To the Graduate Council:

I am submitting herewith a thesis written by Malcolm Hugh Light, II entitled "The Effects of Diazepam and Meperidine Hydrochloride on the Impedance Test Battery." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Audiology.

Charles J. Ferrell

Charles J. Ferrell, Major Professor

We have read this thesis and recommend its acceptance:

Carl W. Cox

David M. Lipscomb

R K Smalley

Accepted for the Council:

Hilton A. Smith

Vice Chancellor
Graduate Studies and Research

THE EFFECTS OF DIAZEPAM AND MEPERIDINE HYDROCHLORIDE ON THE IMPEDANCE TEST BATTERY

A Thesis

Presented for the

Master of Arts

Degree

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Malcolm H. Light, II

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M.H.L.

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CHAPTER I

PURPOSE OF THE STUDY

The purpose of this study was to determine the effect of sedation, as measured on human ears free from middle ear pathologies, on the impedance test battery.

The question under test was:

Is there a statistically significant difference between the impedance test results as measured with and without sedation, for human ears free from middle ear pathologies?

I. IMPORTANCE OF THE STUDY

Audiologists and otolaryngologists occasionally are unable to determine hearing sensitivity of patients, through standard audiometric procedures. Problems often occur because of physical handicaps, mental limitations, immaturity and/or an unwillingness of the patient to respond to pure tone audiometry. This study was undertaken to provide information regarding the applicability of using the impedance test battery during sedation, on children who are difficult to test by any other method.

Jerger, Burney, Mauldin and Crump (1973) have suggested a method for estimating both degree and slope of sensori-neural hearing loss, by comparing stapedial reflex thresholds for pure tones, broad band (white) noise, low-pass filtered noise and high-pass filtered noise. This procedure is described as the Differential Loudness Summation Test (DLST). This test along with tympanometry and static compliance measures, can provide valuable information concerning the mobility of the tympanic

membrane, functional condition of the middle ear system and the sensitivity of the hearing mechanism.

Early identification of children with hearing loss is essential for successful habilitation or rehabilitation. Impedance audiometry has proven to be of substantial benefit when evaluating the hearing sensitivity of children (Northern and Downs, 1974). The selection of appropriate educational programs, determining a need for amplification and/or medical treatment is dependent upon the accurate assessment of the hearing sensitivity of the auditory mechanism. However, difficulty is often encountered when trying to test some young children using conventional audiometric procedures. Difficulty may also arise in getting the child to cooperate for routine impedance testing. The use of the impedance test battery, performed while the patient is under sedation, may be of invaluable help in determining the function of the auditory mechanism in difficult to test children. However, it is not appropriate to recommend using sedation unless it is determined to what extent specific sedation alters responses to one or more elements of the impedance test battery. Also, this would not be recommended for the average child. The use of sedation during impedance testing is a method to be used as a last resort. Most children will respond to routine audiometric procedures.

II. DEFINITION OF TERMS

The following terms were defined to clarify their usage in the present study:

Diazepam (Valium). Valium, which is a brand name, acts on parts

of the limbic system, the thalamus and hypothalamus, and induces calming effects. Diazepam is useful in the symptomatic relief of tension and anxiety states resulting from stressful circumstances (Hoffman-LaRoche, Inc., Nutley, N.J. 07110, 1974).

Differential Loudness Summation Test (DLST). This test, devised by Jerger, et al., (1973), compares reflex thresholds for pure tones of 500, 1,000 and 2,000 Hz, broad band (white) noise, low-pass filtered noise and high-pass filtered noise in such a manner as to give an estimate of both degree and slope of sensori-neural hearing loss.

Fiber-Optic Endoscopy. Fiber-optic endoscopy is a method of observing and photographing the esophagus, stomach and duodenum by means of inserting a flexible tube, made of fiber-optic material, down the esophagus and into the gastrointestinal region. The patients in this study are sedated with Diazepam and Meperidine Hydrochloride immediately prior to this examination.

High-Pass Filtered Noise. High-pass filtered noise is broad-band (white) noise passed through an electronic filter with a cut-off frequency of 2,600 Hz and a slope of 24 dB per octave toward the lower frequencies.

