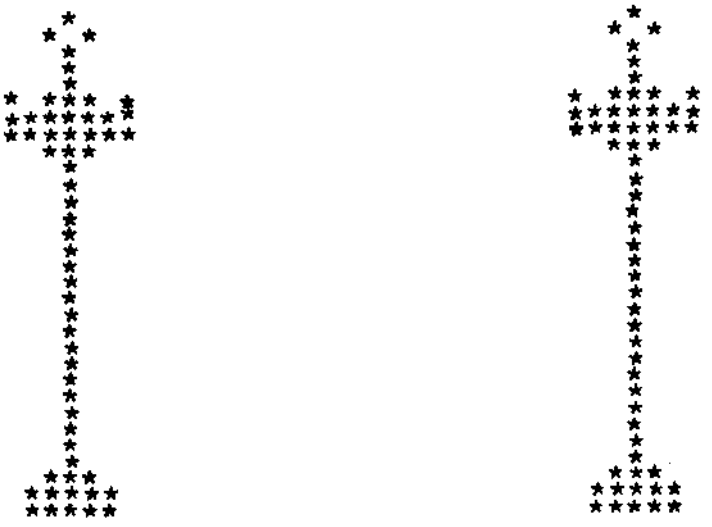
USE OF EXTENDED HIGH FREQUENCY FOR EARLY IDENTIFICATION OF HEARING LOSS

REG.NO.M9205

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

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

MAY 1993



MY BELOVED

P ED AN ANA & PEDALALLI

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MY SWEET DARLINGS:

VASUDHA, ASHOK & CHINTI

CERTIFICATE

This is to certify that the Independent Project entitled: USE OF EXTENDED HIGH FREQUENCY FOR EARLY IDENTIFICATION OF HEARING LOSS is a bonafide work, done in part fulfilment for the first year Degree of Master of Science (Speech and Hearing), of the student with Reg.No.M9205

Mysore

May 1993

Director
All India Institute
of Speech & Hearing
Mysore - 570 006.

CERTIFICATE

This is to certify that this Independent Project entitled: USE OF EXTENDED HIGH FREQUENCY FOR EARLY IDENTIFICATION OF HEARING LOSS has been prepared under my supervision and guidance.

Mysore

May 1993

Dr.(Miss) S.Nikam
GUIDE

DECLARATION

I hereby declare that thi3 Independent Project entitled: USE OF EXTENDED HIGH FREQUENCY FOR EARLY IDENTIFICATION OF HEARING LOSS is the result of my own study under the guidance of Dr.(Miss) S.Nikam, Director, All India Institute of Speech and Hearing, Mysore has not been submitted earlier at any University for any other Diploma or Degree.

Mysore

May 199 3 Reg.No.M9205

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Tb walk, listen, understand me,
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INTRODUCTION

Audiometry literally means measurement of hearing,, It originally meant only the measurement of the auditory threshold for puretones. This restricted meaning was gradually extended, as different techniques of auditory measurement were developed, Ihe term audiometry also includes puretone audiometry, group audiometry, automatic audiometry, and others and recently high frequency audiometry has also become equally important.

High frequency audiometry is defined as finding hearing thresholds for frequencies above 8 KHz. A frequency analysis of speech reveals that the greatest concentration of acoustic energy is between 3OO and 3OOO Hz although frequencies somewhat above and below this range may carry some information. Thus, if an audiologist measures a patient's ability to hear puretones in the frequency range of 125 Hz - 8OOO Hz, he has some basis for predicting whether the patients hearing for speech is normal or impaired. Most of our audiological examinations and tests describe 8 KHz threshold as a reasonable measure of the integrity of the basal turn of the cochlea. it's clinical application is not widespread because of the common belief that

the high frequencies play a secondary role in the perception of speech. Furthermore, the perception of such high frequency is very subjective and this could be the cause of possible errors during testing.

Two major reasons are often cited for this:

(1) Human speech can be very efficiently transmitted at frequencies below 8 KHz.

(2) The practical consideration due to difficulties like reliable production and calibration of very high frequency sound of enough fidelity and intensity.

But with the advancement of science and technology the above mentioned reasons are no longer valid. With the invention of IC's and Piezo electric drivers, much as been achieved such as an increase in the available audiometric frequency range. A knowledge of a person 's high frequency thresholds may serve as useful prediction of future difficulties in understanding the spoken word.

REVIEW OF LITERATURE

Investigators have revealed the possible role of high frequencies in speech perception (Berlin, 1978). It has also been shown that the audibility of very high frequencies is important for intensity discrimination at 2 KHz (Florentine, 1983). Studies have shown that in presbycusis, the loss begins typically at very high frequencies (Rosen et al. 1964; Northern et al. 1972). Goff (1977) has shown that lead intoxication probably is accompanied by high frequency hearing-impairment. High frequency hearing thresholds can be used as reliable indicators of drug ototoxicity (Henry, 1983; Agnen, 198O; Fausti et al. 1981; Jacobson et al. 1969; Prazma, 1981), hyperlipidemia (Cunningham and Goetzinger, 1974); peripheral vascular disease (Rosen and Ohio, 1965) and certain types of noise exposure (Fausti et al. 1981; Dieroff, 1979; Corliss et al. 1970). In noise induced hearing loss, it has been demonstrated that high frequency impairments occur even before the characteristic 4 KHz notch is seen. In all these cases, there was evidence of hearing loss at the routine audiometric frequencies. Vassallo et al. 1968; Dieroff, 1976; reported a relationship

between high frequency hearing loss and exposure to noise. High frequency hearing loss has been correlated with otosclerosis, hereditary sensorirneural hearing loss and Meniere's disease (Osterhammel, 1980).

