IMMITTANCE STUDIES IN HUMANS - A REVIEW OF LITERATURE (1984 - 1989)

Register NO.M8917

AN INDEPENDENT PROJECT IN PART FULFILMENT FOR THE FIRST YEAR M.Sc. (SPEECH AND HEARING),UNIVERSITY OF MYSORE, MYSORE.

ALL INDIA INSTITUTE OF SPEECH AND HEARING: MYSORE - 570 006

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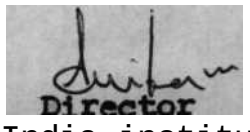
CERTIFICATE

This is to certify that the Independent Project entitled: "Immittance Studies in humans - A Review of Literature (1984 - 1989)" is the bonafide work in part fulfilment for M.sc., in Speech and Hearing, of the student with Register NO.M8917.



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This is to certify that the Independent Project entitled: Immittance Studies in humans- A Review of Literature (1984-1969) has been prepared under my supervision and guidance.

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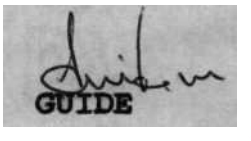

ACKNOWLEDGEMENTS

- I sincerely thank Dr.(Miss) S.Nikam, for her suggestions encouragement and providing an opportunity without which this work would not have been accomplished.

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- I thank all of my classmates and and friends including Bijay, Vinay, R, Vinay K, Shuvana, Prema, Khanal, Swathi and Birendra for encouraging and giving me the moral support to complete this project successfully.

- I thank "akka" for typing out the project so neatly and in time.

DECLARATION

This Independent Project entitled: Immittanee Studies in Human - A Review of Literature (1984-1989) 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.

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INTRODUCTION

At every moment of his life, man in exposed to sounds. The sounds generated in a man's environment are mostly carried by sound waves. These sound waves enter the auditory system through the external ear. The waves which thus enter the ear canal stimulate the fluid-filled inner ear to be transmitted to the higher centers for perception to occur. If the external ear were to be directly connected to the inner ear, the latter would have opposed and reflected most of the sound energy. This is because of the higher impedance of the inner ear fluids when compared to the impedance of air. Such a mismatch in impedance and increased opposition to sound flow would have resulted in a transmission loss of 35 dB (smith, 1968). Fortunately, in human beings, the auditory system is provided with a mechanism which reduces the opposition of the inner ear. This mechanism which reduces the impedance mismatch between the external and inner ear is nothing but the middle ear. Thus, the middle ear performs the function of an impedance matching device and thereby reduces the transmission loss by 25 dB (Smith, 1968). Sound transmission suffers when the middle ear function is abnormal.

Impedance measurements for the purpose of detection and diagnosis of middle ear pathologies are done at the plene of the tympanic membrane. It may be classified as either static or dynamic (Lilly, 1972).

Impedance measurements although primarily meant for diagnostic purposes also aid in screening programs (Brooks, 197ib, 1973, 1977a, 1978a; Liellau Nikalajsen, 1979; Dunn, 1978).

The use of impedance audiometry dates back early in the history of audiology, since then science has widened its horizons and shown new light.

In the field of audiology the progress in science and technology has yielded beneficial results. Progress has been made rapidly in all the spheres of audiology like rehabilitation and management, diagnostic etc. In clinical diagnosis impedance audiometry has gained special place of interest as it plays an important role in changes of middle ear problems.

Advances with respect to impedance audiometry have not concentrated on only one aspect. The roots have gripped all the aspedts, be it the equipment and accessories or the testing parts.

As recently as six years ago, annual audiological convention programs were replete with papers dealing with the refinement of immittance procedures as necessary inclusions in the diagnostic aspect of audiological evaluation. For the past several years, however, the well-deserved acceptance of immittance

as a "Standard" clinical tool seems to have led to an inhibition of further development or usage of new immittance techniques.

Here, an attempt is made to survey the research in the last five years. The difference in methodology, variables studied and their clinical applicability are discussed in the tabular form, for a more concise picture at what is happening.