Impedance Test Battery. The impedance test battery consists of (1) tympanometry, (2) static compliance and (3) a Differential Loudness Summation Test.

Low-Pass Filtered Noise. Low-pass filtered noise is broad - band (white) noise passed through an electronic filter with a cut-off frequency of 2,600 Hz and a slope of 24 dB per octave toward the higher frequencies.

Meperidine Hydrochloride (Demerol). Demerol, which is a brand name, is a narcotic analgesic with actions similar to those of morphine, the most prominent of these involve the central nervous system. The principle actions of therapeutic value are analgesia and sedation (Winthrop Laboratories, Inc., New York, N.Y. 10016, 1974).

Stapedial Reflex. The Stapedial reflex is the reflex response of the stapedius muscle, attached to the neck of the stapes, to an intense sound stimulus. The action of the stapedius muscle is to pivot the footplate of the stapes ventrolaterally from the oval window, increasing tension on the middle ear mechanism. This reflex occurs bilaterally upon stimulation by an intense sound of either ear.

Stapedial Reflex Threshold. The stapedial reflex threshold is defined as the intensity (in dB above the threshold of hearing in the stimulated ear) which is just capable of inducing a reflex contraction of the stapedius muscle, as evidenced by a change in the impedance of the tympanic membrane (Jepsen, 1963).

Static Compliance. Static compliance, taken during the natural resting state and during a condition of poor tonus, is a measurement for the overall mobility of the tympanic membrane and middle ear. It is historically known as "absolute impedance." (Northern, 1974)

Tympanometry. Tympanometry is an objective method of evaluating the functional condition of the middle ear by measuring the impedance changes at the tympanic membrane while varying air pressure within the external auditory meatus. Tympanometry has also been termed "dynamic compliance." (American Electromedics, 1974)

White Noise. White noise contains a broad band of frequencies

at intervals of 1 Hz or less, all at approximately the same intensity. The frequency range covered, exceeds 20 Hz to 20 K Hz.

CHAPTER II

PROCEDURES

I. SUBJECTS

Each of the fifteen subjects of this study were obtained by referral of R. L. Hargrove, M.D., Gastroenterologist. The criteria for subject selection were as follows:

All subjects were free from middle ear pathologies as determined by normal tympanograms, and responded to all portions of the impedance test battery.

II. EQUIPMENT USED

All testing and calibration was performed by the author. An American Electromedics Impedance Audiometer, Model 83, was used for all impedance testing. The pure tone section of the impedance audiometer was calibrated according to American National Standard Specifications for Audiometers (ANSI S3.6 - 1969), using a Bruel and Kjaer Model 159 Audiometer Calibrator. The white noise, low-pass filtered noise and high-pass filtered noise were calibrated using a Bruel and Kjaer Type 2113 Frequency Spectrometer. An American Electromedics Tympanograph Recorder, Model 612, was used for recording of tympanograms. For the purpose of Differential Loudness Summation testing, a biological calibration was conducted as described by Jerger, et al., (1973). Three calibration checks were performed: before the first subject was tested, after the seventh subject was tested and following the testing of the fifteenth subject. The stimuli were delivered

through a TDH-39 earphone encased in a MX/41-AR cushion.

III. METHOD

All testing was conducted at St. Mary's Hospital, Knoxville, Tennessee. The subjects were admitted to the hospital for the purpose of fiber-optic endoscopy studies by Dr. Hargrove. A written consent was required of each subject before testing.

Each subject was tested under two conditions. The first series of tests were conducted in the patient's room prior to the fiber-optic studies and sedation. The second series was administered immediately following Dr. Hargrove's examination, approximately 20 minutes following sedation. Diazepam and Meperidine Hydrochloride were administered intravenously by a nurse to accomplish sedation. One hundred mg. of Meperidine Hydrochloride and 15 mg. of Diazepam were the initial dosages. Supplementary dosages of 15 mg. Meperidine Hydrochloride and 5 mg. Diazepam were used on four patients who did not respond as readily to the initial injection.