Thus, based on the research done, we can say that poor hearing at high frequencies has prognostic significance. We can avoid this by taking necessary steps at initial stages itself. This study has been planned to identify the importance of high frequency for early identification of hearing loss so as to avoid difficulties.

METHODOLOGY

Instrumentation:

A two-channel (Madsen-OB 822) audiometer was used to obtain pure-tone thresholds from 125-12000 Hz. The ear phones are of clrcumaural type. The modified Hughson-Westlake procedure was used to obtain thresholds. Calibration was done prior to, during and on conclusion of data collection. The deviation in output SPL was within permissible limits.

Test Environment:

All measurements were conducted in sound treated room with examination and control room combination.

Subjects:

A group of 30 adults aged 18-45 years. The ten each from three different occupational groups - teachers, bank officers and factory workers served as subjects. The mean and median age of the subjects were: 32 and 27 years respectively. There were 20 males and 1O females. Case histories were taken and only those who reported of no history of any middle ear disease were selected.

Procedure;

Each subject was tested at 25O Hz, 5OO Hz, 1OOO Hz, 2000 Hz, 4000 Hz, 8000 Hz, 1OOOO Hz, and 12OOO Hz via AC and BC.

Null Hypothesis: Put-forth in this study are -

1. There will be no significant ear difference in air-conduction thresholds across all frequencies,,
2. There will be no significant difference in air-conduction thresholds with each other occupational groups.
3. There will be no significant difference in occupational groups - teachers, bank officers and factory workers, across high frequencies (4 KHz - 12 ^z) and low frequencies (250 Hz - 2 KHz).
4. There will be no significant difference of the bone-conduction thresholds with the occupational groups.
5» There will be significant difference of the bone conduction thresholds of the occupational groups across the frequencies.

RESULTS AND DISCUSSION

This study has been conducted in order to find out whether we can use extended high frequency for early identification of hearing loss. It has been found that -

For air conduction thresholds using ANOVA the results are as follows:

1. There was no significant difference between right and left ear air conduction thresholds at 0.05 level across all frequencies (that is 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 3000 Hz, 10,000 Hz, and 12000 Hz) with an F-ratio of 2.99.
2. There was a significant difference between/the various groups (Normal, teachers, bank officers and factory workers? at 0.01 level the F-ratio being 13.73.

A significant difference has also been found across all the frequencies tested (250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz, 8000 Hz, 10,000 Hz, 12,000 Hz).

On Fisher's LSD, it was found that -

a) Normal group is significantly different from teachers, bank officers and factory workers.
b) Teachers group was significantly different from normals and bank officers group.

c) Bank officers group was significantly different from the normal group.

3. All the occupational groups tested were significantly different across high frequencies (4 KHz - 12KHz) and low frequencies (250 Hz - 2 KHz) with an F-ratio of 26.15 at 0.05 level.

4. High frequencies (4 KHz - 12 KHz) were significantly different from low frequencies (250 Hz - 2 KHz). 12 KHz being significantly different from 1 KHz with an F-ratio of 70.49 which is significant at 0.05 level.

On Fisher's LSD it was found that -

a) Normal group was significantly different from teachers, bank officers and factory workers group.
b) Teachers group was significantly different from normals and bank officers group.
c) Bank officers group was significantly different from normals, teachers and factory workers group.
d) Factory workers group was significantly different from normals and bank officers.

For bone conduction thresholds using AN0VA, the following are the results:

1. There was no significant difference of the bone conduction thresholds with the different occupational groups tested with an F-ratio of 2.36 significant at 0.01 level.
2. However, within each group a significant difference was found across the frequencies.
   a) Bone conduction threshold at 250 Hz was significantly-different from 1 KHz, 2 KHz, 4 KHz, 6 KHz. But thresholds at 250 Hz was not significantly different from those at 500 Hz.
   b) Nor were thresholds at 500 Hz significantly different from 1 KHz, 2 KHz, 4 KHz and 6 KHz.
   c) Thresholds at 1 KHz was significantly different from those at 6 KHz, with other frequencies tested there was no significant difference.
   c) Thresholds at 2 KHz was significantly different from 6 KHz, but there was no significant difference between thresholds at 2 KHz and 4 KHz.

DISCUSSION;

For air conduction thresholds, using high frequency we can significantly differentiate normals from teachers, bank officers and factory workers group. Among the high frequencies 12 KHz is found to be significantly different from 1 KHz. Hence, it can be used as an important diagnostic tool in early identification of hearing loss.

