displayed for 10 seconds on the monitor and the answer were expected within 15 seconds. If answered correctly, ten points were awarded to them. If not, the question was not passed on to the next team.

In round D, there were 5 questions put to each team, in 20 seconds the answers were expected, each correct answer carried 2 points and each wrong answer carried-2 points.

Quiz on calibration of Impedance

- A Video film by S. Rajashree

I A) Historical Background

Ql. Who gave the concept of acoustic impedance ?
Ans. Webster in 1919.

Q2. Who constructed the first acoustic impedance bridge?
Ans. Schuster in 1960.

Q3. First study on the impedance of the human ear was done by.
Ans. Troger in 1930.

Q4. Interpretation of Tympanogram using gradient value was 1st recommended by.
Ans. Brooks in 1969.

B) Multiple choice Questions:

Ql. Impedance measurements in the neonates was first carried out in the year?

1970 1973 1965 1980

Q2. Pressure swallow test was developed in the year?

1974 1970 1975 1973

Q3. Reflex relaxation index was given in the year ?

1974 1975 1973 1970

Q4. Reflex decay test was introduced in the year ?

1970 1975 1980 1969

II. Symbols and Formula.

Ql. State the computational formulas for impedance.

$$Z = \sqrt{R^2 + (X_c - X_m)^2}$$

V

Q2. State the symbol and unit of acoustic admittance

Symbol Ya, Unit - Acoustic mho

Q3. State the symbol and unit of Acoustic Suspicions

Symbol - Ba , Unit - Acoustic mho.

Q4. Acoustic Impedance is a ratio of

Sound pressure

Volume velocity.

II. Anagrams

Ql. CEIHMOOPR

Ans. microphone

Q2. IONPTS EHOPN

Ans. Piston phone

Q3. EEAOMNTRM

Ans. Manometer

Q4. VATCOE FTLEIR ETS

Ans. Octave filter set.

IV. Visuals:

Ql. Which procedure is the clinician performing ?

Ans. Tympanometry.

Q2. An instrument used to measure the sound level.

Ans. A sound level meter.

Q3. The instrument that helps in calibrating the pressure.

Ans. U tube Manometer.

Q4. This helps in making a hard copy of the results.

Ans. A graphic level recorder.

V. Rapid fire Questions:

Ql. Calibration is done to check that the instrument meets performance requirements.

True

Q2. Calibrated equipment is a pre-requisite for an accurate audiological evaluation.

True

Q3. Only signal parameters need calibration.

False

Q4. Working voltage need/need not be within the permissible limits.

False

Q5. Preliminary check up is checking the internal parts of the impedance meter.

False

Q6. Sound level meter can be calibrated only with pistonphone.

False

Q7. Compliance has to be checked with the help of a 2cc.

True

Q8. Puretones, ipsilateral stimuli and contralateral stimuli require frequent calibration.

True

Q9. Two types of calibration viz daily listening check and periodic electro acoustic evaluation has to be performed.

True

Q10. The test cavities and tolerances used in calibration of acoustic immittance monitor system should conform to ANSI (1987) Standards.

True

Qll. Changes in temperature and relative humidity have effect on calibration.

False

Q12. Measurements of the probe signal characteristics are performed in a standard HA-1 coupler.

True

Q13. Ipsilateral signals are measured in a 2cc coupler and contralateral signal in a 6 c coupler.

True

Q14. Intensity/Sound pressure level of ipsilateral stimulus will vary with the volume of the ear canal under test.

True

Q15. The instruments used for calibration of ipsilateral and contralateral stimuli are same.

False

Q16. Harmonic distortion can be less than 10% for the probe tube signal.

False

Q17. Any type of microphone can be used for the probe tone calibration.

False

Q18. Harmonic distortion should be less than 3% at all specified frequencies for earphones.

True

Q19. Calibration of response time of the instrument requires a 2cc coupler.

True

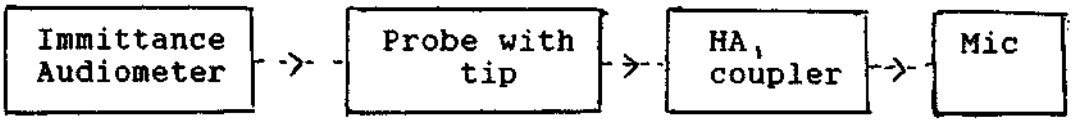
Q20. Calibrated equipment is a pre requisite for an accurate audiological evaluation.

True

Circuitry:

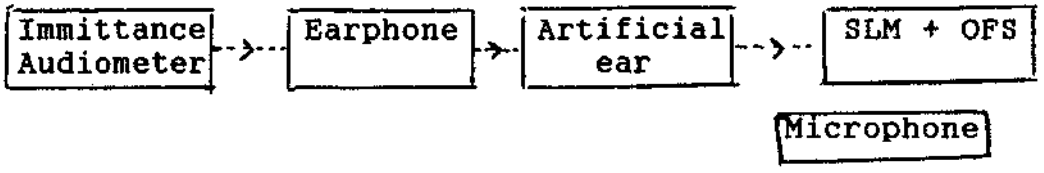
Is the circuit connections correct, if no, what has to be added to give the correct output.

Ql. Output stimulus calibration.



False -> SLM + OFS has to be included

Q2.



Yes

Q3. Insert receiver calibration.