For the purpose of this study, the author arbitrarily chose the right ear as the test ear. The impedance test battery was performed on each subject for each of the two conditions. The procedures for administering the tests were as follows:

(1) Tympanometry:

Because of the nature of impedance testing, tympanograms were recorded bilaterally. This was essential to insure normal middle ear function. If there is a pathology of either middle ear, the stapedial reflex may not be detected by the monitoring equipment. Tympanometry of the

right ear was performed to insure proper middle ear function by obtaining a hermetic seal of the probe tip in the external auditory meatus of the right ear. Positive air pressure (+200 mm H_2O) was introduced into the external auditory meatus of the right ear. The compliance change meter needle was then adjusted to zero and the air pressure was gradually reduced to a negative air pressure of -200 mm H_2O. During the decrease of air pressure, the compliance measurement was traced by the Tympanograph Recorder. The air pressure was then returned to a positive air pressure of +200 mm H_2O where the second measurement, static compliance, was to be made.

(2) Static Compliance:

Static compliance measures were made in equivalent volume of cubic centimeters. Two volume measurements were made. The first volume measurement (C_1) was made with the tympanic membrane in a tonus of poor compliance, wherein it is forced medialward by the air pressure introduced earlier (+200 mm H_2O). The intensity knob of the impedance audiometer was adjusted until the needle of the compliance change meter pointed to balance. The figure indicated by the sliding cursor scale (in c.c. of equivalent volume) was recorded as C_1. The second volume measurement (C_2) was made with the tympanic membrane at the point of maximum compliance, which can be determined by examining the tympanogram and adjusting the air pressure accordingly. The intensity knob was again adjusted until the needle of the compliance change meter pointed to balance. The figure indicated by the sliding cursor scale was recorded as C_2. The calculation for static compliance of the ear was obtained by subtracting C_1 from C_2. This leaves a value of compliance

or mobility of the middle ear mechanisim in c.c. of equivalent volume. (Appendix A)

The probe tip was removed from the right ear and placed in the left ear acquiring a hermetic seal. The earphone was placed on the right ear in order to deliver the reflex stimulus. A tympanogram of the left ear, using the method described above, was essential to insure normal middle ear function. At this point the next test was obtained.

(3) Differential Loudness Summation Test (DLST):

With the headphone on the right ear and the probe tip still sealed in the left external auditory meatus, acoustic reflex thresholds were obtained. Air pressure in the external canal was adjusted to the tympanic membrane's point of maximum compliance. The needle of the compliance change meter was adjusted to the balance mark in order to observe needle deflections more easily. Acoustic reflex thresholds were established by increasing the intensity of the stimulus, which was directed to the test ear (right ear), until the reflex was observed to produce a deflection of the compliance change meter needle. The compliance change meter was marked of in ten c.c. of equivalent volume, with quarter and half c.c. indicated. The author's criteria for acceptance of a reflex was a deflection of one-half c.c. Once threshold was determined, the intensity level was increased by 5 dB to insure that the reflex was present. The reflex contractions were much stronger at the increased intensity level.

Acoustic reflex thresholds were obtained for pure tones (500,

1,000 and 2,000 Hz), white noise, low-pass filtered noise and high-pass filtered noise. The calculations required to determine the degree of sensori-neural hearing loss, by the method of DLST, are:

1) Because the pure tones were calibrated to hearing threshold level (HTL) and the white noise calibrated to sound pressure level (SPL), the pure tones must be converted to sound pressure levels in order to calculate the degree of sensori-neural hearing loss. To convert HTL to SPL, add 11.5 dB to 500 Hz, 7 dB to 1,000 Hz and 9 dB to 2,000 Hz. These sums are then averaged.

2) The white noise acoustic reflex threshold is then subtracted from the averaged pure tone reflex thresholds.

3) A correction factor of 15 dB, as determined by the biological calibration, was added to the pure tone threshold minus the white noise threshold value. This value expresses the degree of sensori-neural hearing loss. The basis used to predict degree of hearing loss according to Jerger, et al., (1973), was a combination of (1) the difference between reflex thresholds for pure tones and white noise and (2) the absolute SPL of the reflex threshold for white noise. The basic concepts are that decreasing the difference between the reflex thresholds for pure tones and white noise means an increase in hearing loss and increasing white noise SPL means an increase in hearing loss. Therefore, both measures must be taken into account. The actual combinations of predictive criteria are shown in Table I.

