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EFFECTS OF HIGH–SPEED DRILL NOISE ON DENTISTS' HEARING

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ABSTRACT

The study deals with noise problems associated with the use of air-turbine drills in dental practice. Noise level measurements were made on various types of dental handpieces, when operated free-running and when used to cut tooth tissue. Hearing acuity tests were also undertaken in 12 randomly selected dental surgeons who have been using these drills for a number of years. The results indicate that although the danger to hearing from high speed drills is small, the possibility of hazardous effects – at least, for susceptible ears – is not excluded.

INTRODUCTION

The high-speed dental drills offer an entirely new concept in cavity preparation and present by far the easiest method of cutting hard dental tissue. With the use of these machines, however, new problems have arisen, one of which is the high noise level, resulting in the possibility of harmful effects on the hearing of dental practitioners due to daily noise exposure. A number of studies (1, 2 and 3) seems to indicate that only a small amount of hearing shift may be produced by exposure to high-speed drill noise, and this requires several years to become measurable. An investigation by Taylor and others (4) showed that there was a definite threshold loss at the higher frequencies in the drill noise exposed group. Skurr and Bulteau (5) also revealed some hearing impairment in dental students after being exposed to high-speed drill noise.

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The small but consistent shifts of hearing found in studies indicate that there is still room for suspicion and because of piercing sound, many dentists believe that high-speed drills could be a real hazard. Therefore, a measurement and analysis of high-speed drill noise and a study of dentists hearing were attempted at some private surgeries.

MATERIALS AND METHODS

Overall sound pressure level measurements together with octave band analyses of air-turbine dental drills in octave centre frequencies 63 to 16000 Hz were made in 10 dental offices of dental practitioners. For this purpose, the Bruel and Kjaer Precision Sound level Meter Type 2203 and Octave Band Analyser Type 1613 have been used with calibration by means of the B & K Pistonphone calibrater Type 4220.

Since it was inconvenient to analyze the noise directly at the time of conservation treatment, the noises were also recorded on tape for subsequent analysis to determine the acoustic spectrum. The instrument used was Tape Recorder UHER 4200 Report Stereo with a tape speed of 19 cm/sec and corresponding frequency range 40—20000 Hz.

All noise measurements were made at the dentists ear level, about 30 cm from the instrument tested, under normal working condition during cavity preparation for patients, on extracted teeth, and while running freely without drilling.

Pure-tone air-conduction audiometry was performed at frequencies 1, 2, 3, 4 and 6 KHz in 5 dB-steps using a simply manually operated audiometer generating pulsed tones. In addition to the acoustic calibration, the audiometer was tested against a Bekesy audiometer.

Twelve dentists took part in the study. They were selected at random from a list of dentists who have been using high-speed drills for a number of years. All dentists were interviewed with a questionnaire and each of them was given two audiometric tests. An audiogram was taken before starting work on Monday, at least 45 hours following the last exposure to occupational noise. Thus, auditory thresholds measured can only include a very small component of temporary threshold shift due to high-speed drill noise which may be ignored. Another audiometric test was carried out immediately after finishing the weekly work, usually on Friday, for the purpose of measuring temporary threshold shift.

Hearing acuity tests were carried out in dental surgeries. The interfering noises were generally low-frequency in character, so that appreciable masking could occur only at 500 Hz and below and this would not unduly affect the tests in the more important higher fre-

quency range. Furthermore, the earphone and the rubber cushions, to some extent, were able to exclude ambient noise.

RESULTS

The overall noise levels and the frequency distribution of air-turbine dental drills, in dB, are given in Table 1. The spectrum of drill noise, in both free-running and cutting modes, is predominantly high frequency. Generally the sound energy is concentrated in the three octave bands 4, 8 and 16 KHz. Figure 1 shows the mean sound pressure level and octave band spectrum of air-turbine drills, together with 95% confidence limits and maximum safe level criterion for eight hours recommended by Schubert and Glorig (6). The typical spectrum of drill noise is also shown in this figure.

The results of audiometric tests of 12 male dentists on Monday morning and at the end of the week are given in Table 2 and 3. The audiometric hearing levels were subjected to a single subtraction of a decibel value determined by age, from a smoothed version of Hinchcliffe's prespycusis data (7), so producing age-corrected auditory thresholds. The mean age-corrected audiograms of the dentists for Monday and for the end of the week are presented in Figures 2 and 3. Figure 4 shows the mean auditory threshold shifts due to high-speed drill noise during the week.

