IMPEDANCE MEASUREMENT IN RHEUMATOID ARTHRITIS

**Independent project submitted in part fulfil-
ment for the III semester MSc in
SPEECH AND HEARING
University of Mysore
1980**

Dedicated to

my parents

CERTIFICATE

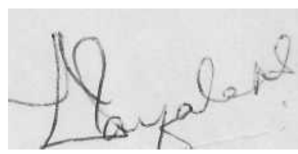
This is to certify that the project entitled "Impedance Measurement in Rheumatoid Arthritis" is the foona fide work in part fulfilment for the degree of M.Sc., III Semester (Speech and Hearing) of the student with Register No.

Director

All India Institute of Speech & Hearing
Mysore

CERTIFICATE

This is to certify that this Independent project work has been prepared under my supervision and guidance.



GUIDE

DECLARATION

This independent project in Audiology is the result of my study undertaken under the guidance of Mr. Jesudas Dayalan Samuel, Lecturer in Audiology, All India Institute of speech and Hearing and has not been submitted earlier at any University for any other Diploma or Degree.

Mysore   Register No. 15

December 1980

ACKNOWLEDGEMENT

Acknowledgement of able assistance is due to my guide Mr. Jesudas Dayalan Samuel, lecturer in Audiology, who has devoted considerable hours for the successful completion of this work. I am greatly indebted to him for rendering this service.

I am indebted to Dr. Rathna, Director-in-Charge of All India institute of speech and Hearing, for having provided the facilities for my project work.

I thank Dr. S. Nikam for making me available necessary instruments to this study.

I wish to express my heart felt thanks to Mr. S.S.Murthy, Head of the Department of Electronics, for his help and encouragement.

I wish to thank Dr. Sindhe, Head of the Department of Medicine, Mysore Medical college. Dr. B.G.Gopinath, Dr. U.Ramachandra Rao, Principal of Mysore Medical College, Dr. Mutt and Dr. Yoganna, who helped me in getting the subjects.

I also wish to extend my thanks to Mr. Copal,s, Mr. Vasu, Mr. R.S.Shukla, p. Basavalingappa and V. Aithal, for enabling this project success.

I express my thanks to Sanjeeva Murthy for typing the manuscript.

Finally I thank all my subjects and friends who have extended a helping hand in all phases of my project work.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

The first written descriptions of the occurance among children of the disease as juvenile arthritis date from the latter half of the nineteenth century. By contrast, the adult forms of rhernatism were recognized and discussed by hippocrates, although for many centuries knowledge of the afflictions remained fragmentory (Grokoesst, 1962).

A great advance in rheumatic studies occured in 1591, when the acute and chronic forms of adult rheumatism were first distinguished. In 1809 study showed that female patients with rheumatoid arthritis outnumbered males in the proportion of 33 to 1. The survey which established this sex ratio might be described as first statistical study of rheumatoid arthritis, although the same was inadequate. These findings, and comparable advances in other branches of the field, gave the physicians of the early twentieth century knowledge of four main categories of arthritis: gouty arthritis, pyogenic arthritis, osteoarthritis and rhematoid arthritis in both adult and juvenile forms.

Descriptions of variants of rheumatoid arthritis bad appeared gradually in medical literature. A number of patients with - rheumatoid arthritis aiso have ulcerative colitis. Iritis, Sjogren's syndrome (lack of tears and/or saliva) and amyloidosis occur as manifestations of the more severe forms of rheumatoid arthritis.

The concept of rhematoid arthritis as a disease of hyper sensitivity might be said to have originated in 1932. At that time it was suggested that an agglutinating reaction which had been observed between rheumatoid sera and strepto-coccus hemolyticus might be immunological in nature. This was disproved in 1958, when it was shown that streptococcus hemolyticus was no more than an inert substance which mad® the rhematoid serological reaction readily visible.

Pathology

Where is the primary lesion in a rheumatoid subject? There is a fragmentary evidence to suggest that in rhematoid arthritis the first recognizable lesion is vasculitls. The vasculitis is characterised primarily by necrosis and fibrinoid . deposits. A stained round-cell inflammatory reaction follows which may (1) beeorme granulomatous, (2) end in scarring, or (3 5 resolve. This sequence explains all the clinical manifesta-tions of rheumatoid arthritis.

Rhematoid arthritis is envisioned as a diffuse systemic disease whose clinical manifestations happen to be mainly musculoarticular. The laymen often infer from the name rhematoid arthritis that the disease attacks the joints of hand.

Rheumatoid arthritis is a major member of a group of inflammatory systemic connective tissue diseases. Common features are, swelling and modification of ground substance, fibrinoid degeneration or necrosis, fibroblastic proliferation and a predominantly mononuclear inflammatory response (Lichtenstein 1970).

Rheumatoid arthritis is classically a chronic and deforming disease that is usually polyarticular and symmetrical. The earliest changes are in the synovium which becomes congested, edematous and then thickened by granulation tissue and infiltration by lymphocytes and plasma cells. Eventually the thickened synovium extends over and becomes adherent to the cartilage surface as pannus that may extend subchondrally. Adhesions between the joint may result in fibrous or bony ankylosis (Gussen 1977).

Diagnostic criteria

The American Rheumatism Association has proposed diagnostic criteria for adut rheumatoid arthritis. Three categories have been decided upon: definite, probable, *and* possible. A "definite" diagnosis of rheumatoid arthritis requires five of the following features together with joint symptoms which have persisted for atleast 6 weeks. A "probable" diagnosis of rheumatoid arthritis can be made if three of these features are present for 4 weeks.

1) Morning stiffness
2) Pain on motion or tenderness
3) Swelling in atleast one joint
4) Swelling in more than one joint (a symptom-free interval before the involvement of a second joint may not exceed 3 months)
5) Symmetrical joint involvement
6) Subcutaneous nodules
7) X-ray changes typical of rhematoid arthritis
8) Positive rhematoid agglutination reaction
9) Poor mucin clot formation in joint fluid
10) Biopsy findings in synovium consistent with rhematoid arthritis
11) Biopsy findings in a nodule consistent with rhematoid arthritis

The incudomalleal articular disc consists of a morphous material and cluster of precartilage cells which are present through out the life. The inner surface of the joint capsule contains synovial cells, which are present in small numbers within the amorphous part of the disc. These cells appear to be the precursors of the precartilage cell clusters. An unusual feature of this joint is the presence of synovial lining on the articular surface of the incus and malleus, which plays a role in the formation of new cartilage and chondro-osseous tissue within the cartilage of the joint. The incudo-malleal disc differs from the intervertebral disc that is separated from the articular cartilage surface by a synovial lining.

The disc material at birth is composed of amorphous eosinophilic-staining material and cluster of cells resembling superficial articular cartilage ceils of ossicles, with increasing age only scattered cluster of these cells remain both within disc and just within the capsule of the joint with the most of the disc composed of amorphous material. The articular surfaces of the joint as well as the cell clusters within the disc are lined by a flat layer of synovial cells.

The normal anatomy of the incudomalleal and incudo-stapedial joints are synovial diathrodial joints. The incudo malleal joint is the articulation between the head of the malleus and body of the incus. The articular surfaces of this joint are saddle shaped and an elastic capsule surrounds the articular margin. From the inner surface of the capsule, a wedge shaped fibrocartilage projects into joint cevity and partially divides it. The incudo stapedial joint is a typical ball and socket joint between the convex lentlform process of the incus and shallow concavity on the head of the stapes. A small circular space at the margin of this joint is occupied either by Investigations of synovia1 membrane or by a small triangular fibra cartilagenous ring.