Jerger, et al., (1973) categorized audiograms according to the predictive criteria and are outlined in Table II.

TABLE I

CRITERIA FOR PREDICTION OF HEARING LOSS

Difference	White Noise SPL	Prediction
20 or Larger	Anywhere	Normal
15 - 19	80 dB or Less	Normal
15 - 19	81 dB or More	Mild to Moderate
10 - 14	Anywhere	Mild to Moderate
Less Than 10	89 dB or Less	Mild to Moderate
Less Than 10	90 dB or More	Severe
Reflexes Not Observed		Profound

TABLE II

CRITERIA FOR CATEGORIZING AUDIOGRAMS ACCORDING TO PURE TONE AVERAGE (PTA)

Category	Criteria
Normal	PTA Less Than 20 dB Hearing Loss
Mild to Moderate	PTA 20 to 49 dB Hearing Loss (Inclusive)
Severe	PTA 50 to 84 dB Hearing Loss (Inclusive)
Profound	PTA 85 dB Hearing Loss or More

To determine the slope of hearing impairment, the reflex threshold for high-pass filtered noise is subtracted from the low-pass filtered noise threshold. The ranges for slope of loss are: -20 dB to -5 dB -- steep; -5 dB to 0 dB -- gradual; 0 dB to 20 dB -- flat. The forms used for reporting both degree and slope of hearing loss are shown in Appendix B. An example for calculating static compliance, degree of sensori-neural hearing impairment and slope of hearing impairment is shown in Appendix C.

CHAPTER III

RESULTS AND DISCUSSION

Data analysis procedures were computed to answer the following question:

Is there a statistically significant difference between the impedance test results as measured with and without sedation for human ears free from middle ear pathologies?

These data were subjected to a t-test for related measures and the Pearson Product-Moment Correlation, "r" (Spence, Underwood, Duncan and Cotton, 1968).

The data analyzed in the present study was obtained from fifteen subjects. It was hypothesized that there would be no significant difference in impedance test results with or without sedation. An alpha level of .05 was selected for rejection or non-rejection of the question under test.

The results obtained from a computation of the data will be discussed in the following order: 1) Tympanometry, 2) Static Compliance and 3) Differential Loudness Summation Test.

I. TYMPANOMETRY

Data from the tympanograms were obtained by observing the maximum needle deflection of the compliance change meter and are displayed in Table III.

In order to ascertain the difference between the sedated and non-sedated conditions, the t-test for related measures was computed

TABLE III

COMPLIANCE DATA OBTAINED FROM THE COMPLIANCE CHANGE METER IN EQUIVALENT VOLUME OF CUBIC CENTIMETERS

Subject No.	Compliance in C.C. Non-Sedated	Sedated
1	7.50	8.00
2	6.50	6.50
3	9.75	9.75
4	9.00	9.25
5	5.00	5.25
6	7.75	7.75
7	7.25	7.25
8	5.50	5.50
9	7.25	7.00
10	5.75	5.50
11	9.75	9.75
12	6.25	6.00
13	7.75	7.50
14	5.75	5.00
15	9.25	9.25
Mean	7.33	7.28
Standard Deviation	1.51	1.27

for degree of compliance. The test yielded a "t" value of 0.67, which is not statistically significant at the .05 alpha level (2.15 for 14 df). The Pearson Product Moment Correlation "r" computed for degree of compliance, yielded an "r" of 0.98, which is a significant correlation coefficient at the .05 alpha level (.50 for 13 df).

A visual inspection of the tympanograms confirmed that each tympanogram was normal and fit Jerger's (1973) classification of a "type A" tympanogram, with the exception of subject number nine. This subject's non-sedated tympanogram had a peak of -50 mm H_2O pressure at the right ear. The tympanogram obtained during sedation had a peak of -60 mm H_2O pressure. On the basis of the original tympanogram, subject number nine was included in the study. Because subject number nine was on the borderline for normals, even a slight negative variation (-10 mm H_2O pressure, in this case) would classify the subject as not being within normal limits. The point of maximum compliance as related to air pressure variability, can vary normally by plus or minus 50 mm H_2O pressure. The sleeping states of the subjects, induced by sedation, may produce varied breathing patterns (snoring in the case of four subjects) which can slightly alter the point of maximum air pressure compliance during tympanometry.