Immittance Audiometer	Transducer	HA 2 Coupler	SLM OFS

Yes

Q4. Ipsilateral stimulus calibration.

Immittance Audiometer	Probe with tip	Mic	SLM + OFS

No HAI coupler has to be included between the tip and mic.

CALIBRATION PROCEDURE

Calibrated equipment is a pre requisite for an accurate audiological evaluation. Failure to calibrate an instrumental at appropriate intervals may lead to erroneous results. Hence the instrument has to be checked on its acquisition and an regular basis there after.

Here given below is the parameters to be calibrated and the brief calibration procedure.

a. Probe signal
b. Manometer system
c. Monitoring system
d. Reflex activating system.

Probe signal calibration:

HA-I coupler is used to calibrate the probe signal. The frequency at specified levels is checked for distortion and noise. The frequency output from the instrument is checked using a frequency counter directly. The reading on the dial and the counter should coincide. If not internal calibration has to be done. ANSI 1987 specifies that the

frequency of probe signal shall remain within +/- 3% of the nominal value.

Distortion, if can be checked by giving the electrical output from the instrument to distortion factor meter. The total harmonic distortion shall not exceed 5% of the fundamental when measured in a 2cc coupler (AHSI 1987).

[1]

Output SPL: The following steps are followed:

1. Calibrate SLM with pistonphone or sound level calibrater.
2. A condenser mic of pressure type is connected to the 2cc coupler which is in turn connected to the *SIM.*
3. Set SLM at slow mode and external filter with octave filter set attached to it.
4. Place the probe with an appropriate coupler.
5. Switch the instrument on and select probe signal, e.g. 226 Hz.

The SLM attenuator should be set at 80 dB. The frequency of octave filter set should correspond to frequency of probe tone selected.

Check reading on SLM if it is not corelating with intensity specified by manufactures. Then internal calibration has to be done.

Manometer System:

The pressure system is to be evaluated to determine the rate of air pressure changes and the accuracy of the graduated steps on the air pressure indicator. A U-tube manometer graduated in calibrated units is used to find manometer accuracy. Connect the probe to manometer or U-tube and find the corresponding change as the pressure dial is rotated. The corresponding reading between manometer and pressure on the instrument must be checked. The air pressure should not differ from that stated on the device by more than +/- 3 daPa or 15% of the reading whichever is greater ANSI (1987) IEC (1986) stresses that the response of the measuring instrument should be at least three times faster than the rate of pressure change.

Acoustic immittance monitor system:

The acoustic immittance or acoustic impedance value indicated by the instrument must correspond to known values

for fixed cavity volumes ANSI (1987). If an external recording device is used the reading on the acoustic immittance meter must correspond with the appropriate value marking on the chart paper for a specific calibration cavity. The acoustic immittance of closed cavity depends on environmental condition such as temperature, humidity and atmospheric pressure. Variation in temperature humidity have negligible effect but changes in pressure needs correction factor.

The stimulus level at which artifacts appear has to be specified by the manufactures ANSI (1987). The artifactual response is relevant for ipsilateral reflex measurement. The presence of an ipsilateral stimulus artifact is determined by placing the probe in 0.5cc cavity and presenting ipsilateral stimulus over the intensity range of the instrument. If the measurement is free of artifact, the meter needle will remain stationary for all presenting levels. If the deflection of the meter needle is observed that is coinciding with stimulus presentation then an artifact is present. The artifact effectively limits the operating range of the instrument the limits should be kept in mind while evaluating the patients.

Response tine of the instrument:

The initial latency, rise time, terminal latency, fall time and the drift are the temporal characteristics to be measured. A recommended procedure for determining the temporal characteristics of an acoustic immittance instrument involves measurement of the output of the instrument in response to various load immittance which is basically similar to that of a standard 2cc acoustic coupler. Load immittance either will be held constant or changes instantaneously.

Acoustic reflex activator system:

Frequency accuracy, output levels, attenuator linearity and harmonic distortion for both contralateral and ipsilateral acoustic reflex signal is measured, contrlateral signals are evaluated in standard NBS-9A 6cc coupler and ipsilateral stimulus in 2cc coupler.

According to ANSI (1987), the SPL of sound activator should be within +/- 3 dB of the stated values for frequency from 250 Hz to 4000 Hz and within +/- 5 dB for frequencies of 6000 Hz and 8000 Hz and for noise.

Calibration of ipsilateral stimulus level:

The following steps have to be followed.

1. Condenser mic of pressure type is attached to a coupler which is in turn connected to a SLM with octave filter set.

2. Probe is connected with appropriate coupler.

3. Select frequency on immittance audiometer as 500 Hz and intensity at 70 dB.

4. SLM to be placed on slow mode and external filter with attenuator setting 70 dB.

5.. Set octave filter set to the frequency chosen.

6. Present stimulus continuously and check the SLM reading to see if the instrument is in calibration.

7. Continue same procedure at ail frequencies.

Calibration of contralateral stimulus level:

Supra-aural earphone/insert/probe type receiver is the transducer used for contralateral stimulus presentation. The procedure is similar to the ipsilateral stimulus calibration.

Noise bands need to be checked if they are the activating stimulus. Broad band noise should be uniform with +/- 5 dB for the range between 250 - 6000 Hz for supra aural earphones. This can be checked by passing the output through transducer with a coupler along with a mic and then passed to the graphic level recorder. The frequency is read directly through frequency counter.

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