

FALSE POSITIVE DP GRAMS

Prof.Dr / Mona mourad

Dr / Samir Asal

Introduction

Distortion-Product Otoacoustic Emissions (DPOAEs) are acoustic energy **in the ear canal** arising from the non-linear interaction of two simultaneously applied pure tones of frequencies *f1 and f2 within the cochlea*

DPOAEs are thought to be generated mostly at the place of greatest overlap of the traveling waves that result from the two pure tone stimuli

When $f2/f1$ ratio of 1.2
also $L1$ is 5-10 dB > than $L2$

The largest DPOAEs amplitude are elicited

DPOAE can be recorded in almost any normal-hearing subject and in subjects with hearing loss up to 50 dB HL.

At severe and profound hearing loss , the use of DP grams may be misleading

Aim of the work

The aim of this work is to determine the levels of f_1 and f_2 , (primaries) at which DPOAEs **only** reflect active, nonlinear mechanical processes in the cochlea

Materials and Methods

Study Groups Alex University H&C

- 1- **group (A)**: {adult, age>20 years}
 - A1 7 ears with normal hearing
 - A2 7 ears with profound to total SNHL
- 2- **group (B)** {children, age 2-12 years}
 - B1 7 ears with normal hearing
 - B2 7 ears with profound to total SNHL
- 3- **group (C)** {infants, age <2 years}
 - C1 4 ears with normal hearing
 - C2 4 ears with profound to total SNHL
- 4- dummy **cavity (D)** that simulate adult EAC



All subjects in this study underwent the following:

1-Detailed history taking and family history of hearing loss.

2-Otologic examination to exclude any external ear pathology.

3- Assessment of hearing threshold using Pure Tone Audiometry in groups A and B and ABR in group C

4- Distortion Products Otoacoustic Emissions (DP gram)

Two pure-tone signals, f_1 and f_2 ($f_1 < f_2$; $f_2/f_1 = 1.22$), were presented simultaneously as primary tone frequencies that generate $2f_1 - f_2$ DP.

DP-gram was collected at 3 points /octave steps at stimulus levels so that $L_1 > L_2$ by 10 dB. . The first levels of the primaries used were 80 dB SPL for L_1 & 70 dB SPL for L_2 then the levels decreased by 5 dB step until $L_1 = 60$ dB $L_2 = 50$ dB

Results and Discussion

Table (1) : Age of study groups

		Age
Group A (adult)	Group A1	33±3.6
	Group A2	34±4.1
Group B (child)	Group B1	5±2.5
	Group B2	6±3.2
Group C (infant)	Group C1	1±.5
	Group C2	.8±.6
dummy cavity (D)		

Table (2): Descriptive statistics of hearing thresholds in dB

		Pure tone average
Group A (adult)	Group A1	15±5 dB
	Group A2	100±10
Group B (child)	Group B1	10±7.5
	Group B2	105±10
Group C (infant)	Group C1	20 (ABR threshold)
	Group C2	Absent ABR

The subject is considered as passing the DP gram test when the DP levels are above the noise floor at all frequencies by 5 dB and DP levels are > -10 dB (i.e. normal DP-gram) as in (Fig. 1). If the DP levels are within the noise at all frequencies, it is considered failed DP-gram (Fig 2).

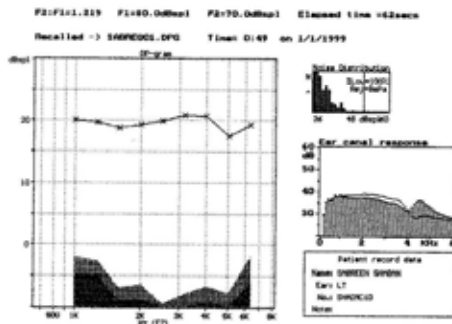


Fig (1) pass DP gram

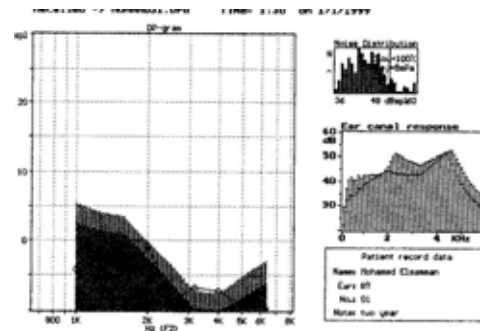
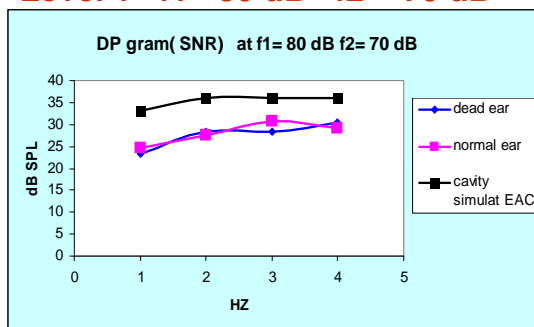