DISCUSSION

The possibility of damage to hearing due to noise must be considered in the light of appropriate criteria. The maximum safe exposure levels in the frequency range of high-speed drill noise for daily exposures of less than eight hours have been outlined by Schubert and Glorig (6). Applying these criteria to the dental drill noise, and considering that the exposure time in each case is one hour or even more, this noise with the maximum level of 84 dB would not be expected to have any serious effect on hearing acuity of "average ears", but it is not possible to conclude that "sensitive ears" would remain free of risk with exposure to this type of noise after a number of years.

Annoyance is another important effect of high-speed drill noise which is distinct from the potentially damaging effects on hearing. The whining noise of the dental drill seems to be annoying even when it occurs infrequently. Most of the energy from these drills lies in the high-frequency range and a high-pitched noise is more piercing and annoying than an equally intense low-pitched noise (8). However, the annoyance produced by the noise of dental drills may be balanced by

compensating advantages, a reaction associated with the noise of an efficient tool.

When average hearing loss at 0.5, 1 and 2 KHz (speech band threshold) exceeds 26 dB, hearing for speech is considered to be impaired and it is probable that some difficulty will be encountered in the perception of faint speech (9). An alternative frequency combination 1, 2 and 3 KHz may be used. For this an average 40 dB would probably be the minimum loss at which a real disability exists (10). Table 2 shows none of the dentists tested having impaired hearing according to this definition.

Taking the mean of hearing losses, there is a difference between the left and right ears, and the left ear exceeds the right by a few decibels. This difference might indicate that left ears in right-handed subjects show greater losses than right ears. The majority of dentists appear to work on the patient's right side. This difference is not statistically significant.

Comparison of the audiograms taken on Monday and at the end of the week show that there is a temporary threshold shift at the higher frequencies due to drill noise during the week. The temporary threshold shift is statistically significant at 4 KHz for the left ear ($P < 0.05$) and at 3 KHz for the right ear ($P < 0.05$).

One of the subjects, number 12, was tested just a few minutes after being exposed to the drill noise and showed a marked temporary threshold shift at the left ear. Since the overall sound level was about 80 dB(A), he might be the kind of individual who could be classified justifiably as being hypersensitive to noise.

ACKNOWLEDGEMENT

I am greatly indebted to Dr. J. Steel of the Department of Occupational Health and Hygiene, University of Newcastle upon Tyne for his advice and technical assistance.

Table 1.

Mean sound pressure levels and octave band analysis of dental air-turbine drills together with 95% confidence limits

	Sound Pressure Level (dB) (re-20 $\mu N/m^2$)		
	Drill free-running	Drill cutting tooth tissue	Drill free-running or cutting
dB(A)	75.2±9.6	78.7±7.2	76.5±9.3
Overall Sound Pressure Level	76.6±9.2	80.5±6.6	78.0+9.0
Centre Frequency Hz			
63	52.0±15.1	55.5±12.1	53.3±13.7
125	51.4±14.9	54.0±12.0	52.0±13.6
250	50.8±15.1	52.5±12.1	51.4±13.7
500	47.2±13.5	51.2±11.5	48.9±13.2
1000	53.8±13.4	58.5±10.9	55.5±13.1
2000	60.4±13.3	54.0±10.8	62.1±13.1
4000	67.0±13.4	71.6±10.9	68.7±13.1
8000	73.6±13.5	78.2±11.5	75.3±13.2
16000	67.4±12.4	72.7±8.0	69.4±12.1

Table 2
Auditory thresholds (dB) of 12 dentists on Monday morning

No.	Age (Years)	Time in job (Years)	Left Ear-Auditory Threshold(dB)					Right Ear-Auditory Threshold (dB)				
			1	2	3	4	6KHz	1	2	3	4	6KH
1	28	4	5	15	15	15	30	5	5	5	5	20
2	29	6	10	15	20	20	25	5	15	10	20	15
3	35	11	-5	0	0	0	15	-5	0	0	10	10
4	40	14	5	0	10	10	25	5	5	10	10	20
5	42	15	15	10	15	25	50	0	15	15	15	30
6	43	16	0	5	10	15	20	5	5	10	15	35
7	44	20	0	5	20	30	35	5	10	20	20	40
8	45	23	5	5	20	20	30	5	0	5	10	20
9	46	24	5	5	10	10	15	10	10	15	10	10
10	49	25	10	15	20	20	30	15	15	15	10	25
11	51	26	5	15	15	5	5	0	5	10	15	5
12	53	26	20	10	15	25	40	15	10	15	25	40

