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Cochlear Implant Fitting in Child: Sweep and SHCHUP

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Abstract

Routine technique of stapedial reflex registration on electric stimulation is applied for cochlear implant fitting of small children. The problem is long duration of this procedure. In order "to shrink" time of reflexometry we suggest method of consecutive stimulation of all 12 electrodes of implant with simultaneous registration of stapedial reflexes – SWEEP method (patented). Threshold levels of stapedial reflex are used as Most Comfortable Levels (MCLs). But these levels are not the best ones for cochlear implanted patients.

Since CI-patients hear sounds, we have to use sounds for fitting too. So we propose our method of fitting by sound stimuli. We divided spectrum of white noise in accordance with widths of every channel, equalized Sound Pressure Level (SPL) of all these bands and summed bands of 1-4, 5-8, 9-12 channels. Patient establishes most comfortable SPL of these stepped noises. In accordance with results of investigation we regulates electrical MCL in appropriate channels (patented). Our method SHCHUP is successfully used for cochlear implant fitting of small children after ESRT-fitting.

Keywords: Cochlear implantation; Fitting; Stapedial reflex; Sweep stimulation-registration; Stepped noise; Most comfortable SPL; Threshold of discomfort

Abbreviations

CI: Cochlear Implanted; MCL: Most Comfortable Level; SPL: Sound Pressure Level

Case Presentation

The basis for successful rehabilitation of implanted patient is optimal fitting of speech processor, i.e. precise setting of threshold and most comfortable levels for each channel. Implant fitting of small children represents the difficult task since they cannot reliably estimate loudness of single electrical stimuli.

In these cases routine technique of stapedial reflex registration on electric stimulation is applied. Threshold levels of stapedial reflex are used as MCLs.

Definition of reflex threshold levels is performed independently for each of 12 channels. It is too long procedure for small child. Not every child will agree to pass the whole procedure in one examination.

In order "to shrink" time of reflexometry we use our method.

Practical use of SWEEP-method

Impedance meter AA220 is set into DECAY mode; program Maestro is set into DINAMIC SWEEP-stimulation mode. Amplitude of stimuli – MCLs in program under research.

Research is performed as follows: a child is in setup mode, probe of impedancemeter is entered in the contralateral ear and the impedancemeter is ready for work. Duration of electrical impulses is 300ms, interval between them equals to 600ms. With this parameters of stimuli we are able to stimulate consecutively all 12 channels of implant OPUS-2 and to register (or do not to register) reflexes during one session of Decay mode scan. Simultaneously "Decay" mode on the impedancemeter and "Sweep" program on PC in Maestro are executed. On display of the impedancemeter we see/don't see 12 stapedial reflexes.

If threshold reflexes in some channels are discovered we do not change the stimulus level in these channels. In those channels, where clear reflex was discovered, we decrease levels of stimulation. In others, where reflex was absent, we increase levels and conduct new session of SWEEP stimulation-registration. This procedure is repeated until threshold levels of reflex will be registered in all channels.

As example of the procedure, the results of research for one examinee are presented in following pictures. Pictures 1-3 were printed from screen of impedancemeter and then were scanned (Figure 1).

Reflexes are absent in channels 4, 8 and 11, greater than threshold in channels 1, 2, 3, 10 and 12 and are close to threshold in channels 5, 6, 7, 9. We increase, decrease, and don't change MCLs in corresponding

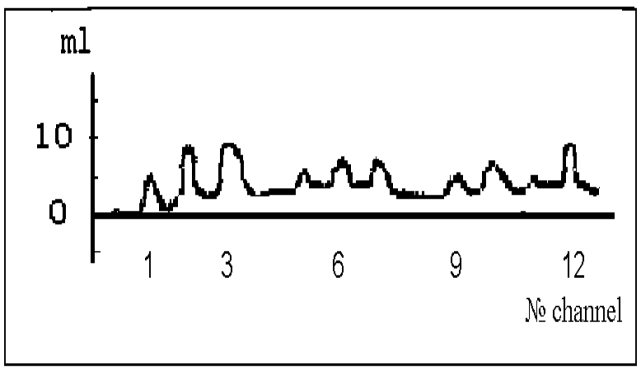

Figure 1: The first session of reflex stimulation-registration.
Abscissa axis – channel number; Ordinate axis – compliance, ml.