Both joints show an articular cartilage with a typical hyaline pattern. The superficial cells are small and arranged with a long axes parallel to articular surface. The intermediate layer is made up of more oval .shaped cells and deeper layer consists of large oval or round cells which penetrate into the adjacent, to become surface. The intercellur substance consists of collageneous fibers embedded in amorphous ground substance. The capsule of these joints consisted of three layers.

1. an inner layer of synovial membrane;

2. an intermediate fibrous capsule;

3. outer layer of mucous membrane continuous with that of middle ear. Most of these joints are made up of elastic fibres. The synovial membrane lines the joint cavity completely except an articular cartilage (Ethom and Belal, 1974).

Brief, plan of the study

Three rheumatoid arthritis subjects were examined otologically and audiologically. Audiological tests included puretone audiometry, speech audiometry and middle ear assessment. Results of these three subjects are compared to the results obtained in normal hearing subjects who did not have rheumatoid arthritis.

Purpose of the study.

Purpose of the study was to determine whether there was any effect on middle ear tranducer mechanism in patients with rheumatoid arthritis.

Definitions of the terms used

Pure-tone threshold: Pure-tone threshold is the at least audible sound pressure level of a sound at which it can be heard by an individual 50% of the time.

. Speech audiometry : It is a technique whereby standardised samples of language are presented through a calibrated system in order to measure some aspect of hearing ability. The standardized material can be presented from a recording or monitoring voice (Carhart, 1965).

Speech discrimination, score: is a percentage of test items a person can identify correctly by ear (Carhart, 1965). .

Tympanogram; is the graph showing pressure-compliance relationship of the middle ear.

Acoustic reflex, threshold : is the intensity in dBs above the threshold of simulated ear which is just capable of inducing a reflex contraction of stapedial muscle as induced by compliance change in the impedance of tympanic membrane (Feldman, 1976).

Contralateral reflex: the acoustic reflex monitored in one ear and stimulated in the contralateral ear. It is also called as crossed reflex (Feldman, 1976).

Ipsilateral reflex: the acoustic reflex monitored on the same side as the reflex inducing stimulus is presented (Feldman, 1976).

Synovia : transparent, viscid fluid secreted by the synovial membrane and found in joint cavities.

Edematous : a condition where an abnormal accumulation of fluid in intercellular spaces of the body.

Lymphocytes: a mono-nuclear, non granular cells containing dense chromation and a pale blue-staining cytoplasm.

Granulation: the division of a hard substance into small particles

CHAPTER II

REVIEW OF LITERATURE

Otoadmittance measurements in patients with rheumatoid, arthritis

Study on above topic is very rare. Hence each study is reviewed in detail.

Moffat, D.A. et al (1977)

Analysis of middle ear function has for many years been accomplished by acoustic impedance measurements and this has proved of great clinical value (Feldman 1964, Priede 1970, Zwislocki & Feldman 1970). Commercially available electro-acoustic bridges such as Peters or Madsen are most commonly employed. These have been derived from mechanical acoustic bridges, originally that of Schuster (1934) and laterly, modified versions of Metz (1946) and of Zwielocki (1963).

Purpose of the study was to determine whether there was any effect on middle ear transducer mechanism in patients with rheumatoid arthritis, conductive hearing loss, presumed to have been due to rheumatoid involvement of synovia1 joints (Copeman 1963), but others have failed to substantiate the findings (Heyworth & Liyanage 1972).

Selection of patients

A well characterized group of patients with classical or definite rheumatoid arthritis as defined by the American Rheumatism Association (Roopes et al 1959) and a control group matched for age and sex were studied. The patients fulfilled the following criteria.

1. No history of ear disease
2. Clinically normal tympanic membrane
3. No conductive hearing loss (assessed by puretone audiometry)

Otoadmittance measurements were obtained from 55 rheumatoid arthritis and 50 control ears respectively.

Apparatus

The Grason stadler 1720 B otoactaittance meter was used through out the study. This instrument is similar to the electro-acoustic impedance bridges in that it contains a pressure pump system which automatically varies the air pressure gradient across the tympanic membrane (from -300 mm H20 to + 300 mm H_20) and a small probe tip with tubes for air pressure, transmission and reception of acoustic signals. However, instead of rectifying the resultant wave maintained in the ear canal, the signal is first fplit and compared, both in phase and 90^0 out of phase with the original probe tone. The resultant signal is also fed through an automatic volume control circuit which electrically modifies the level of probe tone fed to the ear canal maintaining it at 85 dB SPL.

Otoadmittance meter is linked to an XY plotter. The probe tone frequency was set (blue trace on the XY plotter-220 Hz and the red - 660 Hz) and the susceptance and conductance tympanograms, at each probe tone frequency were traced out over successive pressure sweeps. A zero cross technique was adopted, i.e., a sweep from negative to positive pressure was followed by a sweep from positive to negative pressure. The sweep frequency was 15 mm H_2O pressure changed per second.

<u>Results & discussion</u>

The use of otoadmittance meter in assessing middle ear function, in a series of patients with rheumatoid arthritis, showed that a much higher proportion than of the control group exhibited marked notching of the 660 Hz susceptance characteristic of "loosening pathologies". This was presumably due to an increase in flaccidity of a clinically normal tympanic membrane. If the predominant effect had been due to rhematoid involvement of the synovial ossicular joints, then reverse would have occured, i.e., an increase in stiffness of the system.

38% of rheumatoid ears showed marked notching in the 600 Hz susceptance curve characteristic of a loosening condition and *8%* of control ears showed the similar abnormality. The pattern suggests a decrease in the stiffness of the transducer mechanism in rheumatoid arthritis.

Middle ear immitance in rheumatoid arthritis,
Reiter.D, et al (1980)

The incudomalleal and incudostapedial articulations are synovial joints with cartilagenous articular discs. Consequently, they should be subjected to rheumatoid arthritis involvement similar to that observed in similar joints elsewhere in the body. To date, however, research findings from histologic investigations concerned with this relationship have been equivocal. Although hearing impairment has been associated with rheumatoid arthritis, the nature and extent of such involvement has not been fully delineated.

Copeman (1963) described three patients with hearing loss that increased with activity of definite rhematoid arthritis. The possibility of conductive impairment was stressed. Copeman (1963) coined the term "otoarthritis" to connote this symptom complex.

Goodwill (1972) reported substantially greater severity of sensorineural hearing loss in patients with rheumatoid nodules as compared to that of the reminder of their sample with arthritis. In addition, post mortem of patients (who had rheumatoid arthritis) three sets of ossicles were examined and found no evidence of rheumatoid synovitis.

Moffat et al (1977) reported in this study that a high incidence (38%) of notched 660 *Hz* susceptance tympanometric function. Those findings were suggestive of decreased stiffness in the tympano-ossicular system.

Purpose of Reiter.D et al's study (1980) was to see the effect of rheumatoid arthritis on middle ear mechanism and type of hearing loss.