Table 3

Auditory thresholds(dB) of 12 dentists at the end of the week

No.	Age (Years)	Time of weekly work (hours)	Left Ear -Auditory Threshold (dB)					Right Ear-Auditory Threshold (dB)				
			1	2	3	4	6KHz	1	2	3	4	6KHz
1	28	35	10	15	15	15	30	5	5	10	10	20
2	29	37.5	10	15	25	25	30	5	15	20	25	25
3	35	40	-5	0	0	0	20	-5	5	5	0	10
4	40	37.5	5	5	10	15	25	5	0	10	10	20
5	42	37.5	15	10	15	25	55	5	15	15	20	35
6	43	37.5	0	10	15	20	25	5	5	10	20	30
7	44	32.5	0	5	25	40	40	5	10	20	15	40
8	45	41.25	5	10	25	30	40	5	0	10	5	20
9	46	48	5	5	10	5	15	10	10	15	10	10
10	49	35	15	15	15	25	30	15	15	20	15	25
11	51	40	5	10	15	5	5	5	10	10	25	5
12	53	41.25	20	35	35	45	70	20	10	15	20	40

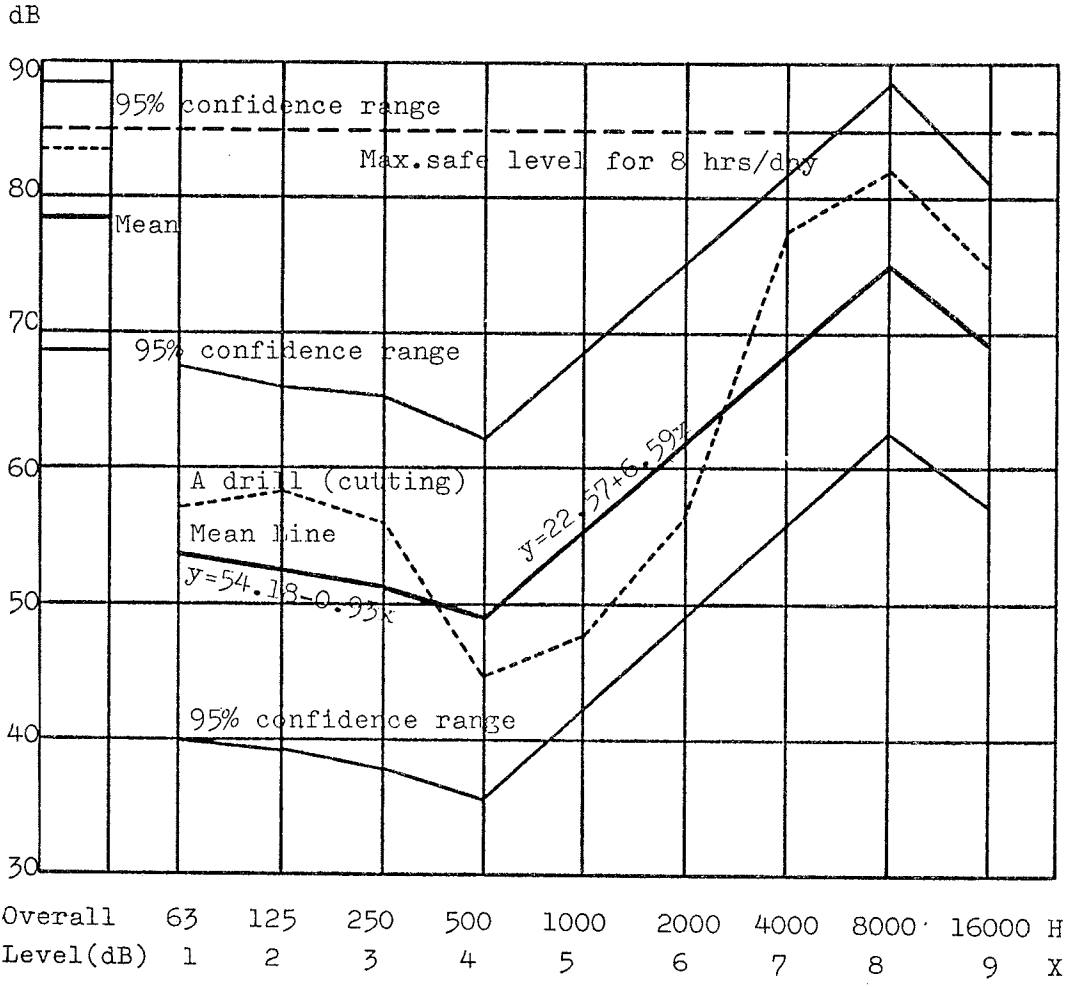

Fig. 1- Mean overall sound pressure level and octave band spectrum of dental air-turbine drills, together with 95% confidence ranges and maximum safe level criterion for 8 hours a day recommended by Schubert and Glorig(1963).