The results of this analysis indicate considerable reliability for the use of Diazepam and Meperidine Hydrochloride for performing tympanometry during sedation. This finding was consistent with that of Robinette, et al., 1974.

II. STATIC COMPLIANCE

The data for static compliance is shown in Table IV. The t-test for related measures was computed for static compliance and yielded a "t" value of 0.07, which is not statistically significant at the .05 alpha level (2.15 for 14 df). The Pearson "r" was computed for static compliance and yielded a score of 0.92 which correlates significantly at the .05 alpha level (.50 for 13 df).

These results indicate that the presence of Diazepam and Meperidine Hydrochloride does not affect the results of static compliance measurements.

TABLE IV

DATA OBTAINED FROM STATIC COMPLIANCE MEASUREMENTS IN CUBIC CENTIMETERS

Subject No.	Static Compliance in C.C. Non-Sedated	Sedated
1	0.65	0.57
2	0.50	0.50
3	0.70	0.70
4	0.42	0.45
5	0.30	0.28
6	0.45	0.50
7	0.40	0.45
8	0.35	0.35
9	0.85	0.75
10	0.45	0.65
11	0.33	0.30
12	0.95	0.85
13	1.05	1.20
14	0.35	0.37
15	1.00	0.80
Mean	0.58	0.58
Standard Deviation	0.50	0.80

III. DIFFERENTIAL LOUDNESS SUMMATION TEST

The data for stapedial reflex thresholds for pure tones (Table V), white noise (Table VI), low-pass filtered noise and high-pass filtered noise (Table VII) was statistically analyzed. The t-test for related measures was computed for both degree and slope of sensori-neural hearing impairment. The degree of loss yielded a "t" value of 1.83, which is not statistically significant at the .05 alpha level. A "t" value of 0.43 was calculated for the slope of loss, which also is not statistically significant at the .05 alpha level.

The Pearson "r" was 0.92 for degree of loss and 0.92 for slope of loss. Both of these are significant correlation coefficients at the .05 alpha level.

These results indicate that the effects of sedation with Diazepam and Meperidine Hydrochloride do not significantly alter the results derived through the Differential Loudness Summation Test. Table VIII displays the computed values for both the t-test and Pearson's "r" for tympanograms, static compliance and the Differential Loudness summation Test.

IV. RELIABILITY

In order to ascertain the author's consistency in administering the impedance test battery, the following procedures were used. Three of the fifteen subjects used in this study were available for a third series of tests on the day following the sedated tests. No drugs had been administered to the subjects for at least eight hours prior to re-testing. The procedures utilized were identical to those of the initial test conditions described in Chapter II.

TABLE V

STAPEDIAL REFLEX THRESHOLDS FOR PURE TONES
IN HEARING THRESHOLD LEVEL

Subject No.	Stapedial Reflex Thresholds .5k Hz X	.5k Hz Y	1k Hz X	1k Hz Y	2k Hz X	2k Hz Y
1	85	85	85	80	85	80
2	90	90	90	90	90	90
3	80	80	80	80	80	80
4	95	95	95	90	95	95
5	85	85	85	85	90	85
6	95	100	90	90	90	90
7	85	80	85	80	85	80
8	115	115	115	115	110	115
9	85	85	85	85	85	85
10	100	100	95	95	100	100
11	90	90	90	90	85	85
12	95	95	90	90	85	85
13	80	80	90	90	90	90
14	90	90	85	85	85	85
15	100	100	85	85	90	90
Mean	91.33	91.33	89.66	88.66	89.66	89.00
S.D.	8.84	9.39	7.84	8.26	7.18	8.79

