

Attachment 1

Appendix 1

Elliptical-circular approximation method

To determine the frequency band assignment, a constant distance of 0.5 mm between the lateral wall (LW) and the organ of Corti was assumed in accordance with the work of Alexiades et al. [1]. Based on this assumption, the parameters A_{OC} and B_{OC} were determined using the following calculations:

$$A_{OC} = A_{LW} - (2 * 0.5 \text{ mm}) = A_{LW} - 1 \text{ mm} \quad \text{Equation 2}$$

$$B_{OC} = B_{LW} - (2 * 0.5 \text{ mm}) = B_{LW} - 1 \text{ mm} \quad \text{Equation 3}$$

The parameters A_{OC} and B_{OC} were then used together with the previously calculated cochlear duct length ($CDL_{(LW)}(\theta)$) using the equation of Alexiades et al. [1] to calculate the CDL_{OC} and $CDL_{OC}(\theta)$ using the following equations:

$$CDL_{OC}(\theta) = [pBTL(\theta) * [1.18 * (A_{OC}) + 2.69 * (B_{OC}) - \sqrt{(0.72 * A_{OC} * B_{OC})}]] + HRL \quad \text{Equation 4}$$

$$CDL_{OC} = [1.71 * [1 * 1.18 * (A_{OC}) + 2.69 * (B_{OC}) - \sqrt{(0.72 * A_{OC} * B_{OC})}]] + HRL \quad \text{Equation 5}$$

The “hook” region [21] was taken into account with an average value of 2.5 mm (hook region length, $HRL=2.5$ mm). The size CDL_{OC} describes the complete length of the organ of Corti including the hook region, while $CDL_{OC}(\theta)$ describes the length of the organ of Corti for a given angle θ .

Greenwood function [14] was used to convert the linear length along the basilar membrane into the corresponding frequency in Hertz (Hz):

$$f = A (10^{ax} - K) \quad \text{Equation 6}$$

Here “f” stands for the characteristic frequency of a sound in Hz, “A” is 165.4 Hz for the human cochlea, “a” is the parameter 2.1 and “K” is the parameter 0.88. The value “x” represents the distance along the basilar membrane from the base to a certain point.

By inserting all constants, “x” remains as the only variable. By applying CDL_{OC} and $CDL_{OC}(\theta)$ in the Greenwood equation, the frequency at each location of the basilar membrane could be calculated using the following equation:

$$f = 165.4 * (10^{(2.1 * ((CDL_{OC} - CDL_{OC}(\theta)) / CDL_{OC}) - 0.88)}) \quad \text{Equation 7}$$

Appendix 2

Table 4 (to Figure 1): tonotopic assignment (in Hz), determined from the electrode insertion angle of the most apical electrode for different electrode arrays, standard deviation (SD), spiral ganglion plane (SG-Freq), organ of Corti plane (OC-Freq), incompletely inserted electrodes N=5 excluded.

Electrode type	SG frequency			OC frequency			
	Mean value	Median	SD	Mean value	Median	SD	Quantity
PRECURVED	1042.6	987.1	236.0	1170.0	1114.8	301.5	34
STRAIGHT	948.7	919.1	163.6	1064.2	1022.3	218.6	9
CONTOUR SLIM	739.7	717.2	139.0	786.7	741.5	181.3	10
FLEX26	403.0	388.5	127.2	454.9	452.9	114.7	10
FLEX28	279.8	239.4	109.3	326.6	282.6	123.6	33

Table 5: Analysis of variance frequency mismatch (FMM) and electrode type for the most apical electrode N=95 (Kruskal-Wallis tests), divided into spiral ganglion (SG) and organ of Corti (OC) level. Incompletely inserted electrodes N=5 excluded.

<i>Pairwise comparisons of electrode type</i>					
Sample 1–Sample 2	Test statistics	Std. error	Standard test statistics	Sig.	Anp. Sig. ^a
FLEX28–FLEX26	2.553	9.951	.257	.798	1.000
FLEX28–CONTOUR SLIM	27.603	9.951	2.774	.006	.055
FLEX28–STRAIGHT	29.470	10.367	2.843	.004	.045
FLEX28–PRECURVED	51.348	6.787	7.566	<.001	.000
FLEX26–CONTOUR SLIM	25.050	12.329	2.032	.042	.422
FLEX26–STRAIGHT	26.917	12.667	2.125	.034	.336
FLEX26–PRECURVED	48.795	9.951	4.903	<.001	.000
CONTOUR SLIM–STRAIGHT	1.867	12.667	.147	.883	1.000
CONTOUR SLIM–PRECURVED	23.745	9.951	2.386	.017	.170
STRAIGHT–PRECURVED	21.879	10.367	2.110	.035	.348
Each row tests the null hypothesis that the distributions in sample 1 and sample 2 are equal. Asymptotic significances (two-sided tests) are displayed. The significance level is .050.					
^a Significance values are fitted by the Bonferroni correction for multiple testing.					

Table 6 (to Figure 2): Overview of insertion angles, manufacturer independent, in relation to the results of the Freiburg monosyllabic test (%), standard deviation (SD), incompletely inserted electrodes N=5 excluded.

Insertion angle	Einsilberversprechen			
	Mittelwert	Median	SD	N
200–250°	45.	45.0		1
250–300°	55.6	52.5	28.6	8
300–350°	66.4	75.0	24.5	21
350–400°	67.9	70.0	20.8	17
400–450°	70.6	80.0	19.6	9
450–500°	65.0	62.5	27.8	8
500–550°	56.0	67.5	27.3	12
550–600°	59.4	55.0	21.3	16
600–650°	62.5	67.5	25.3	4