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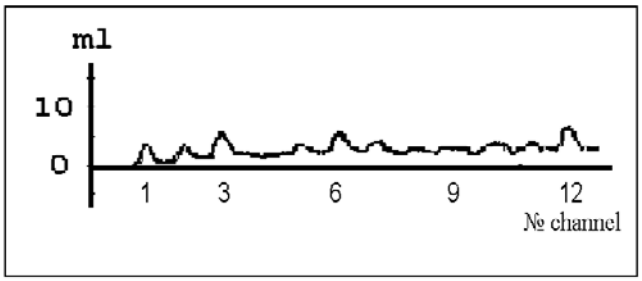

Figure 2: The second session of reflex stimulation-registration. Abscissa axis – channel number; Ordinate axis – compliance, ml.

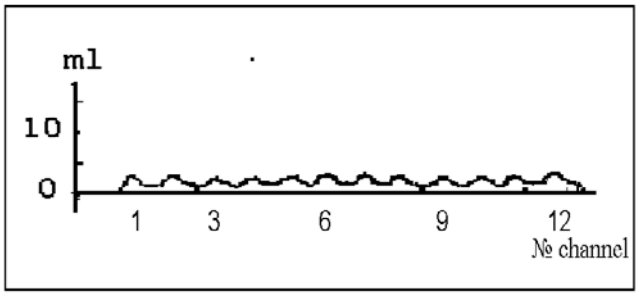

Figure 3: The third session of reflex stimulation-registration. Abscissa axis – channel number; Ordinate axis – compliance, ml.

channels and repeat stimulation- registration (Figure 2).

Reflexes are absent in channels 4 and 8, greater than threshold in channels 3, 6 and 12 and are close to threshold in channels 1, 2, 5, 7, 9, 10 and 11. We increase, decrease, and don't change MCLs in corresponding channels and repeat stimulation- registration (Figure 3).

In all channels threshold levels of stapedial reflex were registered. And this result we had achieved during only 1, 5 minutes. It is not very durable and exhausting procedure for a small child [1-3]. Reducing time of impedancemetry under anesthesia for patient also has a positive effect. For this technique we got a patent of Russian Federation [4].

Threshold levels of stapedial reflex on electric stimulation are applied for fitting of cochlear implant as MCLs. But these levels are not the best ones for CI patients [5,6].

So we offer our method of fitting with the use of special sound stimuli.

There is clarification of our method SHCHUP. As CI-patients hear sounds, we have to use sounds for fitting too. Real sounds (toys, musical instruments, drums, phonemes, speech and so on) have wide (sometimes comb) spectrum with irregularities of amplitudes in different parts of their spectrum. SPLs of such sounds are uncontrolled ones. So it is necessary to create special stimuli.

SHCHUP was created after investigation of 7 adult CI patients with 8-channel implant «Tempo». They were fitted so optimal programs were second programs.

We cut off 8 bands from white noise. Widths of bands are equal

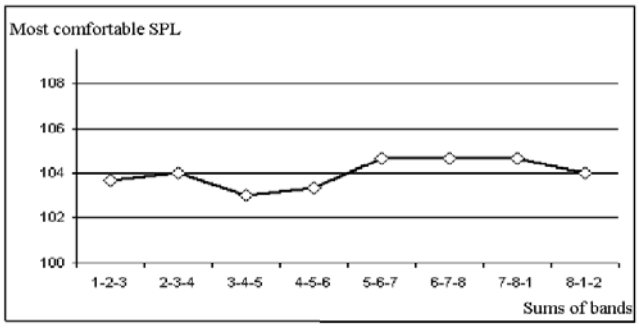

Figure 4: Most comfortable SPLs of 4-channel bands.

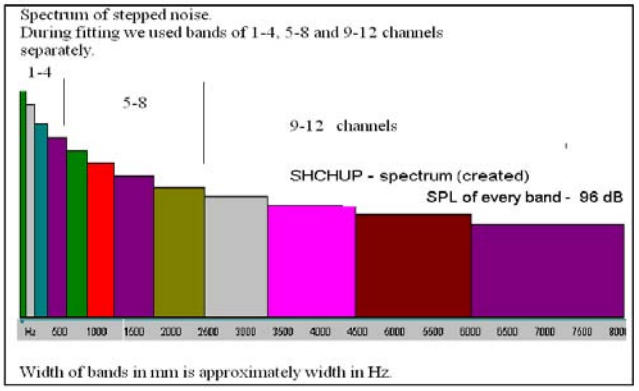

Figure 5: Spectrum of stepped noise (schematically).

to widths of every channel band. We equalized Sound Pressure Level (SPL) of all bands and summed 3 bands of adjacent channels. Result is eight 3-channel stepped noises. The task of a patient was to set SPL of these sums as sound MCL. Amplifier is "Azur 640A», most comfortable program (Figure 4).

Most comfortable SPLs were 103-105 dBs. So 104 dB SPL can be used as most comfortable sound pressure level.