Key: X = Non-Sedated
Y = Sedated
S.D. = Standard Deviation

TABLE VI

DATA FOR CALCULATING DEGREE OF HEARING LOSS

Subject No.	Pure Tone Average (SPL) X	Y	White Noise SRT (SPL) X	Y	Degree Of Loss X	Y
1	94.1	90.8	90	85	19.1	20.8
2	99.1	99.1	95	95	14.1	19.1
3	89.1	89.5	90	90	14.1	14.1
4	104.1	102.4	100	95	19.1	22.4
5	95.8	94.1	90	85	20.8	24.1
6	100.8	102.4	95	90	20.8	27.4
7	94.1	89.1	65	60	44.1	44.1
8	120.8	124.1	120	120	15.8	19.1
9	94.1	94.1	90	95	19.1	14.1
10	107.4	107.4	100	95	22.4	27.4
11	97.4	97.4	95	95	17.4	17.4
12	99.1	99.1	85	85	29.1	29.1
13	97.7	95.8	85	85	27.7	25.8
14	95.8	95.8	85	85	25.8	25.8
15	100.7	100.8	100	100	15.7	15.4
$\bar{X}$	99.34	98.79	92.33	90.66	21.67	23.0
S.D.	7.17	8.38	11.23	11.95	7.47	7.4

Key: $\bar{X}$ = Mean X = Non-Sedated Y = Sedated
S.D. = Standard Deviation

TABLE VII

DATA FOR CALCULATING SLOPE
OF HEARING LOSS

Subject No.	Stapedial Reflex Thresholds Low-Pass X	Low-Pass Y	High-pass X	High-pass Y	Slope X	Slope Y
1	95	90	95	90	0	0
2	105	105	105	100	0	5
3	95	95	105	105	-10	-10
4	105	105	115	110	-10	-5
5	100	95	95	95	5	0
6	95	95	95	95	0	0
7	75	70	60	60	15	10
8	125	125	115	115	10	10
9	100	100	105	105	-5	-5
10	105	105	105	105	0	0
11	100	95	105	100	-5	-5
12	100	100	90	90	10	10
13	100	100	90	95	10	5
14	95	100	95	100	0	0
15	105	105	110	110	-5	-5
Mean	100	99	99	98.3	0	0.66
S.D.	9.83	10.98	13.06	12.4	7.41	6.02

Key: X = Non-Sedated
Y = Sedated
S.D. = Standard Deviation

TABLE VIII

COMPUTED VALUES FOR t-TEST AND PEARSON'S "r"

	Tympanometry Compliance	Static Compliance	Differential Loudness Summation	
			Degree	Slope
t-Test	0.67	0.07	1.83	0.43
"r"	0.98	0.92	0.92	0.92

.05 alpha level:

t = (2.15 for 14 df)

r = (.50 for 13 df)

Visual inspection of the tympanograms revealed normal tracings bilaterally. Subject six varied by 0.05 c.c. with the computed static compliance score. Subjects ten and twelve had slightly different measurements, but their computed measurements yielded scores identical to those of the initial test conditions. The slightly different measurements may be attributed to probe tip placement within the external auditory meatus. This would change the actual measurement values, but not the calculated scores.Stapedial reflex thresholds did not vary from the initial non-sedated test conditions (Table IX).

TABLE IX

TEST RE-TEST DATA

Subject No.	Static Compliance		Stapedial Reflex Thresholds .5k Hz		1k Hz		2k Hz		White Noise		High Pass		Low Pass	
	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y	X	Y
6	0.45	0.40	95	95	90	90	90	90	95	95	95	95	95	95
10	0.45	0.45	100	100	95	95	100	100	100	100	105	105	105	105
12	0.95	0.95	95	95	90	90	85	85	85	85	95	95	100	100

Key: X = Non-Sedated

Y = Sedated

CHAPTER IV

SUMMARY AND CONCLUSIONS

I. SUMMARY

It was the purpose of this study to investigate the effects of sedation using Diazepam and Meperidine Hydrochloride on the impedance test battery.

Fifteen adults, ranging in age from 21 to 67 years, were selected as subjects by referral of R. L. Hargrove, M.D., Gastroenterologist. The criteria for subject selection was that all subjects were free from middle ear pathologies as determined by normal tympanograms, and respond to all portions of the impedance test battery.