Selection of patients

23 individuals with classic or definite rheumatoid arthritis, diagnosed according to the criteria of the American Rheumatism Association, served as experimental subjects. They ranged in age from 33 to 70 years, with a mean age of 58 years. Fourteen volunteers, matched with experimental counter-parts for age and sex, served as control subjects. The control group had neither history of nor symptoms compatible with any arthropathy and age range is 28 to 61 years, with a mean age of .52 years.. Participants in both the groups were selected based on the criteria of intact tympanic membranes without

visible scarring and negative history for otorrhea, oto-logle surgery, occupational or recreational noise exposure, skull trauma, or upper respiratory infection within one month of participation in the investigation.

Otologic evaluation

Examination with hand held microscope was carried out for all the participants.

Audiologic evaluation

Audiologic assessment were conducted in sound treated room, suitable for threshold testing. Testing included assessment of pure tone air and bone conduction thresholds, speech reception thresholds and speech discrimination score.

Immitance measurement

Tympanometric graphs were plotted for both susceptance and conductance at probe tone frequences of 220 Hz and 660 Hz Finally, the direction of pressure variation, tympanometric function and probe-tone frequency were counter—balanced to avoid systematic order effects.

Instrumentation

Clinial audiometric instrumentation, calibrated to 1969 American National Standards Institute Specifications was used for audiologic testing. Immittance data were obtained with an otoadmittance meter and an associated X-Y recorder calibrated to manufacturer's specifications.

Results

Audiological assessment revealed that subjects with rheumatoid arthritis had a higher incidence of hearing impairment of both conductive and sensorineural type than their normal counterparts. Three of the subjects with rheumatoid arthritis *(13%* of the sample), demonstrated mild bilateral conductive hearing loss. Conductive components for these subjects ranged from 30 to 35 dB at 250 and 500 Hz. There were no control subjects with audiological findings suggestive of conductive involvement. Eleven of the subjects with rheumatoid arthritis (48% of the sample) demonstrated mild to moderate bilateral hearing loss of sensorineural type, compared to two control subjects *(15%* of the sample) with similar impairment. The audiometric configuration for nine of the patients with rheumatoid arthritis with sensorineural hearing loss was sloping high frequency (2000 to 8000 *Hz),* with remaining two essentially flat. Both of the control subjects with sensorineural hearing loss demonstrated flat audiometric configurations.

Examination with electroacoustic middle ear immittance instrument following datas were revealed: Normal tympanometric patterns were observed for 41% of the ears in the sample with rheumatoid arthritis (19 of 46 ears), whereas 96% of ears in control sample (27 of 28 ears) had normal patterns. Conversely, abnormal tympanometric patterns were seen in 59% of arthritic ears (27 of 46), with 22% (ten ears) of notched configuration and 37% (17 ears) demonstrating negative pressure convergence of susceptance functions. Only one ear front the control group was found to be tympanometrically abnormal with a convergence pattern of susceptance tympanograms. Tympanometric patterns of two subjects with rheumatoid arthritis with conductive hearing impairment were notched, while the third had converging and crossing susceptance tyrapanogram patterns with no notching.

Summary

The findings of this investigation support the hypothesis that a pathologic stiffening of the middle ear occurs in many patients with rheumatoid arthritis. There does appear to bo a trend for the non-steroid-treated group to have a higher incidence of abnormal tympanometric patterns. 66% (21 of 32 ears) of the non-steroid-treated group demonstrated abnormal tympanometric patterns, only 43% (6 of 14 ears) of patterns of the steroid-treated group were abnormal.

CHAPTER III

METHODOLOGY

The present work aimed at studying the middle ear function and its characteristics in three individuals affected by rheumatoid arthritis.

SUBJECTS:

Experimental group consisted of three individuals with confirmed rheumatoid arthritis. They ranged from 29 to 66 years. Two of them were males (29 and 47 years) and one female (66 years). The individuals fulfilled the following criteria.

i) no history of ear disease;

ii) clinically normal tympanic membranes without visible scarring as ascertained by microscopic examination and negative history for otorrhea, otologic surgery, occupational noise exposure, skull trauma or upper respiratory tract infection one month prior to participation in the investigation.

Control groups consisted of three normal hearing individuals. They were matched for age *an®* sex with experimental group, This group had neither history nor symptoms compatible with any arthopathy. Except this, other conditions were similar to experimental group.

EQUIPMENT AND TEST ENVIRONMENT:

A two channel diagnostic audiometer (Beltone 200 C) was used to obtain pure-tone thresholds, speech reception thresholds and speech discrimination scores. The audiometer was equipped with telephonic type TDH-39 earphones which were enclosed in MX 41-AR cushions.

Testing was performed in the custom made sound treated room of the All India institute of Speech & Hearing, Mysore. The noise level in the test room was measured by sound level meter (B&K type 22O3) and the noise levels were far below the interference level.

The test equipment was placed in the examination room. Subjects were seated in the testing room *and* observation window facilitated visual communication between the two rooms. The test room had a talkback microphone by which the subjects communicated their response. The equipment was calibrated to ANSI (1969) requirements. Pure-tone and speech calibration

18 (a)

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

AUDIOGRAM

Name : A

Experimental group

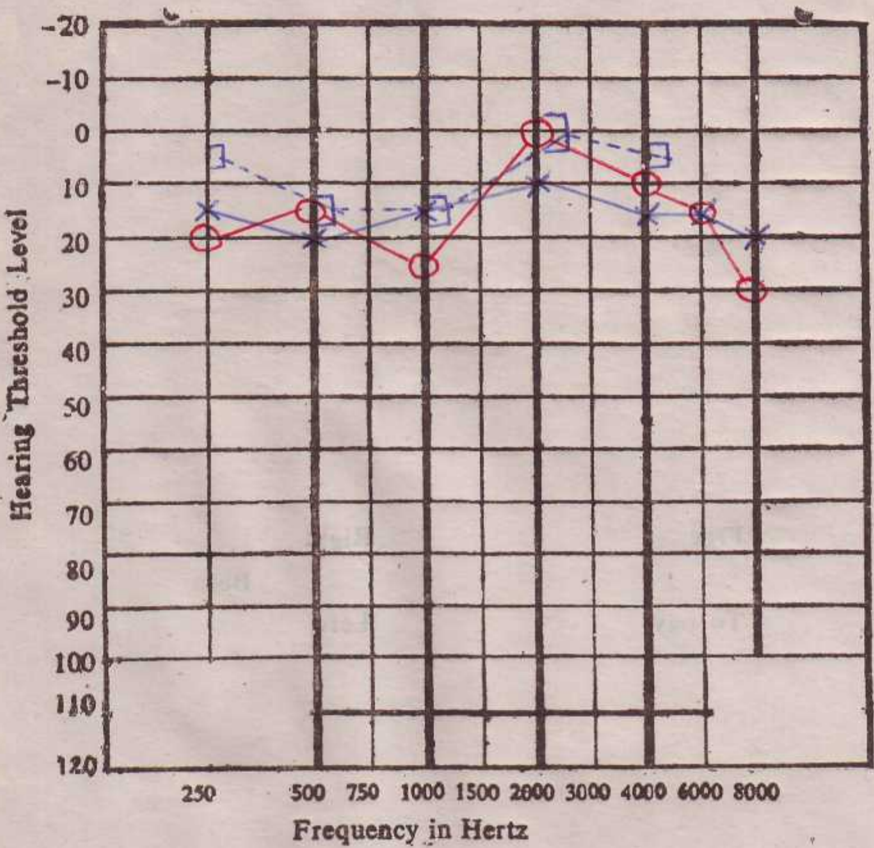
Date :

Case No.