Sl. No.	Author / Year	Article	Journal	Vol. No.	Test of presentation: Automatic	Test of presentation: Manual	Test of presentation: Computerized	Test of presentation: Tympanometry type	Test mode: Contra-lateral	Test mode: Ipsilateral	Test mode: Static compliance	Subject variables: Age range	Subject variables: Subject sex	Subject variables: Organic condition of ear	Administration and stimuluc variables: Frequency range	Administration and stimuluc variables: Intensity range	Administration and stimuluc variables: Probe tone	Administration and stimuluc variables: Noise vs. tone.
1.	Kanhkunen & Liden (1984)	Ipsilateral ART in neonates and in (n) hearing and hearing impaired pre-school children	Scandinavian Audiology	13 (2)	—	✓	—	A type	Absent	✓	reduced	1 month to 5yrs	20 neonates 220 - n hg. and 56 - SN hg. loss	56 cases are pathalgies	For neonates - 1 KHz & for n.hg. 500 Hz to 4 KHz.	85 dB HL with SD varying between 5 & 9 dB.	660 Hz	Broad band noise
2.	Lindeman, Holmquist and Aberg (1984)	Ear drum mobility and ME volume measured with tympanometry	Scandinavian Audiology	13 (3)	—	✓	—	✓	Not measured	Not measured	reduced	Not specified	23 patients sex is not specified	Normal	Not specified	Not specified	220 Hz	Not specified
3.	Decraemer, Creten et al (1984)	Tympanometric ME pressure determination with two component admittance meters	Scandinavian Audiology	13 (3)	—	—	✓	✓	Not measured	Not measured	Not specified	Not specified	5 subjects	Normal	Not specified	Not specified	220 Hz & 660 Hz	Not specified
4.	Wilson, Shanks et al (1984)	Tympanometric changes at 226Hz and 678 Hz across 10 trials and for two directions of ear canal pressure change	Journal of Speech & Hearing Research	27 (2)	—	✓	—	✓	Present	Absent	reduced	Mean age is 25.6 years	24 adults Sex is not specified	Normal	500 Hz to 2000 Hz	105 dB SPL	226 Hz & 678 Hz	Not specified

Sl. No.	Author / Year	Article	Journal	Vol. No.	Test of presentation: Automatic	Test of presentation: Manual	Test of presentation: Computerized	Test of presentation: Tympanometry type	Test mode: Contra-lateral	Test mode: Ipsilate-ral	Test mode: Static com-pliance	Subject variables: Age range	Subject variables: Subject sex	Subject variables: Organic con-dition of ear	Administration and stimuluc variables: Frequency range	Administration and stimuluc variables: Intensity range	Administration and stimuluc variables: Probe tone	Administration and stimuluc variables: Noise vs. tone.
5.	Korabic and Cudahy E.A. (1984)	Acoustic reflex temporal - summation measured at threshold.	Ear and Hearing	5(6)	✓	—	—	✓ Normal	Present	Present	Not specified	22 - 32 years	3 subjects (Male)	SN hearing loss	250 to 8000 Hz	Not specified	220 Hz	Broad band noise at six durations between 20 and 500 msec.
6.	Donna G. and Greenfield (1985)	Acoustic reflex Dynamics and the LDL.	Journal of Speech & Hearing Disorder	50(1)	—	—	✓	—	Present	Absent	reduced	20 - 25 years	15 subjects (Male)	Normal	1000 to 4000 Hz	L D L	220 Hz	Both
7.	Birch L. and Elbrond O. (1985)	Daily impedance audiometric screening of children in a day - cone institution.	Scandinavian Audiology	14(1)	—	✓	—	✓ Normal	✓	✓	Less than 0.25ml	3 - 6 years	M - 32 F - 25	SN hearing loss	Not specified	85 dB	226 Hz	Not specified
8.	Creten, Vande A.H., Heyning & Van Champ (1985)	Immittance audiometry (Normative data at 220 Hz and 660 Hz).	Scandinavian Audiology	14(3)	✓	—	—	✓	Not specified	Not specified	—	Gp.1. 20-25 yrs Gp.2. 1-80 yrs Gp.3. 1-90 yrs	M - 24, F - 22 360 subjects 224 subjects	Normal	Not specified	Not specified	220 Hz & 660 Hz	Not specified

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9.	Wiley & Goldstein (1985)	Tympanometric and Acoustic reflex studies in neonates	Journal of Speech & Hearing Research	28(2)	—	✓	—	AD type	Present	Present	Not specified	Neonates under one month of age	Not specified	Not specified	—	—	220 Hz & 660 Hz	Broad band noise
10.	Roberto M. and Zito F. (1985)	Oscicular chain interuption with present acoustic reflex.	Journal of Laryn-gology & Otology	99(1)	—	✓	—	A type & W type	✓ Present	—	—	33 years	One subject(F)	Not specified	500Hz to 4000Hz	90 dB	220 Hz & 660 Hz	Not specified
11.	Mc.Millan, Shurin et al (1985)	Ipsilateral and contralateral acoustic reflexes in neonates.	Ear and Hearing	6(6)	✓	—	—	✓	Present	Present	Not specified	5 - 118 hours	51 subjects Sex not specified	Not specified	500Hz to 4000Hz	Not specified	220 Hz & 660 Hz	Not specified
12.	Schuchman and Jochims (1985)	Tympanometric assessment of ET function of Divers.	Ear and Hearing	6(6)	✓	—	—	✓	Not specified	—	—	19 - 26 years	62 Males	Not specified	250Hz to 4000Hz	105 dB SPL	220 Hz	Not specified