We checked our results. At first quieter program patients did not feel discomfort at level more than 105 dB SPL. At their optimal program all participants subjectively adjusted sound MCLs of stepped noise stimuli in range of 103-105 dB SPL (mean 104 dBs). At third louder program patients felt discomfort at levels less than 105 dB SPL [7].

Now we use three 4-channel stepped stimuli for 12 channel implant.

Spectrum of stepped noise (schematically) is at (Figure 5).

Practical use of SHCHUP

We are slowly changing SPL of stepped noise and observe reaction of patient. After measuring of sound most comfortable SPL of three 4-channel stepped stimuli we regulate electrical MCL in appropriate channels. We increase electrical MCL in channels if patient did not feel discomfort at intensity level more than 105 dB SPL. We decreased MCL if patient felt discomfort at level less than 105 dB SPL. We did not change MCL in channels if patient adjusted sound MCL at level around 105 dB SPL. A few hundreds of CI-patients were fitted using

SHCHUP.

We would like to emphasize that this method of loudness estimation is very suitable method for fitting of small prelingual children in low, middle and high frequency ranges of spectrum separately. And especially for patients with two implants! Reactions of child are similar at equal loudness of stepped sounds of different frequency bands. At SPL near discomfort level child begins to hide face, frowns, conceal himself, turns head to mother with question in eyes and stretches his arm to antenna and so on. There is evident feedback. And reactions are the same ones at the same loudness level in right and left ears.

We want to emphasize the convenience of practical use: If we are slowly increasing SPL we can slightly touch threshold of discomfort at any SPL (90, or 97, or 102 dB SPL…) and immediately decrease intensity of sound. To touch, to notice beginning of negative reaction and quickly to decrease SPL of stepped noise. Child's feedback is carefully observed. Or we cannot achieve (touch) discomfort at 105 and more dB SPL. And in accordance with our observations of patient's reaction we regulate electrical MCLs in patient's map. Our experienced patients said that the estimation of comfortable loudness of one-channel electrical stimulus is much more difficult task for them than an estimation of sound MCL of 4-channel stepped noise stimuli. Participants themselves gave such comments during our experiment.

N.B. Since high SPL are used in SHCHUP there is no need to use a very soundproof chamber. We successfully used circumaural headphone in our practice. It is possible to create "Device for cochlear implant fitting" with 3, 5 or more 4-channel bands for any models of implant.

At end of fitting we create second program using results of SHCHUP. First program is 3 steps lower. Third and forth programs are 3 and 6 steps higher than second program accordingly.

For selection of comfortable program we give instruction-explanation to the parents of CI patients. "During our life we all use always the same program. Sometimes we hear loud sounds. But we do not always use earplugs. Why cannot your CI-child hear loud sounds? Sometimes. Can. And must. Sometimes!!! Program is optimal one if your child sometimes hears loud sounds" [8].

Conclusion

1. Developed procedure SWEEP is faster and more comfortable than routine procedure of estimation reflex thresholds consecutively in each channel. Significant reduction of the reflexometry duration is very important for small children examination.

2. Stepped noises are adequate and suitable stimuli for cochlear implant fitting. Especially of small children. It is very suitable method after ESRT-fitting.

References

1. Petrov SM. Initial Information about Setting of Speech Processor of Cochlear Implant.Vestn. Otolaringol. 2002; 4: 18-20.
2. Lorens A, Walkowiak A, Piotrowska A, Skarzynski H, Anderson I. ESRT and MCL Correlations in Experienced Paediatric Cochlear Implant Users. Cochlear Implants Int. 2004; 1: 28-37.
3. Bergeron F, Hotton M. Comparison of eSRTs and Comfort Levels in Users of Digisonic SP Cochlear Implants. Cochlear Implants Int. 2015; 2: 110-114.
4. Daikhes NA, Pashkov AV, Petrov SM, Yanov Y K. Method of the Cochlear Implant Fitting. 2008.
5. Bresnihan M, Norman G, Scott F, Viani L. Measurement of Comfort Levels by means of Electrical Stapedial Reflex in Children. Arch. Otolaryngol. Head Neck Surg. 2001; 8: 963-966.
6. Petrov SM, Shchukina AA. Objective Methods of Fitting Speech Processors of Cochlear Implants Combi-40/40+ and Tempo+: Impedance Technique. Vestn. Otorinolaringol. 2007; 5: 20-22.
7. Petrov SM, Schukina AA. Method of the Speech Processor Fitting. Patent of Russian Federation. 2009.
8. Petrov SM, Tsjuk AA. Instruction for audiologists and cochlear implanted patients. 2015.

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