Test No. : 9:10:1980.

Age : 29yrs.

Tested by



AIR CONDUCTION	Rt.	Lt.
Un-masked	○	×
Masked	△	▽
BONE CONDUCTION		
Un-masked	[	]
Masked	⌈	⌉
A. C. not heard	○	×
B. C. not heard	⌈↓	↓⌉

Audiometer used : Beltone 20

Procedure :

Standard/Play Audiometry

	Right	Left	Aid in Ear Rt	Aid in Ear Lt
3 frequency average	15dB	15dB		
S. R. T.	5dB	5dB		
Discrimn. (P. B. Max.)	95 %	90%		

SPECIAL TESTS

	Right Ear				Left Ear			
	500	1000	2000	4000	500	1000	2000	4000
SISI								
ABLB								
STENGER								
Olsen's TDT	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve

18 (8)

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

AUDIOGRAM

Name : B

Experimental group

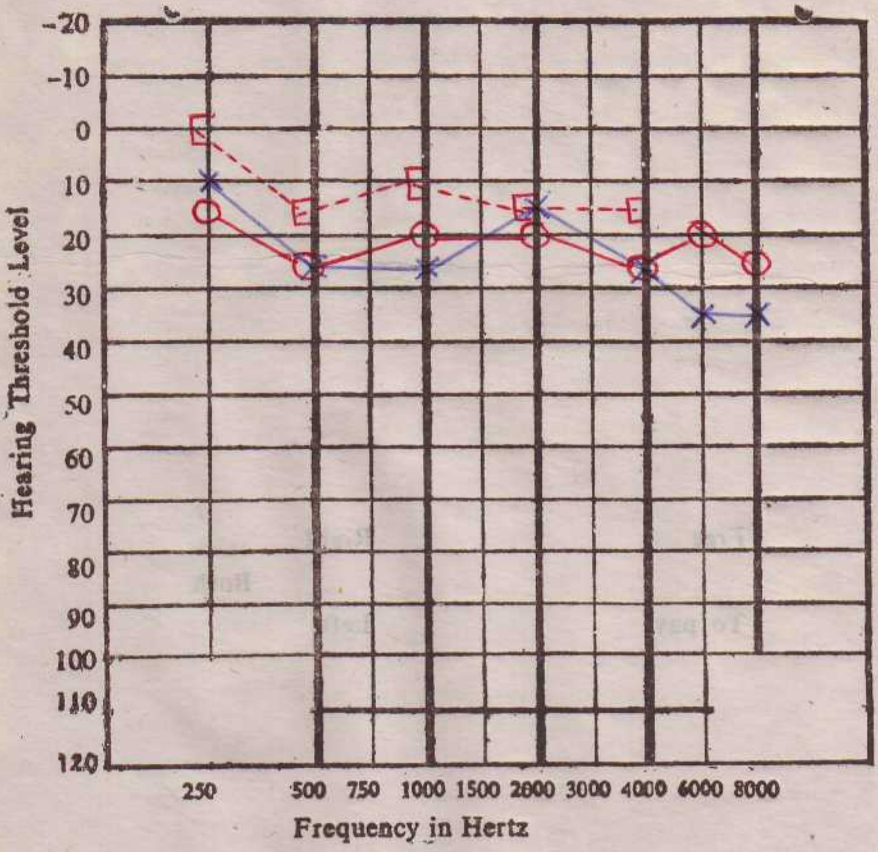
Case No.

Age : 47 yrs

Date : 13.10.1980.

Test No. :

Tested by



	Rt.	Lt.
AIR CONDUCTION		
Un-masked	○	×
Masked	△	▽
BONE CONDUCTION		
Un-masked	[	]
Masked	⌈	⌉
A. C. not heard	○	×
B. C. not heard	⌈↓	↓⌉

Audiometer used : Beltone 200

Procedure :

Standard/Play Audiometry

	Right	Left	Aid in Ear Rt	Aid in Ear Lt
3 frequency average	21.6dB	21.6dB		
S. R. T.	20dB	15dB		
Discrimn. (P. B. Max.)	90%	95%		

SPECIAL TESTS

	Right Ear				Left Ear			
	500	1000	2000	4000	500	1000	2000	4000
SISI								
ABLB								
STENGER								
olsonic TDT	-ve	-ve	-ve	-ve	-ve	-ve	-ve	-ve

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

AUDIOGRAM

Name : C

Experimental group

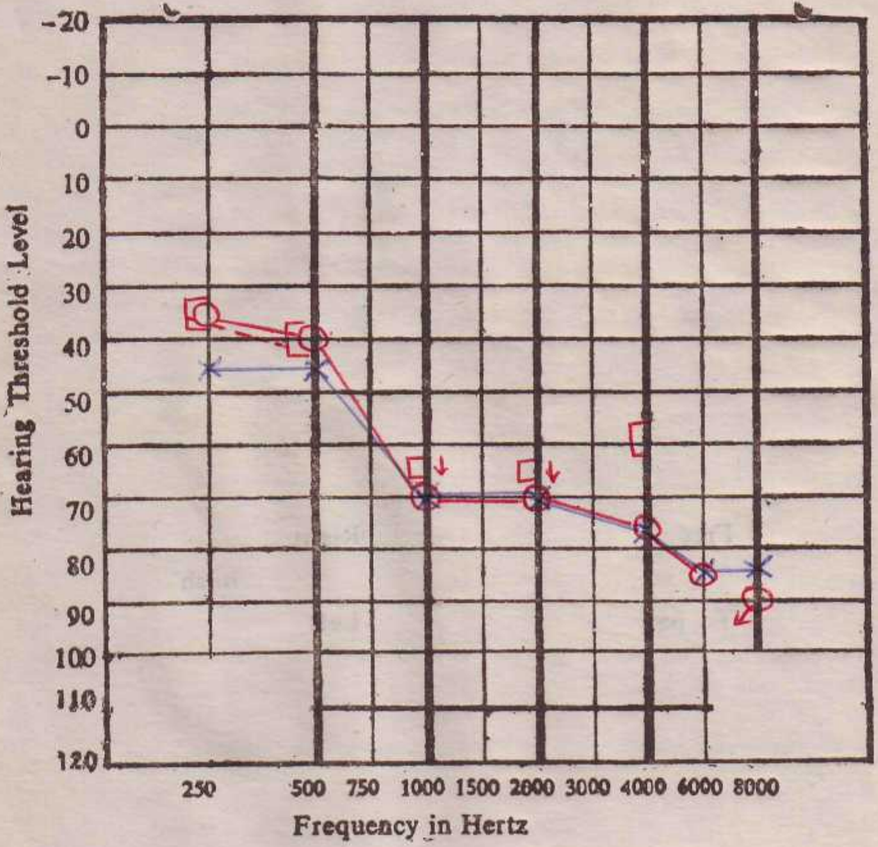
Date : 10 : 10 : 1980

Case No.

Test No. :

Age : 66 yrs

Tested by



AIR CONDUCTION Rt. Lt.