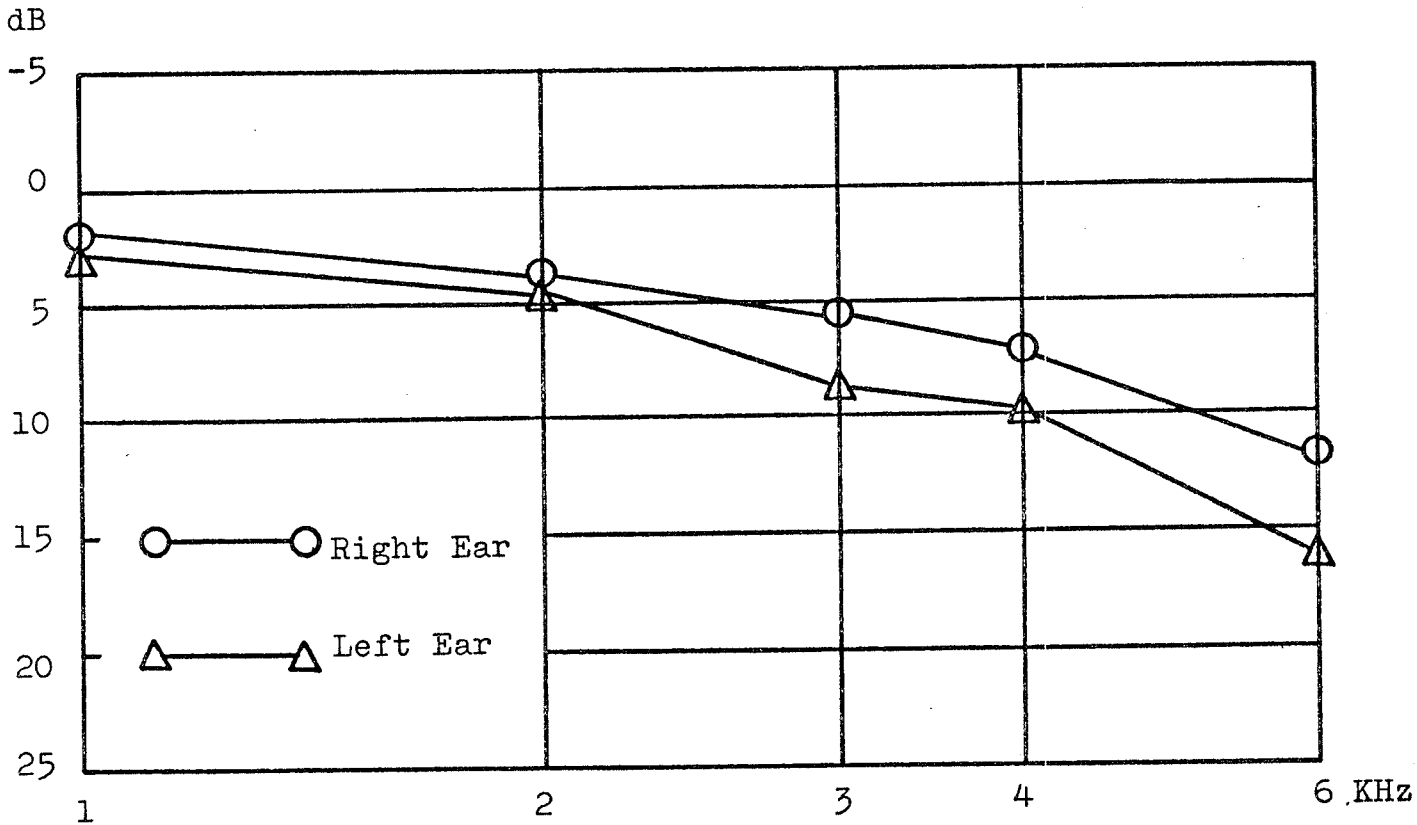

Fig. 2- Mean age-corrected audiograms of 12 dentists on Monday before starting weekly work.