Each of the subjects were tested under two conditions. The first series of tests were conducted in the patient's room prior to sedation. The second series were administered immediately following Dr. Hargrove's examination, while the subject was still sedated. The impedance test battery consisted of tympanometry, static compliance measures and the Differential Loudness Summation Test (DLST).

The test scores obtained during the two test conditions were compared statistically utilizing a t-test for related measures and the Pearson Product Moment Correlation. The statistical analysis indicated: 1) Tympanometry performed during sedation with Diazepam and Meperidine Hydrochloride were consistent measures highly correlated to the non-sedated test situation. These measures should help determine the functional condition of the middle ear system in children, if such

sedation is necessary to carry out impedance audiometry. 2) Static compliance measurements were not significantly altered by sedation with Diazepam and Meperidine Hydrochloride. This test lends supportive evidence as to the overall condition of the middle ear system and should be performed routinely as a part of the impedance test battery. 3) The Differential Loudness Summation Test was not significantly altered by utilizing Diazepam and Meperidine Hydrochloride as a sedative. The DLST is considered a reliable indicator for the sensitivity of the cochlea in the speech frequency range of 500 Hz to 2,000 Hz. The DLST performed during sedation with Diazepam and Meperidine Hydrochloride therefore, can be considered a reliable indicator of hearing sensitivity.

II. CONCLUSION

The results of this study indicate that the utility of the impedance test battery is not hindered by the use of sedation with Diazepam and Meperidine Hydrochloride. This is especially helpful in determining the hearing sensitivity in difficult to test children.

Diazepam and Meperidine Hydrochloride administered intravenously produce sedating effects within a few minutes. The level ofconsciousness produced by Diazepam and Meperidine Hydrochloride should be judged by a physician as adequate before performing the impedance test battery. The impedance test battery can be performed bilaterally in approximately thirty minutes, from the time of sedative administration to completion of testing, on patients who previously may have had to return for examination many times in order to get even the most basic idea of the sensitivity of the hearing mechanism.

III. IMPLICATIONS FOR FURTHER STUDY

The following topics are suggested for possible further research:

1) A replication of this study is recommended in which children are used as subjects.

2) Differing types of sedatives should be investigated to determine the most appropriate drug to be used in examining difficult to test children.

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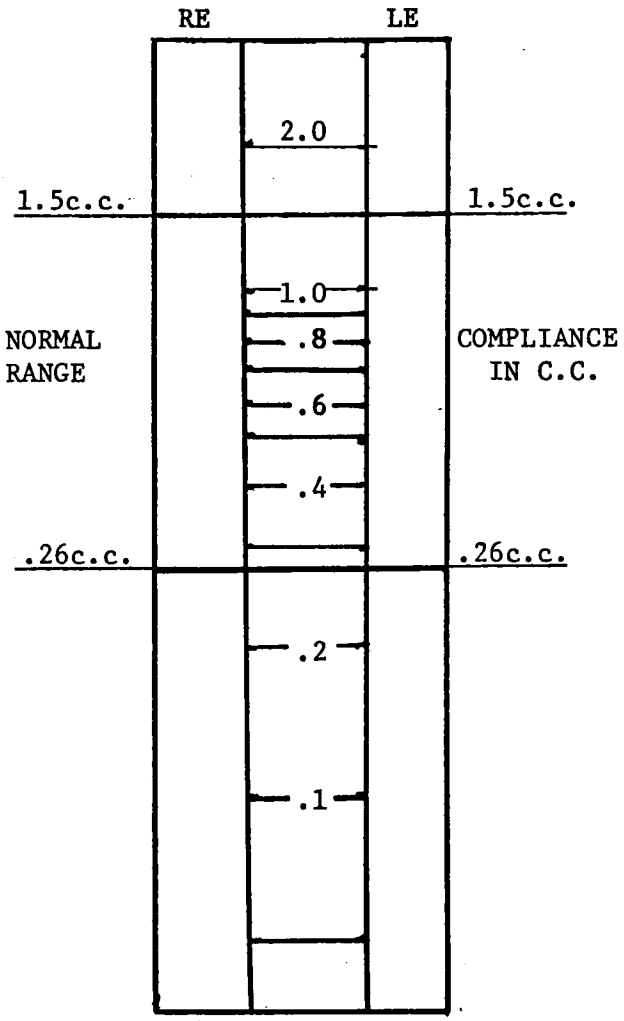
Winthrop Laboratories Inc., N.Y., N.Y. 10016