Un-masked ○ ×

Masked △ ▽

BONE CONDUCTION

Un-masked [ ]

Masked

A. C. not heard ○ ×

B. C. not heard

Audiometer used : Beltone 200

Procedure :

Standard/Play Audiometry

	Right	Left	Aid in Ear Rt	Aid in Ear Lt
3 frequency average	60dB	61.6dB		
S. R. T.	50dB	55dB		
Discrimn. (P. B. Max.)	35%	50%		

SPECIAL TESTS

	Right Ear				Left Ear			
	500	1000	2000	4000	500	1000	2000	4000
SISI								
ABLB								
STENGER								
TDT								

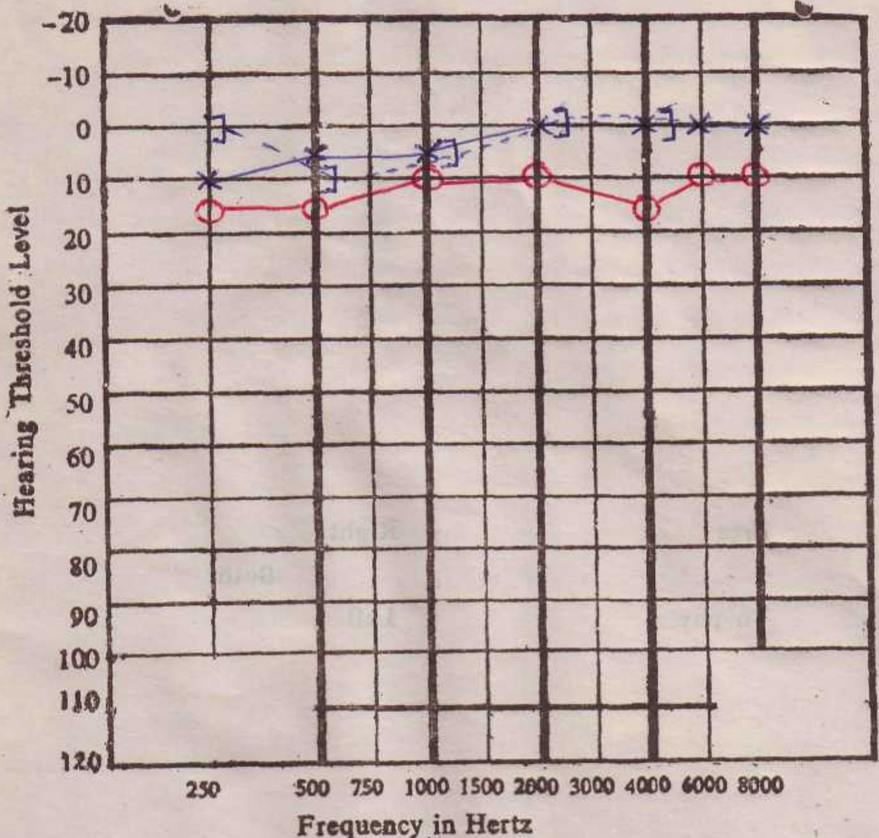
18 (d)

ALL INDIA INSTITUTE OF SPEECH AND HEARING, MYSORE-570 006
AUDIOGRAM

Name : A   control group   Date : 13.11.1980.

Case No   Test No. :

Age : 29 yrs   Tested by



AIR CONDUCTION Rt. Lt.

Un-masked ○ ×

Masked △ ▽

BONE CONDUCTION

Un-masked [ ]

Masked

A. C. not heard ○ ×

B. C. not heard

Audiometer used :

Procedure :

Standard/Play Audiometry

	Right	Left	Aid in Ear Rt	Aid in Ear Lt
3 frequency average	11·6dB	3·33dB		
S. R. T.	5 dB	10 dB		
Discrimn. (P. B. Max.)	100%	100%		

SPECIAL TESTS

	Right Ear 500	Right Ear 1000	Right Ear 2000	Right Ear 4000	Left Ear 500	Left Ear 1000	Left Ear 2000	Left Ear 4000
SISI								
ABLB								
STENGER								
TDT								

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

AUDIOGRAM

Name : B

control group

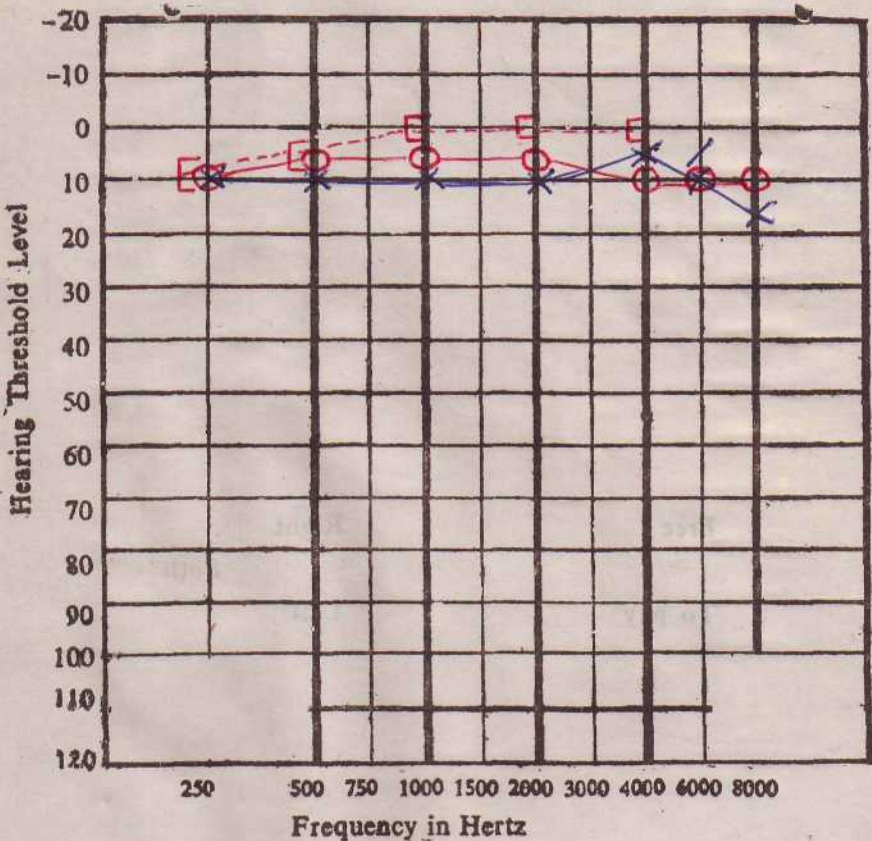
Date : 14. 11. 1980.

Case No

Test No. :

Age : 47 yrs

Tested by



AIR CONDUCTION Rt. Lt.