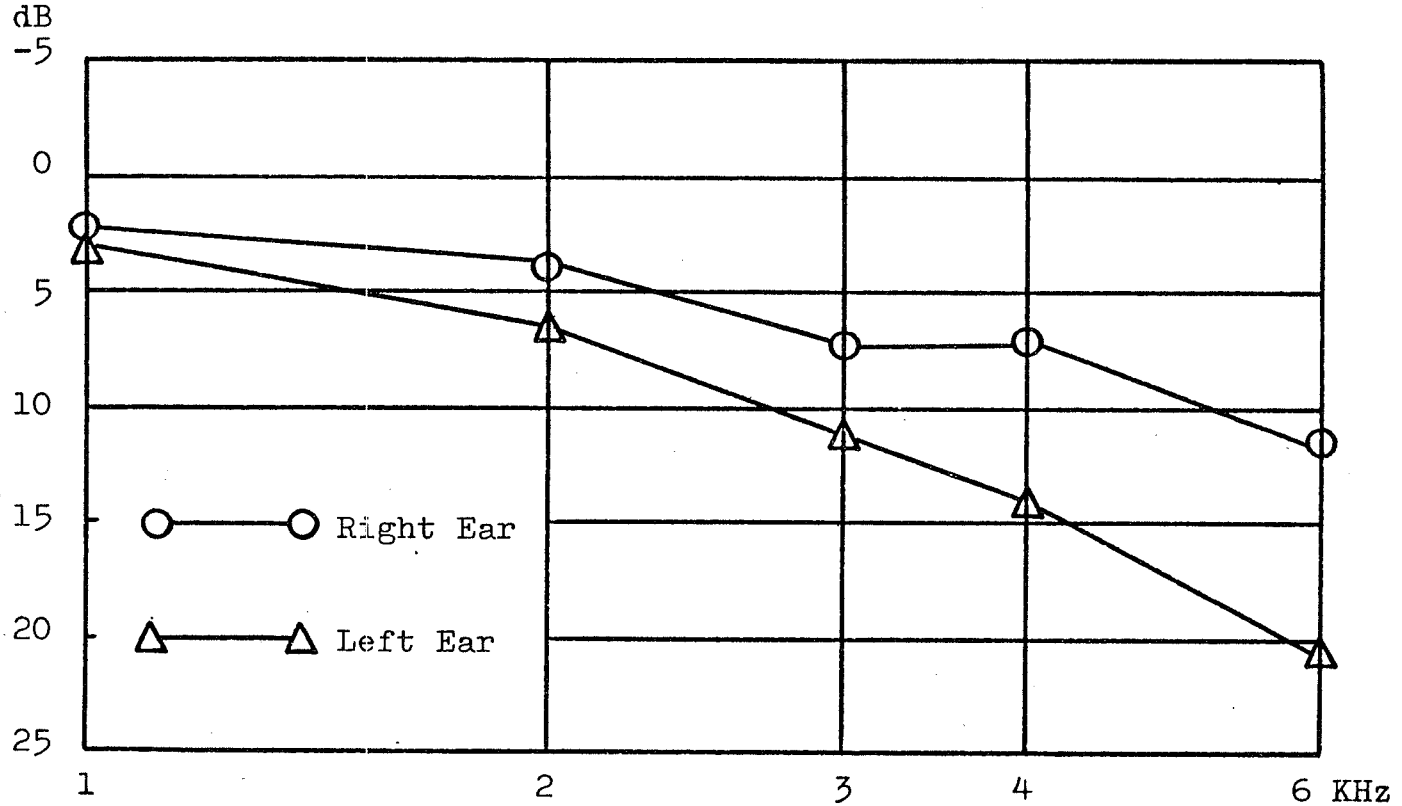

Fig. 3- Mean age-corrected audiograms of 12 dentists at the end of the week, after the weekly work.