Sl. No.	Author / Year	Article	Journal	Vol. No.	Test of presentation: Automatic	Test of presentation: Manual	Test of presentation: Computerized	Test of presentation: Tympanometry type	Test mode: Contra-lateral	Test mode: Ipsilateral	Test mode: Static compliance	Subject variables: Age range	Subject variables: Subject sex	Subject variables: Organic condition of ear	Administration and stimuluc variables: Frequency range	Administration and stimuluc variables: Intensity range	Administration and stimuluc variables: Probe tone	Administration and stimuluc variables: Noise vs. tone.
13.	Shanks & Wilson (1986)	Effects of direction and rate of earcanal pressure changes on tympanometric measures	Journal of Speech & Hearing Research	29(1)	—	—	✓	Normal tympanogram	✓	—	Not specified	Mean age 29.5 years	24 subjects (Male)	M.E. Pathology	500 Hz to 2000 Hz	110 dB SPL	220 Hz & 660 Hz	Not specified
14.	Steen Girusing (1986)	Inversion of the stapedial reflex in ossicular chain lesions	Journal of Laryng ology & Otology	100(4)	—	✓	—	✓	✓	✓	Not specified	9 years	Male - 1 Female - 1	Head Trauma	500 Hz to 4000 Hz	95 dB SL	220 Hz	Not specified
15.	Ernad & Rasmy (1986)	Stapedius reflex after stapedectomy with preservation of the stapedius tenden.	Journal of Laryng ology & Otology	100(5)	—	✓	—	✓	✓	✓	range 0.3 to 0.7 cm	20 - 40 years	Male - 12 Female - 13	Not specified	500Hz - 2000Hz but at 1000Hz & 2000 Hz, Reflex are not elicited	L DL	220 Hz	Not specified
16.	Van Camp and Vogleer M. (1986)	A tympanometric approach to otoselerosis.	Scandinavian Audiology	15(2)	Group I. for normals													
					—	✓	—	✓	Not specified	Not spefified.		12-62 yrs.	M - 15 F - 15	N.S.	500Hz - 2000 Hz	N.S.	220 Hz & 660Hz	N.S.
					Group II. for Otosclorisis													
					—	✓	—	A type & AS type	abse-nt	absent.		12-62 yrs.	14 Subjects	M.E Pathology	500Hz - 2000 Hz		660Hz	N.S.

Sl. No.	Author / Year	Article	Journal	Vol. No.	Test of presentation: Automatic	Test of presentation: Manual	Test of presentation: Computerized	Test of presentation: Tympanometry type	Test mode: Contra-lateral	Test mode: Ipsilate-ral	Test mode: Static com-pliance	Subject variables: Age range	Subject variables: Subject sex	Subject variables: Organic con-dition of ear	Administration and stimuluc variables: Frequency range	Administration and stimuluc variables: Intensity range	Administration and stimuluc variables: Probe tone	Administration and stimuluc variables: Noise vs. tone.
17.	Willy, Block et al (1987)	Acoustic - Immittance measures in normal ears	Journal of Speech & Hearing Research	30(2)	✓	—	—	✓	✓	✓	—	Mean age 25 years	Male - 70 Female-50	Normal	125Hz to 8000Hz	L D L	220Hz & 660Hz	used tone & Broad based noise
18.	Riedel Wiley & Block (1987)	Tympanometric measurements of Eustachian tube function	Journal of Speech & Hearing Research	30(2)	—	—	✓	✓	Not specified	—	—	18 - 30 years	24 - Male	Normal	250 to 4000Hz	100 dB HL	220 Hz & 660 Hz	Not Specified
19.	Robinson, Allen & Root (1988)	Infant tympanometry: Differential results by Race. (Black & Whites)	Journal of Speech & Hearing Disorder	53(3)	—	✓	—	Type B either Type C	—	—	0.2ml or greater	6 - 13 months	Infant 63 - Black 74 - White	M.E. dys. function	Not specified	Not specified	226 Hz	Not Specified
20.	Silman, Silverman & Lutolf (1988)	Ipsilateral, ARA, testing for detection of facial-nerve pathology: three case studies.	Journal of Speech & Hearing Disorder	53(4)	✓	—	—	✓	✓	✓	—	21 - 78 years	200 (Male)	Pathological cases facial palsy	500 Hz to 2000 Hz	Not Specified	220 Hz	Not Specified