APPENDICES

APPENDIX A

STATIC COMPLIANCE REPORT FORM

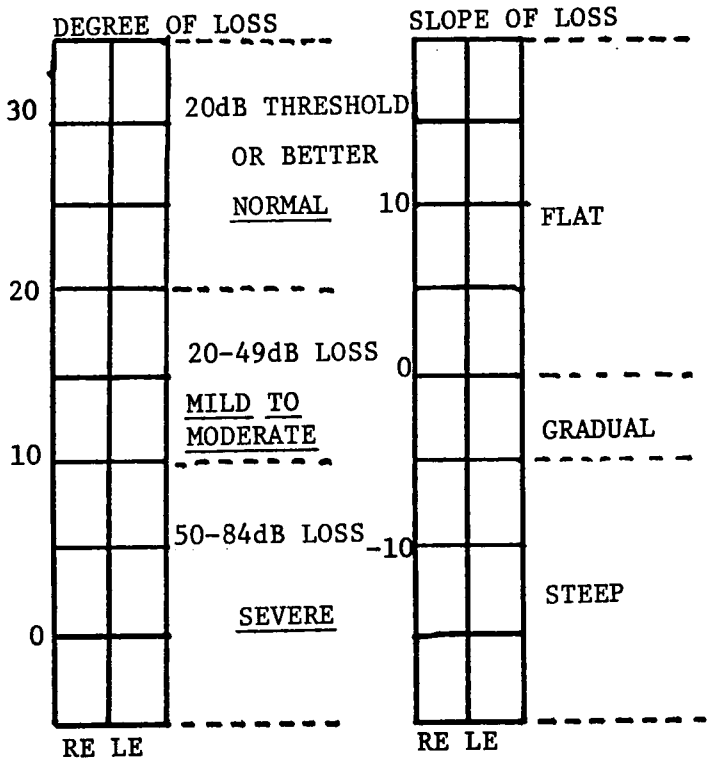
STATIC
COMPLIANCE



APPENDIX B

DLS REPORT FORM

DIFFERENTIAL LOUDNESS SUMMATION EVALUATION



APPENDIX C

EXAMPLE CALCULATIONS

C_1	C_2	.5k Hz (HTL)	1k Hz (HTL)	2k Hz (HTL)	White Noise (SPL)	Low Pass (SPL)	High Pass (SPL)
1.05	1.9	95	90	85	85	100	90

Static Compliance: $C_2 = 1.90$

$-C_1 = \underline{1.05}$

0.85

DLST: 1) Convert HTL to SPL

$95 + 11.5 = 106.5$
$90 + 7 = 97$
$85 + 9 = \underline{94}$
297.5

2) Average

$297.5 - 3 = 99.2$

3) Subtract White Noise from PTA

99.2
$-\underline{85.0}$
14.2

4) Add Corection Factor

14.2
$+\underline{15.0}$
29.2 = Degree of Loss

5) Subtract High -Pass from Low - Pass

100
$-\underline{90}$
10 = Slope of Loss

Hearing Sensitivity = :

1) Degree is Normal

2) Slope is Flat

VITA

Malcolm Hugh Light II was born in Kingsport, Tennessee on December 8, 1946. He attended elementary schools in that city and in Wood - Ridge, New Jersey. He graduated from Wood - Ridge High School in 1964. That summer he entered the United States Marine Corps and was discharged during the summer of 1968. In September of 1968 he entered Fairleigh Dickenson University and transferred to the University of Tennessee after his second year. He received a Bachelor of Science degree in Audiology in August, 1973. He entered graduate school at the University of Tennessee in September, 1973 and received a Master's degree with a major in Audiology in March, 1975.

He is a member of the National Student Speech and Hearing Association, student member of the Southern Audiological Society and a student member of the Tennessee Speech and Hearing Association.

He is married to the former Patricia Agnes Cushing of Bayone, New Jersey. They have a son Malcolm Hugh Light III (Tres).