Un-masked ○ ×

Masked △ ▽

BONE CONDUCTION

Un-masked [ ]

Masked

A. C. not heard ○ ×

B. C. not heard

Audiometer used :

Procedure :

Standard/Play Audiometry

	Right	Left	Aid in Ear Rt	Aid in Ear Lt
3 frequency average	5dB	10dB		
S. R. T.	15dB	10dB		
Discrimn. (P. B. Max.)	100%	95%		

SPECIAL TESTS

	Right Ear 500	Right Ear 1000	Right Ear 2000	Right Ear 4000	Left Ear 500	Left Ear 1000	Left Ear 2000	Left Ear 4000
SISI								
ABLB								
STENGER								
TDT								

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

AUDIOGRAM

control group

Name : C

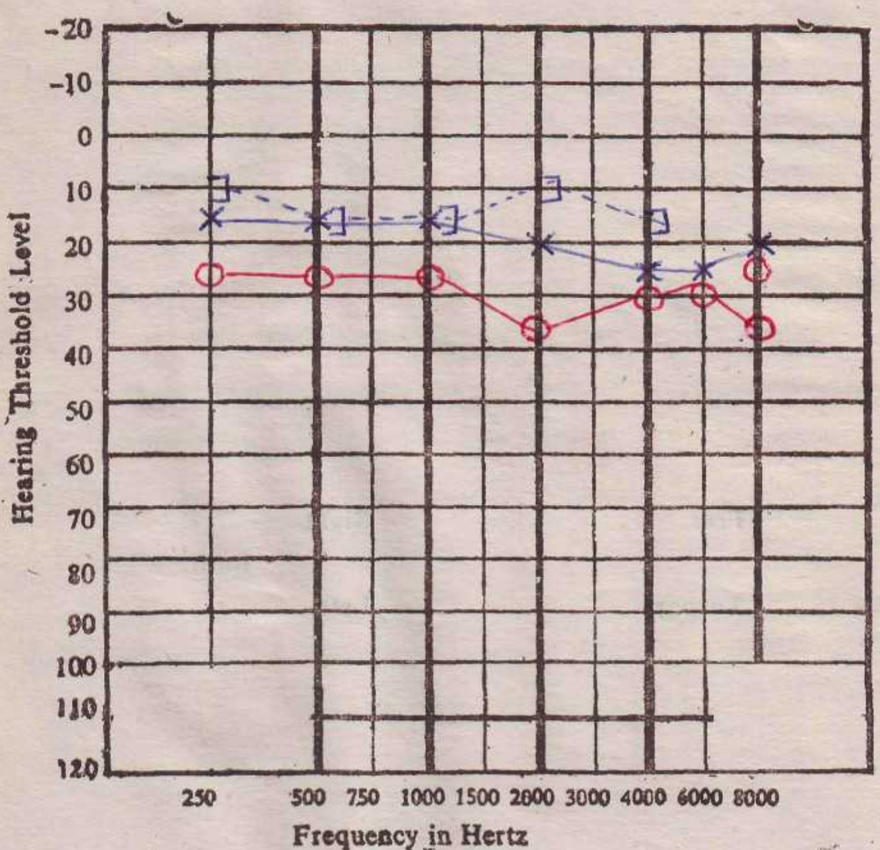
Case No.

Age : 67 yrs.

Date : 14. 11. 1980

Test No. :

Tested by



AIR CONDUCTION Rt. Lt.

Un-masked ○ ×

Masked △ ▽

BONE CONDUCTION

Un-masked [ ]

Masked ⌈ ⌉

A. C. not heard ○ ×

B. C not heard ⌈↓ ↓⌉

Audiometer used :

Procedure :

Standard/Play Audiometry

	Right	Left	Aid in Ear Rt	Aid in Ear Lt
3 frequency average	28.3dB	16.6dB		
S. R. T.	35dB	25dB		
Discrimn. (P. B. Max.)	95%	95%		

SPECIAL TESTS

	Right Ear				Left Ear			
	500	1000	2000	4000	500	1000	2000	4000
SISI								
ABLB								
STENGER								
TDT								

was done as instructed by wilber (1978).

An American Electromedics 86-AR tympanometer -was used to obtain tympanogram, ipsilateral and contralateral reflex thresholds.

TEST PROCEDURE:

All the subjects of both experimental and control group underwent routine otologic examination using zeiss west German Operating Microscope. Pure-tone thresholds were obtained by using Hughson-westlake method, for the following frequencies: 250, 500, 1000, 2000, 4000, 6000 and 8000 Hz (Carhart & Jerger, 1954). Speech reception threshold was determined by using Ventry and Chaiklin (1974) procedure. The Kannada speech reception test material of Mythill (1980) used for this purpose. A11 the subjects were fluent in Kannada language. For speech discrimination measurement, Mayadevi's (1974) common monosyllabic lists were presented 40 dB above speech reception thresholds,

TYMPANOGRAM:

Automatic tympanographs were obtained using American Electromedics - 86 AR tympanometer. A hand probe (tip assembly is fitted with rock ear tips) was gently pressed into the external auditory canal.

The tympanometer is totally automatic, when an air-tight seal of the probe tip is obtained (as indicated by green light) positive air pressure of +200 mm H_2O is achieved and the tympanometer automatically decreases the air pressure in the ear canal cavity while the chart recorder measurement provides with an automatic tympanogram. The probe tip consists of two concentric metal channels. A 220 *Hz* probe tone is emitted into closed ear canal cavity during the test time period.

Physical volume test: (PVT) is a digital readout in cubic centimeters of the cavity size of the external ear, it measures the intactness of the ear drum. The measurement is usually made at +200 mm H_2O (Tyropanometer instruction manual).

REFLEX THRESHOLD MEASUREMENT

(a) Ipsilateral reflex testing: After obtaining tympanograph probe tip was held in same position. The instrument automatically conducted an ipsilateral reflex test at 1000 *Hz*, 105 dB SPL. if the reflex was present, the stylus deflected upward proportional to the amplitude of the reflex. A reflex was considered present if the stylus moved higher than the black mark (0.2) on the reflex scale of the paper.

(b) Contralateral reflex testing: An undergraduate student held the earphone (TDH-39) against the test ear. A built in audiometer of American Electromedics 86-AR was used to obtain oontralateral acoustic reflex threshold. An upward deflection of the needle above the black portion of reflex area was considered as the presence of reflex. Tones were presented two or three tines in order to verify that the movement is due to presentation of the stimulus rather than movement of the patient or clinician.

An undergraduate student held the earphone to one of the ear and probe tip was held by an audiologist and test stimulus was presented by the investigator, thus reflex thresholds were obtained for 500, 1000, 2000, 3000, 400O, 6000 and 8000 Hz. same procedure was repeated for both ears.

CHAPTER IV

RESULTS AND DISCUSSION

The results of this study are shown in Tables 1, 2a, 2b, 3, 4a, 4b, 5a and 5b.

Table 1 shows the bilateral pure-tone average, speech reception threshold and speech discrimination score of both experimental and control group.

As seen in table 1, subject A of experimental group showed pure-tone average of 15 dB, whereas, subject A of control group showed 7.46 dB.

The average speech reception threshold of subject A of experimental group showed 5 dB, whereas, subject A of control group showed 7.5 dB.

The average speech discrimination score of subject A of experimental group showed 92.5%, whereas, subject A of control group showed 100%.

The pure-tone average of subject B of experimental group showed 21.6 dB, whereas, the subject a of control group showed 7.5 dB.

The average speech reception threshold of subject B of

Subjects	PTA		SRT		SB	
	Control	Experi-mental	Control	Experi-mental	Control	Experi-mental
A	7.46	15.00	7.5	5.00	100%	92.5%
B	7.5	21.6	12.5	17.50	37.5%	92.5%
C	21.45	60.80	30.00	52.50	95%	42.5%

Table 1 shows bilateral average performance of control group and experimental group with regard to pure-tone average, speech reception thresholds and speech discrimination score.