Sl. No.	Author / Year	Article	Journal	Vol. No.	Test of presentation: Automatic	Test of presentation: Manual	Test of presentation: Computerized	Test of presentation: Tympanometry type	Test mode: Contra-lateral	Test mode: Ipsilate-ral	Test mode: Static com-pliance	Subject variables: Age range	Subject variables: Subject sex	Subject variables: Organic con-dition of ear	Administration and stimuluc variables: Frequency range	Administration and stimuluc variables: Intensity range	Administration and stimuluc variables: Probe tone	Administration and stimuluc variables: Noise vs. tone.
21.	Ogisi F.O. (1988)	Impedance screening for otitis media with effusion in higerian children	Journal of Laryn-gology & Otoology	102	✓	—	—	Type B & Type C	Absent	Absent	—	5 - 6 years	Male - 207 Female- 224	Not Specified	500 Hz to 2000 Hz	105 dB	220 Hz.	Not Specified
22.	Niswander P.S. & Mitchell M. (1988)	Observations on the ART in institutionalised retarded adults taking mellarial and/or thorazine.	Ear and Hearing	9(1)	✓	—	—	Normal	Present ✓	✓	—	Age range 20 - 53 years	Male - 15 Female - 20	Mental retarted	500 Hz to 2000 Hz	110 dB HL	Not Specified	Broad based noise
23.	Holmes Muier et al (1989)	Acoustic reflectometry ME screening	LSHSS	20(1)	✓	—	—	✓	Not specified	Not specified	—	5 months to 19.3 years	Male - 169 Female- 188	166 subjects Pathalogical cases	250 to 4000 Hz	100 dB HL	220Hz & 660 Hz	Not Specified

Types of presentation and stimulus variables		Subject variables			
		Adults		Infants	
		Normals	Abnormals	Normals	Abnormals
1. Manual		75	44	277	173
2. Automatic		1534	458	51	-
3. Compute-rised		44	24	-	-
4. Tympano-metry		1638	526	328	193
5. Probe tone	220 Hz	558	3	-	357
	660 Hz	-	14	277	56
	Both 220 Hz and 660 Hz	904	54	51	-

CONCLUSION

The review of above articles reveal, the following trends:

1. Through all 3 types of presentation - manual, automatic and computerized, have been used a majority have utilized automatic (76.23%) and others have used manual (21.23%) and the remaining computerized (2.53%).
2. The subjects studied belong to including groups of normal and pathological.
   - Normal adults
   - Normal infants
   - Pathological adults
   - Pathological infants.
3. Manual tympanometry is mostly done on infants (48.68%) 30.4% pathological) and less frequently on adults (13.18% normal, 7.73% abnormal).
4. Automatic tympanometry in mostly utilized on adult population (75.08% on normal, 22.4% on abnormal), and less frequently on infants (2.49% normal).
5. Computerized impedance in totally used among adults and in that onnormals (64.7%).
6. Tympanometry is done in all groups normal and abnormal both infant and adult population. Tympanometry is most frequently reported on normal adults (61.%) and less frequently on abnormal adults (19.59%).

7. If one looks at the kind of probe tone used, one comes with the following observations.
8. 220 Hz - 45%; 660 Hz - 9% and both 220 Hz and 660 Hz - 45.45%. A majority of the articles have utilized 220 Hz probe tone or both 220 Hz and 660 Hz as probe tone.
9. Comparison also reveals that, 660 Hz tone in exclusively used among pathological cases.
10. 220 Hz tone is used among normals (60% of the articles and both 220 Hz and 660 Hz tone is also commonly done on normals (80%).
11. Impedance audiometry , the time tested instrument is a valid way of assessing integrity of one's auditory system. It is still regarded as an efficient way of testing infants and finds a place in the battery of tests for diagnosis and also in screening of infants and children.

The new areas in impedance are being explored for utilizing it in more different ways. Using different probes tones such as 660 Hz in one such experiment, impedance research still focuses on normal adults for knowing the middle ear mechanism better and such knowledge is being applied later to pathological cases. This is evident from percentage of tests done on normals and pathological cases.

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