

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

Register NO.M8917

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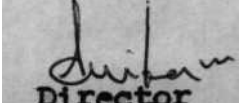
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This is to certify that the Independent Project entitled: "Immittance Studies in humans - A Review of Literature (1984 - 1989)" is the bonafide work in part fulfilment for M.sc., in Speech and Hearing, of the student with Register NO.M8917.

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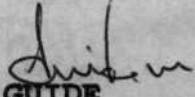
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All India institute of
Speech and Hearing
Mysore-6

CERTIFICATE

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.

Mysore
May 1990



Dr. G. S. Murthy
GUIDE

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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 is 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 plane 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, 1971b, 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 aspects, 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				Test mode			Subject variables			Administration and stimulus variables			
				Automatic	Manual	Computerized	Tympanometry type	Contra-lateral	Ipsilateral	Static compliance	Age range	Subject sex	Organic condition of ear	Frequency range	Intensity range	Probe tone	Noise vs. tone.
1.	Kanhkunnen & 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 pathalogies	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				Test mode			Subject variables			Administration and stimulus variables					
					Automatic	Manual	Computerized	Tympanometry type	Contra-lateral	Ipsilateral	Static compliance	Age range	Subject sex	Organic condition of ear	Frequency range	Intensity range	Probe tone	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	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)		<		<	Normal	Absent	Present	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		Op.1. 20-25 yrs Op.2. 1-80 yrs Op.3. 1-90 yrs	M - 24, F - 22 360 subjects 224 subjects	Normal	Not specified	Not specified	220 Hz & 660 Hz	Not specified	

Sl. No.	Author Year	Article	Journal	Vol. No.	Test of presentation				Test mode			Subject variables			Administration and stimulus variables			
					Automatic	Manual	Computerized	Tympanometry type	Contra-lateral	Ipsilateral	Static compliance	Age range	Subject sex	Organic condition of ear	Frequency range	Intensity range	Probe tone	Noise vs. tone.
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		220 Hz & 660 Hz	Broad band noise	
10.	Roberto M. and Zito F. (1985)	Oscicular chain interruption with present acoustic reflex.	Journal of Laryngology & Otolology	99(1)		<			A type & W type	Present			33 years	One subject(F)	Not specified	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	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	Not specified		19 - 26 years	62 Males	Not specified	220 Hz	Not specified	

Sl. No.	Author Year	Article	Journal	Vol. No.	Test of presentation				Test mode		Subject variables			Administration and stimulus variables				
					Automatic	Manual	Computerized	Tympanometry type	Contra-lateral	Ipsi-lateral	Static compliance	Age range	Subject sex	Organic condition of ear	Frequency range	Intensity range	Probe tone	Noise vs. tone.
13.	Shanks & Wilson (1986)	Effects of direction and rate of ear canal pressure changes on tympanometric measures	Journal of Speech & Hearing Research	29 (1)			<				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 Laryngology & Otolaryngology	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 & Rasmay (1986)	Stapedius reflex after stapedectomy with preservation of the stapedius tendon.	Journal of Laryngology & Otolaryngology	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 Voglear M. (1986)	A tympanometric approach to otosclerosis.	Scandinavian Audiology	15 (2)		<	<	<			Group I. for normals Group II. for otosclerosis	12-62 yrs.	M - 15 F - 15	N.S.	500Hz - 2000 Hz	N.S.	220 Hz & 660Hz	N.S.
						<	<	<				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				Test mode			Subject variables			Administration and stimulus variables				
					Automatic	Manual	Computerized	Tympanometry type	Contra-lateral	Ipsilateral	Static compliance	Age range	Subject sex	Organic condition of ear	Frequency range	Intensity range	Probe tone	Not Specified	Specified
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	Not Specified
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)	<		<	<			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)	facial palsys	500 Hz to 2000 Hz	Not Specified	220 Hz	Not Specified	

Sl. No.	Author Year	Article	Journal	Vol. No.	Test of presentation				Test mode			Subject variables		Administration and stimulus variables				
					Automatic	Manual	Computerized	Tympanometry	Contra-lateral	Ipsilateral	Static compliance	Age range	Subject sex	Organic condition of ear	Frequency range	Intensity range	Probe tone	Noise vs. tone.
21.	Ogisi P.O. (1988)	Impedance for screening for otitis media with effusion in Nigerian children	Journal of Laryngology & Otolology	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 thiorazine.	Ear and Hearing	9(1)	<			Normal	Present	<		20 - 53 years	Male - 15 Female - 20	Mental retarded	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	<		5 months to 19.3 years	Male - 169 Female - 188	166 subjects pathological 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. Computerised		44	24	-	-	
4. Tympanometry		1638	526	328	193	
5.	220 Hz	558	3	-	357	
	Probe tone 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 is mostly utilized on adult population (75.08% on normal, 22.4% on abnormal), and less frequently on infants (2.49% normal).
5. Computerized impedance is totally used among adults and in that on normals (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 is 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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