Subjects		Shape	Amplitude	Pressure peak
A	Rt	Normal	l.OO	-25
	Lt	Normal	1.00	-10
B	Rt	Normal	1.00	-140
	Lt	Normal	0.90	-100
C	Rt	Normal	1.00	-25
	Lt	Normal	1.00	-15

Table 2a shows the description of tympanogram of right and left ear, i.e., shape, amplitude and pressure peak of experimental group.

Subjects		Shape	Amplitude	Pressure Peak
A	Rt	Normal	O.85	-15
	Lt	Normal	1.00	0
B	Rt	Normal	0.65	-15
	Lt	Normal	0.75	-25
C	Rt	Normal	1.00	-25
	Lt	Normal	1.00	-75

Table **2b** shows description of tympanogram of right and left ear, i.e., shape, amplitude and pressure peak of control group.

Subjects		Control	Experimental
A	Rt	O.20	Absent
	Lt	O.2O	0.20
B	Rt	0.35	0.30
	Lt	0.20	0.20
C	Rt	O.3O	Absent
	Lt	0.45	Absent

Table 3 shows the amplitude of right and left ipsilateral reflex thresholds of both control and experimental groups

Subjects		Frequency in **Hertz**						
		500	100C	2000	3000	4000	6000	8000
A	Rt	110	85	90	95	95	100	80
	Lt	105	95	95	90	110	105	100
	Rt	100	90	85	85	85	90	95
	Lt	100	95	75	85	85	105	Ab
C	Rt	Ab	Ab	Ab	Ab	Ab	Ab	Ab
	Lt	110	1C5	as		Ab	Ab	Ab

Table 4a shows right and left ear centralaterai reflex thresholds of experimental group.

Hote: Ab - Absent

Subjects		Frequency in Herts						
		500	1000	2000	3000	4000	6000	8000
A	Rt	95	95	90	85	95	95	80
	Lt	90	80	85	85	90	85	80
B	Rt	100	105	90	110	Ab	Ab	Ab
	Lt	90	95	90	90	95	95	95
C	Rt	105	100	110	110	Ab	Ab	Ab
	Lt	95	90	100	105	Ab	Ab	Ab

Table 4b shows right and left ear centralateral reflex thresholds of control group.

Note: Ab - Absent

Subjects		Frequency in Hertz					
		500	1ooo	2OOO	4OOO	6000	8000
A	Rt	95	60	90	85	85	SO
	Lt	85	80	85	95	90	80
	Rt	75	70	65	60	70	7O
	Lt	75	70	60	60	70	
c	*Rt*	-	-	-	-		- -
	Lt	65	35	-	-	- -	

Table*i* 5a shows the difference between acoustic reflex threshold and pure-tone threshold at different frequencies of experimental group.

Subjects		Frequency in Hertz					
		500	1000	2000	4000	6000	8000
A	Rt	85	85	80	80	85	70
	Lt	85	75	85	90	85	80
B	Rt	95	100	85	-	-	-
	Lt	80	85	80	90	85	70
C	Rt	80	75	75	-	-	-
	Lt	80	75	80	-	-	-

Tables 5b shows the difference between the acoustic reflex threshold and pure-tone threshold at different frequencies of control group.

experimental group showed 17.5 dB, whereas, the subject B of control group showed 12.5%.

.

The average speech discrimination score of subject B of experimental group showed 92.5%, whereas, the subjects/of B control group showed 97.5%.

The average pure-tone average of subject c of experiments group showed 60.8 dB, whereas, the subject C of control group **showed 21.45dB.**

The average speech reception threshold of subject c of experimental group showed 52.5 do, whereas, subject C of control group showed 30dB.

The average speech discrimination score of subject C of experimental group showed 42.5%, whereas, the subject C of control group c showed 95%.

The table 2a and 2b gives the description of tympanogram of right and left ear with regard to shape, amplitude and pressure peak of experimental group and control group respectively.

The shape of both ears tympanogram of the subject A of both experimental and control group were normal.

The amplitude of the right ear tympanogram of the subject

A of experimental group was more than 1.00 on compliance scale left ear being more than 1.00 whereas the right ear tympanogram of the subject A of control group 0.85 on compliance scale and left ear being more than 1.00.

The pressure peak of right ear tympanogram of subject A of experimental group was -25 mm H_20 and left ear being -10 mm H_20, whereas, right ear tympanoyram of subject A of control group was -15 mm H_20 and left ear being 0 mm H_2O.

The shape of both ears tympanogram of the subject of B of experimental and control group were normal.

The amplitude of the right ear tympanogram of subject B of experimental group was more than 1.00 on compliance scale, left ear being 0.9, whereas, the right ear tyrapanogram of the subject B of control group was 0.65 on compliance scale and left ear being 0.75.

The pressure peak of the right ear tympanogram of the subject B. of experimental group was -140 mm H_20 and left ear being -100 mm H_2O whereas, right ear tympanogram of the subject B of control group was -15 mm H_2o and left ear being -25 mm H_2o

The shape of the both ears tympanogram of the subject C of experimental and control group were normal. .

The amplitude of right ear and left ear tyrnpanogram of the subject c of both experimental and control group were more

than 1.00.

The pressure peak of right ear tympanogram of subject C of experimental group was -25 mm H_2O and left ear being -15 mm H_2O, whereas, right ear tympanogram of subject C of control group was -25 mm H_2O and left ear being -75 mm H_2O.

Table 3 shows amplitude of right and left ears ipsilateral reflex thresholds (for 1 KHz at 105 dB SPL) of both control and experimental group.

As seen in table 3, subject A of experimental group did not exhibit reflex in right ear and in left ear with an amplitude of o.2, whereas , the subject of A of control group obtained reflex similar amplitude of 0.2 in both ears.

In the subject B of experimental group the amplitude of reflex in right ear were 0.3 and in left ear 0.2, whereas, in the subject B of control group the amplitude of reflex in right ear was 0.35 and in left ear 0.20.

In the subject c of experimenal group the amplitude of reflex were absent in both ears whereas in the subject C of control group, the amplitude of reflex in right ear was O.3O

and in left ear 0.45.

Table 4a and 4b shows right and left ear centralateral reflex thresholds of both experimental and control group

respectively.

In right ear at 500 Hz of experimental group- of subject A the contralateral reflex was obtained at 110 dB and in left ear at 105dB, whereas in right ear of control group, of subject A contralateral reflex obtained at 95 dB and in left ear

90 dB.

In right ear at 1000 *Hz* of experimental group of subject A the contralateral reflex was obtained at 85 dB and in left ear 95 dB, whereas, in right ear of control group of subject A contralateral reflex «as obtained at 95 dB and in left ear 80 dB.

In right ear at 2000 Hz, of experimental group the subject A the contralateral reflex was obtained at 90 dB and in left ear 95 dB, whereas, in right ear of control group of the subject A the ccntrslateral reflex was obtained at 90 da and in left ear 85 dB.

In right ear at 3000 Hz of experimental group the subject A the contralateral reflex was obtained at 95 dB and in left ear 90 dB, whereas in right ear of control group of subject A the contralateral reflex was obtained at 85 dB and in left ear 85 dB.