But bone conduction thresholds fail to significantly differentiate normals from the other occupational groups tested. Teachers group was significantly different from normals and bank officers but there was no significant difference from factory workers. This may be due to the age group of the subjects ie. 4 out pf 10 teachers selected for testing are of the age of 43-45 years, whereas the other subjects were younger. The difference in age might have contributed to the difference in thresholds observed.

CONCLUSION;

From the above R&D (Results and Discussion) we can conclude that -

1. There is a significant difference in thresholds of those subjects who are exposed to greater noise as compared to those who are exposed to less noise.
2. There is also significant difference in threshold at various frequencies,
3. There was significant different in the threshold between low frequencies and high frequencies.
4. Compared to air conduction threshold, bone conduction threshold could not be used for diagnosis.

From the present study and those reviewed on clinical application of high frequency audiometry, it can be said that clinical application of high frequency audiometry is feasible and can be used as diagnostic tool for early identification of hearing loss especially those Who are exposed to noise.

BIBLIOGRAPHY

Ahonen, J. E. , McDermott, J.C (1984): Extended high frequency hearing loss in children with cleft palate. Audiol. 23(5), 467-76.

Briter, R.C. , Talley, T.N. (1976): High frequency audiometry above 8000 Hz. Audiol. 15, 207-214.

Briter, R.C. , and Rupp, R.R. (1972) t Standard audiometric procedures for thresholds above 8 KC/S: A normative study. J.Aud. Res. 12(3), 199-202.

Corso, J.F. (1963): Bone conduction thresholds for sonic and ultrasonic frequencies. J.Acoust,Soc.Am. 35, 1738-1743.

Cunningham, D.R. , Goetzinger, C.P. (1974): Extra high frequency hearing loss and hyperlipidemia. Audiol. 13, 470-484.

Cunningham, D.R. , Vise, L.K., and Jones, L.A. (1983): Influence of cigarette smoking on extra high frequency auditory thresholds. Ear Hearing, 4, 162.

Dieroff, H.G. (1982): Behaviour of high frequency hearing in noise. Audiol, 21, 83-92.

Diseta, E. ,Bertali, G.A. , and Filipo, R. (1985): High frequency audiometry above 8 KHz. Audiology, 24, 254.

Dreschler, W.A., Vander Hulst, R.J.A.M. , and Tange, R.A, (1984): Ototoxicity and the role of high frequency audiometry. J.Acoust. Soc.Am. Suppl. 176-74.

Dreschler, W.A. , Vander Hulst, R, J.A.M. , and Tange, R.A, et al. (19): T*he* role of high frequency audiometry in early detection of ototoxicity, Audiology, 24, 387-395.

Fausti/ S.A, , Frey,R.H. , Rappaport, B.Z. , Erickson, D.A. , (1978): An investigation of the effect of Bumetanide on high frequency (8-20 KHz) hearing in humans. J.Aud.Res. 19, 243-250.

Fausti, S.A. , Erickson, D.A. , Frey, R.H. , Rappaport, B.z. , Schchter, M.A. (1981): *The* effects of noise upon human hearing sensitivity from 8OOO to 20,000 Hz. J.Acoust.Soc.Am. 69, 1343-1349.

Eilipo,R., Deseta, E. , Bertoli, G.A. (1985): High frequency audiometry in Juvenile Diabetes in advances in audiology: disorders with defective hearing. 3, 106-112.

Fletcher, J.I. ,(1965): Reliability of high frequency thresholds. J.Aud.Res. 5, 133-137.

Fletcher, J.L. ,Cairns, A.B. , Collins, F.G. , and Endicolt, J. (1967): High frequency hearing following meningitis. J.Aud.Res. 7, 223.

Flottorp, G. ,(1973): Effects of noise upon the upper frequency limits of hearing. Acta Oto.Lar.75, 329-331.

Green, D.M. , Kidd, G. Jr. and Stevens, K.N. (1987): High frequency audiometric assessment of a young population. J.Acoust. Soc.Am. 49, 6OO-6O1.

Jacobson, E,J. , Downs, M.P. , Fletcher, J.L . (1969): Clinical findings in high frequency thresholds during known ototoxic drug usage. J. Aud.Res. 9, 379-389.

Osterhammel, D. (1979): High frequency audiometry and noise induced hearing loss. Scand.Audiol. 8, 85.

Osterhammel, D. , Osterhammel, B. (1979): High frequency audiometry, age and sex variations. Scand. Audiol. 8, 73.

Osterhammel, D. (1980): High frequency audiometry clinical aspects. Scand. Audiol. 9(4), 249-256.

Rosen,S. , Plester, D. , ElMofty, A, , Rosen, H.V, (1964) t High frequency audiometry in presbycusis. Arch.Otolar.79, 34-48.

Seigel, S. (1956): Non-parametric statistics for the behavioural sciences. McGrawHill, Kogakusha Ltd., Tokyo.

Zislis, T. , and Fletcher, J.L. (l966)s Relation of high frequency threshold to age and sex. J, Aud.Res.6, 189-198.