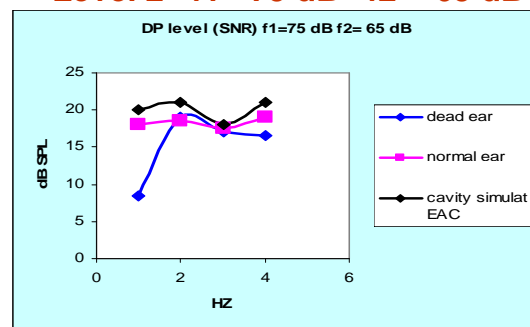
Fig (2) failed DP gram

Dp grams results of group (A) {adult} and (D) {dummy cavity simulating adult EAC}

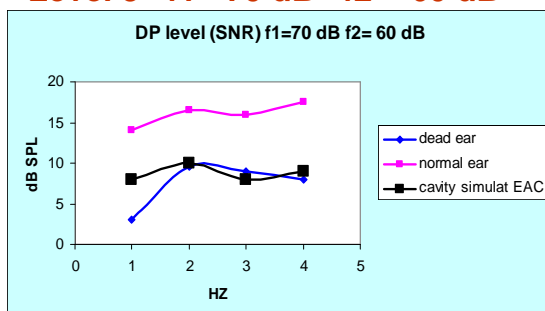
Level 1 f1= 80 dB f2= 70 dB



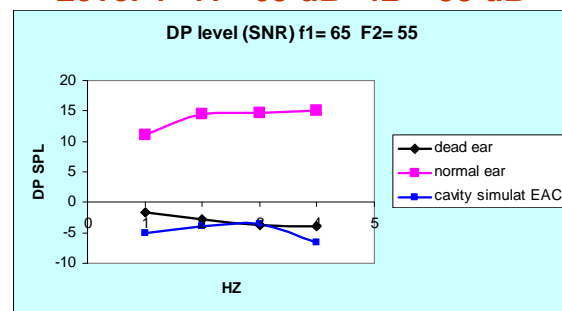
Level 2 f1= 75 dB f2= 65 dB



Level 3 f1= 70 dB f2= 60 dB



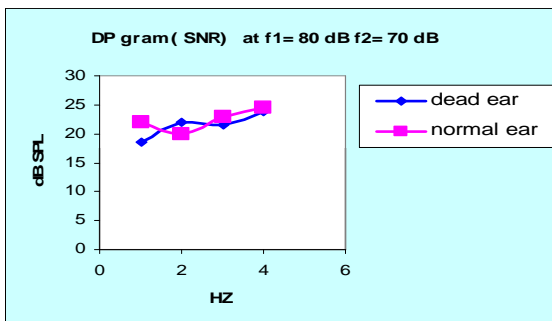
Level 4 f1= 65 dB f2= 55 dB



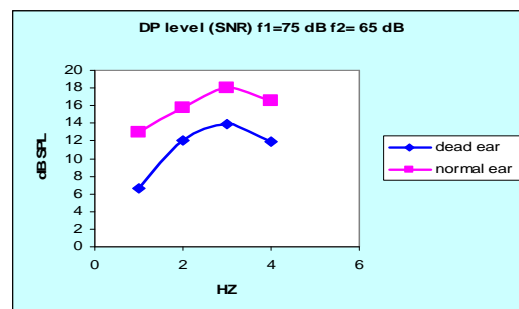


Dp grams results of group (B) {children}

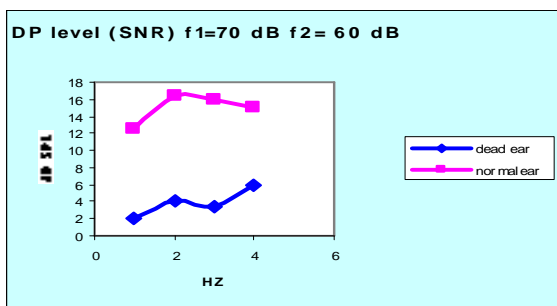
Level 1 f1= 80 dB f2= 70 dB



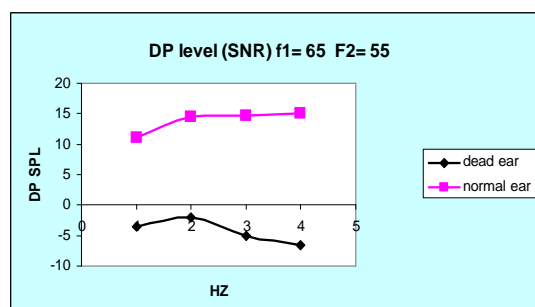
Level 2 f1= 75 dB f2= 65 dB



Level 3 f1= 70 dB f2= 60 dB

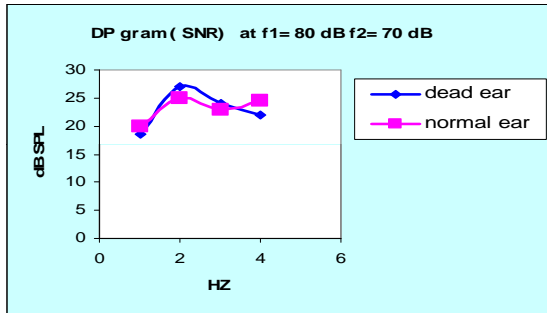


Level 4 f1= 65 dB f2= 55 dB

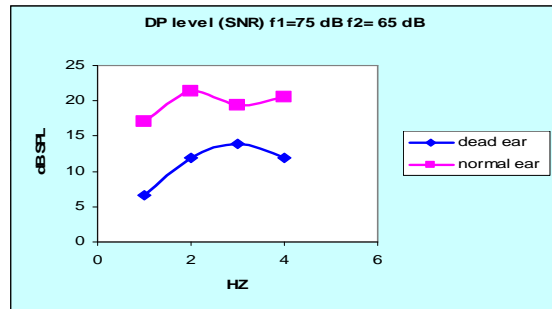


Dp grams results of group (C) {infants}

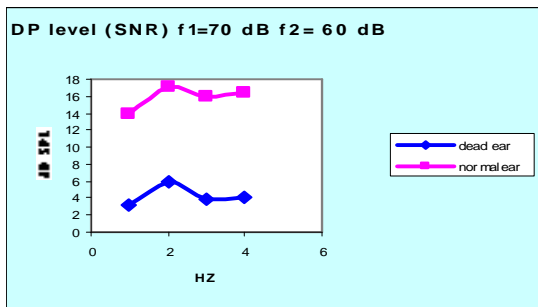
Level 1 f1= 80 dB f2 = 70 dB



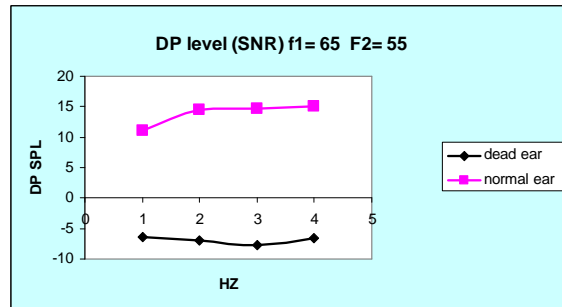
Level 2 f1= 75 dB f2 = 65 dB



Level 3 f1= 70 dB f2 = 60 dB



Level 4 f1= 65 dB f2 = 55 dB



All ears in the three groups with total SNHL showed pass DP grams at L1=80/L2=70 dB , L1=75/L2=70dB , and L1=70/L2=60 dB and failed DP gram at intensity levels L1=65/L2=55 and below these levels.

In other hand all ears with normal hearing in the three groups showed pass DPOAEs at all intensity levels examined

The presence of false positive Dp grams at high intensities ($\geq 60-70$ dB SPL) is due to either •

1- passive nonlinear macro mechanical properties of the cochlea

Or

2- acoustic interaction of the two primaries in EAC

The presence of positive DP gram in the cavity simulating EAC suggest that false positive DP gram at high intensity is due to acoustic interaction of the two primaries in the EAC

Conclusion

Distortion product otoacoustic emissions (DPOAE) elicited by tones below 60-70 dB SPL are significantly more sensitive to cochlear insults. The vulnerable, low-level DPOAE have been associated postulated active cochlear process

Whereas the DPOAE at high intensities of the primaries is due to acoustic interaction of the two tones in the EAC

in conclusion, for purely audiometric purpose,
DPOAEs turn out to be rather insensitive to
hearing loss whenever stimulus levels equal
or exceed 60 - 70 dB SPL .

THANK YOU