In the right ear at 4000 the of experimental group of subject A the contralateral reflex was obtained at 95 dB and in left ear 110 dB, whereas in right ear of control group of subject A the contralateral reflex *was* obtained at 95 dB and

in left ear 90 dB.

In the right ear at 6000 Hz of experimental group of subject A the contralateral reflex was obtained at 100 dB and in left ear 105 dB, whereas, in right ear of control group of subject A the contralateral reflex was obtained at 35dB and in left ear 85 dB.

In the right ear at 8000 Hz of experimental group of subject A the centralsteral reflex was obtained at 80 dB and in left ear 100 dB, whereas, in right ear of control group of subject A the contralateral reflex was obtained at 80 dB and in left ear 80 dB.

In the right ear at 500 Hz of experimental group of subject B the contralateral reflex was obtained at 100 dB and in left ear 100 dB, whereas, in right ear of control group of subject B the contralateral reflex was obtained at 1OO dB *and* in left ear 90 dB.

In the riqht ear at 1000 Hz of experimental group of subject B the contralateral reflex was obtained at 90 dB and in left ear 95 dB, whereas, in right ear of control group of subject B the contralateral reflex was obtained at 105 dB

and in left ear 95dB.

In the right ear at 2000 Hz of experimental group of subject B the contralateral reflex was obtained at 85 dB and in left ear 75 dB, whereas, in right ear of control group of subject 3 the contralateral reflex was obtained at 90 dB and in left ear 90 dB.

In the right ear at 3000 Hz of experimental group of subject B the contralateral reflex was obtained at 85 dB and in left ear 85 dB, whereas, in right ear of control group of subject B the contralateral reflex was obtained at 110 dB and in left ear 90 dB. -

In right ear at 4000 Hz of experimental group of subject B the contralateral reflex was obtained at 85 dB and in left ear 85 dB, whereas, in right ear of control group of subject B the eontralateral reflex was absent and in left ear

95 dB.

In the right ear at 6000 Hz of experimental group of subject B the contralateral reflex was obtained at 90 dB and in left ear 105 dB, whereas, in right ear of control group of subject B the contralateralreflex was absent and in left ear

95 dB.

In right ear at 8OOO Hz of experimental group of subject *B* the contralateral reflex was obtained at 95 dB and in left ear reflex was absent, whereas, in right ear of control group of subject B the contralateral reflex was absent and in left ear 95 dB.

In right ear for the frequencies of .500, 1000, 2000, 3000, 4000, 6000, 8000 Hz of experimental group of subject C the contralateral reflex was absent and in left ear for the frequencies of 500 and 1000 Hz contraleteral reflexes were 110 and 1O5 dB respectively. In control group of subject C of both right and left ear contralateral reflexes were obtained at 500, 1000, 2000 and 3000 Hz. For the frequencies of 4000, 6000 and 8000 Hz reflexes were absent.

Table 5a and 5b shows the difference between acoustic reflex threshold and pure-tone threshold at different frequencies of experimental and control group respectively.

Pure-tone audiometry

The experimental group consistently showed elevated pure-tone average compared to control group. The pure-tone average was elevated maximally in one of the subjects of experimental group.

Speech audiometry

In two of the three subjects of experimental group showed higher speech reception threshold than control group. Only one subject of control group had higher speech reception threshold with regard to corresponding subject in the experimental group.

All the subjects of experimental group revealed lower speech discrimination score compared to control group.

As a Whole, the experintental group showed poorer performance on both pure-tone audiometry and speech audiometry compared to control group. This has also been supported by the findings of Peiter et al (1980), who concludes that subjects with rheumatoid arthritis had a higher incidence of hearing impairment.

with respect to the shape of the tympanograms of both experimental and control group had normal shape.

In case of tympanogram amplitude, all most all the subjects of experimental group showed greater than 1.00 CC, whereas, in the control group 50% of the ears (three ears) had the amplitude of greater than 1.00 CC. Based on this it can be said that rheumatoid arthritis subjects have more complaint in middle ear than the control group. This has been supported by the findings of Moffat et al (1977). His findings shows that patients with rheumatoid arthritis exhibited characteristic of "loosening pathologies". This was presumably due to an increase in flaccidity of a clinically normal tympanic membrane. This also suggests a decrease in the stiffness of the transducer mechanism in rheumatoid arthritis. However, the findings of Reiter et al (1980) indicate that pathological stiffening occurs in rheumatoid arthritis.

Data of experimental group, pressure peak was variable to compare with control group. Exceptionally one of the subjects of experimental group showed negative pressure peak at -140 mm H_2O (right ear) and -100 mm H_2O (left ear) and corresponding subject of control group showed -15 mm H_20 (right ear) and -25 mm H_2O (left ear).

Ipsilateral reflex measurement were made at only 1 KHz of 105 <3B SPL isrere presented in all subjects of control group but whereas reflexes were obtained in only S0?i of ears (3 ears)

of experimental group.

Contralateral reflex threshold of experimental group showed variable data to compare with control group. However it is quite evident that one of the subject of experimental group did not exhibit reflex in right ear with regard to corresponding to the subject of control group.

CHAPTER V

SUMMARY AND CONCLUSION

Three rheumatoid arthritis subjects were served as experimental group and three normal hearing subjects who did not have rheumatoid arthritis *were* taken as control group. Both the groups were tested otologicaily and audiology.

The findings of this investigation reveals that there is poor performance on pure-tone audiometry for rheumatoid arthritis group compared to normals.

Impedance audiometry reveals that rheumatoid arthritis subjects had a more complaint middle ear.

Reflexometry findings lend support to view that higher incidence of hearing loss in rheumatoid arthritis subjects.

BIBLIOGRAPHY

Carhart, R: Problems in the measuresnt of speech discrimination. Arch Otolaryngol. 90, 253-259, 1965

Carhart, R and Jerger J.F: Preferred method for clinical determination of puretone thresholds IN Ira M. Ventry and others (ed.) Hearing Measurement. Newyork, Appleton-Century-Crafts, 1971, 96-108

Ethora, B. and Belal, A: Senile changes in the middle ear Ann. Otol. Rhlnol. Larynqol. 83, 49-54, 1974

FaH, A.E: The care of rheumatoid hand. California, The C.V. Mosby company, 1968

Feldman, A.S. and wilber, L.AJ Acoustic Impedance and Admittance. The measurement of middle ear function. Baltimore, Williams and Williams Co., 1976

Grokoest, A.W: Juvenile rheumatoid Arthritis. Boston, Little brown company, 1962

Gussen, R: *A* typical ossicle joint lesions in rheumatoid arthritis with Sicca syndrome (Sojogren syndrome). .Arch otolaryngol. 103, 284-286, 1977

Liclitenstein, L: Diseases of bone and joints, California, - The *C.V.* Mosby company, 1970 .

Martin, P.N: Introduction of Audiology, New Jersy: Prentice Hall, inc. 1975

Mayadevi, M: "The development and standardization of a commonn speech discrimination test for Indians" Unpublished Master's Dissertation, University of Mysore, 1974

Moffat, D.A and others: Otoadmittance measurements in patients with rheumatoid arthritis. J. Laryngol Otol. 91, 917-927, 1977

Reiter, D and others: Middle ear immitance in rheumatoid arthritis. Arch, otolaryngol. 106, 114-116, 1980