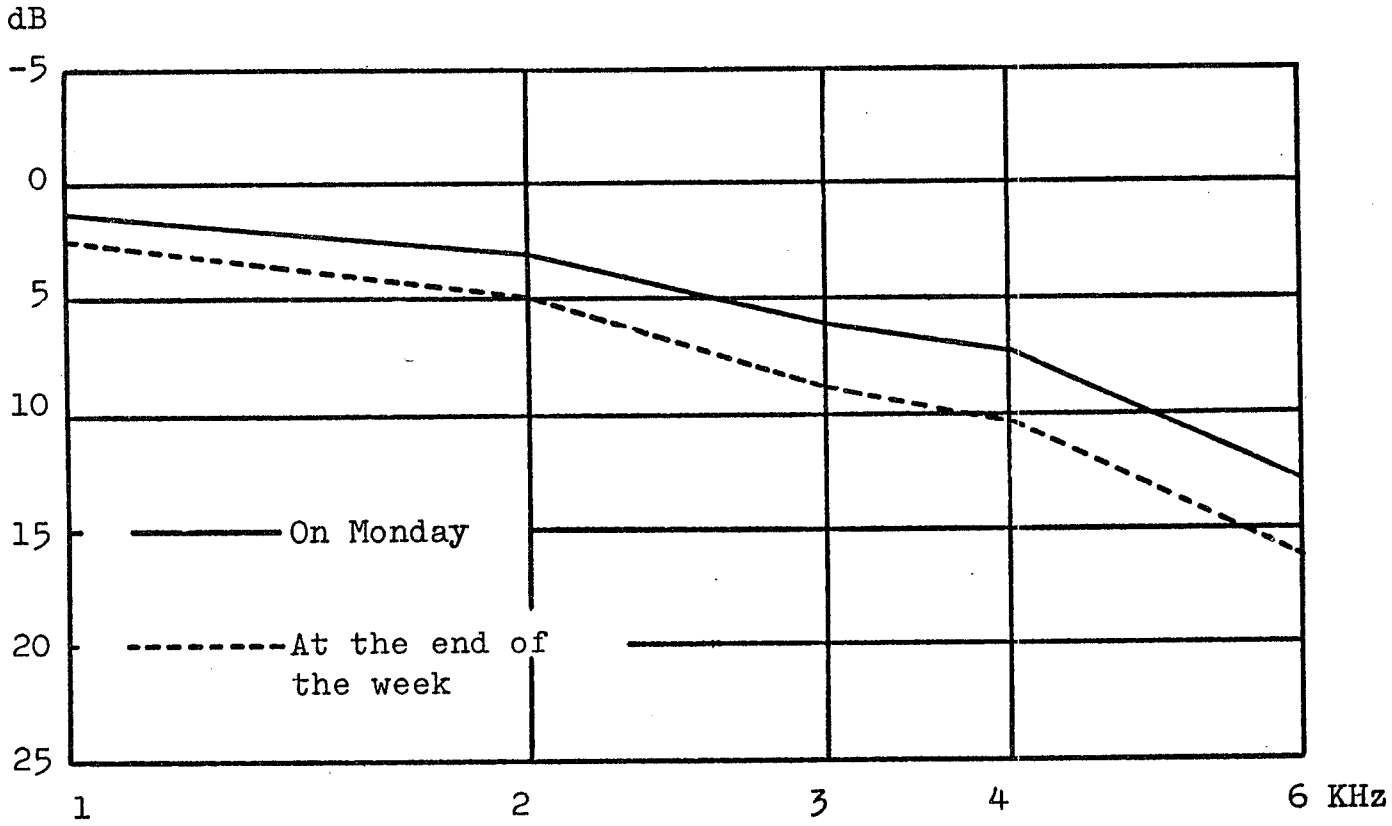

Fig. 4- Mean auditory threshold shifts due to high-speed drill noise during the week.

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LE PRÉMIERE CAS LA CRYPTOCOCCOSE GENERALISÉ EN IRAN

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RESUMÉ

Le premier cas de la Cryptococcose observé en Iran et L'aspect de la souche isolée ont été discutés.

Nous avons rencentré pour la première fois une cryptococcose generalisée chez une fillette agée de 4 ans. La diagnostic a été fait a partir d'une ponction intraossuse, dont nous avons realisé des examens directes, la mise en culture, histopathologie et inoculation expérimentale. Pourtant, durant des années 1965-1978 quelques cas de la cryptococcose non confirmés ont été étudies dans notre laboratoire.

OBSERVATION

La malade est une indigène musulmane, habitant dans un petit village au nord est du pays, situé a 17 Km de Gorgan. Elle a eu depuis 3 mois, selon son père, des douleur abdominales, pendant la nuit elle a toussé, et elle avait de fièvre et elle ne sentait pas bien. La première diagnostic fait par un medecin de province était la tuberculose et le traitement n'avait pas de succés et ensuite elle a été hospitalisée a Téhéran. Elle est morte 13 jours après son hospitalisation, nous l'avons rencontré lors de l'autopsie (4 jours après la mort) avec des poumons massives, un grossisement du fois, de la rate et des nodules lymphatiques.

Dans les preparations histologiques, le foie, la rate, les poumones et le cerveau ont été envahi avec Cryptococcus neoformans (Photo, A,B.C,D.).

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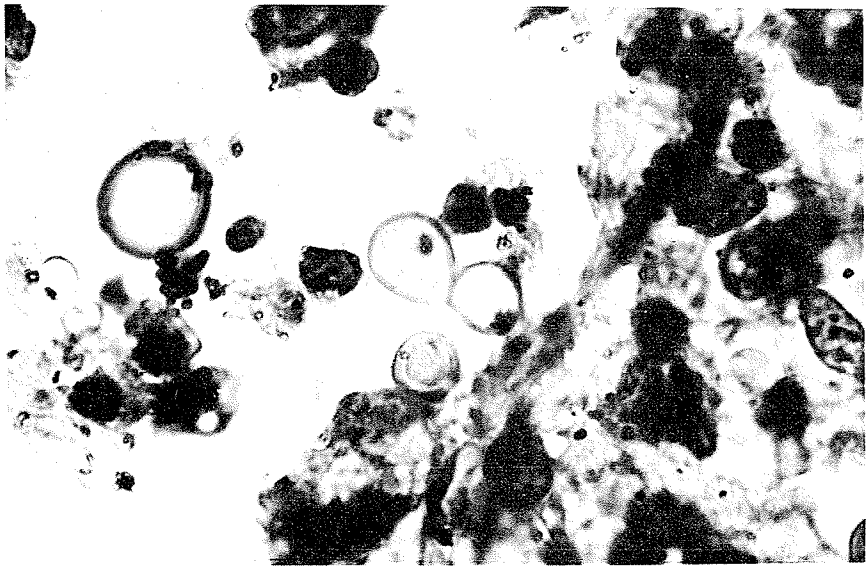

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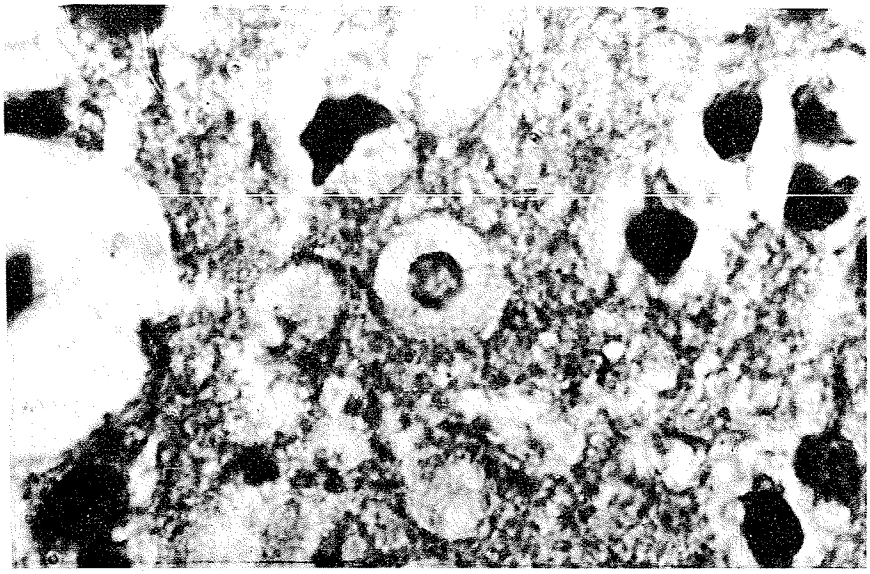

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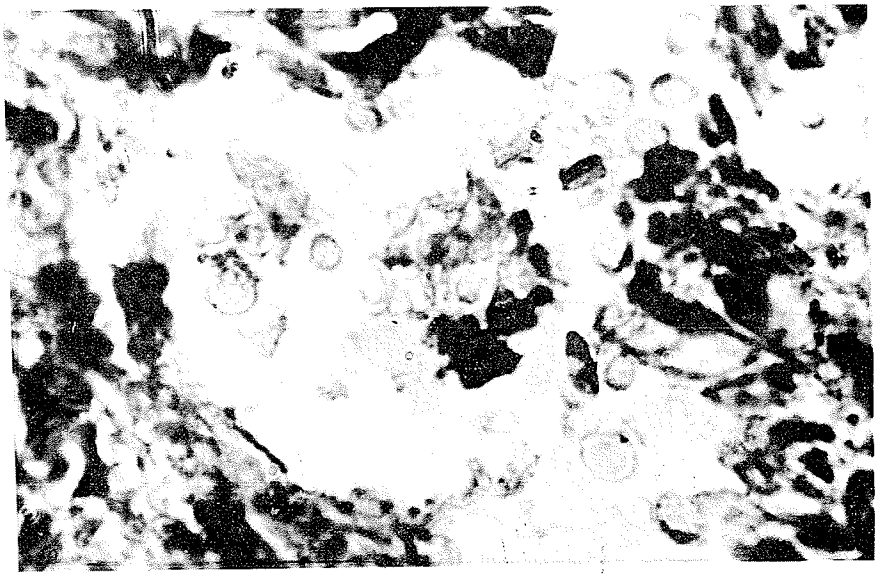

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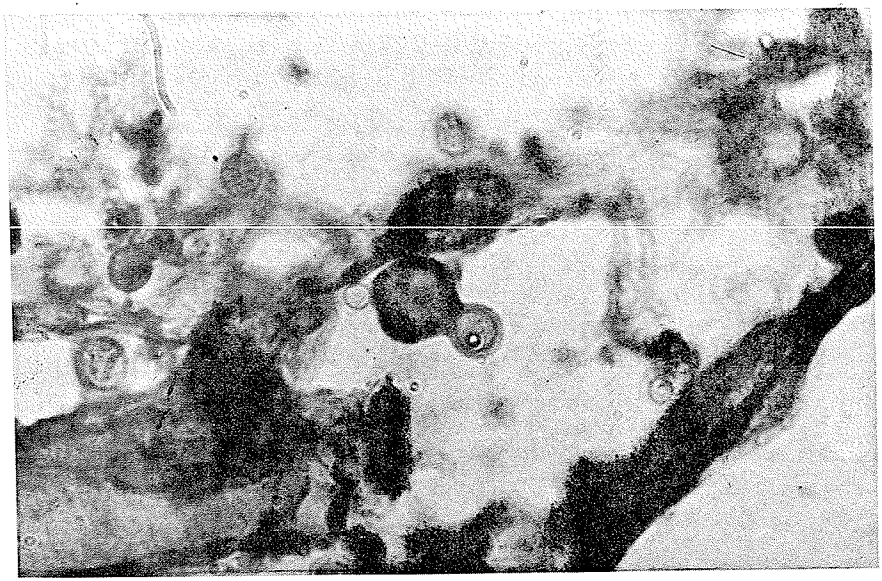

L'isolement très facile de C. néoformans chez cette malade nous pose que les autres cas cliniquement diagnostiqué comme la Cryptococcose étaient au moins suspects.

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