Early Changes of Electrical Stapedius Reflex Threshold over Time in Patients Supplied with CI

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Keywords

Electrical stapedius reflex, CI fitting, postoperative ESRT, temporal development

Background/aims

The measurement of postoperative electrical stapedius reflex threshold (ESRT) provides a good predictor of comfort levels for the fitting of cochlear implants (CI) (Bresnihan et al., 2001; Hodges et al., 2003; Spivak & Chute, 1994; Stephan & Welzl-Müller, 2000). In many cases, the ESRT values are directly used for setting comfort levels in the map of the speech processor. The aim of the present study was to evaluate the temporal development of ESRT in an early stage of implant use.

Methods

In a retrospective study, postoperative ESRT data from 16 patients supplied with MED-EL Combi40+ or Pulsar CI^{100} implant devices were analyzed. The patients were tested in routine fitting sessions for speech processor adjustment. ESRT was determined in each of the 12 channels of the cochlear implant using a standard test procedure well established in our department (Stephan et al., 2005). The first ESRT data were collected approximately 4 weeks after switch-on of the implant. Further measurements of ESRT were performed in subsequent routine fitting sessions up to about one year of implant use. In order to quantify the change of ESRT over time, the stimulation intensity at ESRT (charge units) of consecutive fitting sessions were subtracted and divided by the time interval between the sessions yielding a relative quantity of charge per time unit (dQ/dt). No selection of patients despite availability of complete data sets was done.

Results

ESRT channel profiles (i.e. ESRT vs. channel number) of four subsequent fitting sessions for a single subject are shown in figure 1. The first ESRT measurement in this example was carried out 59 days after surgery, the last after about 1 year.

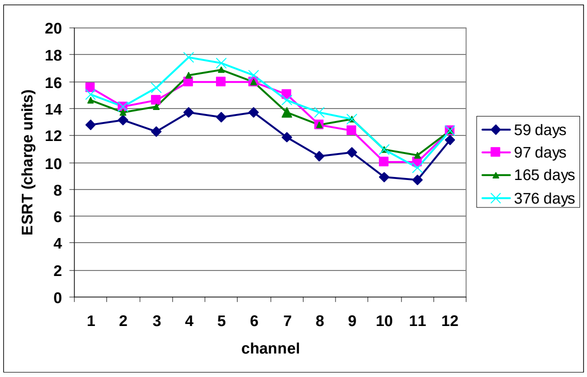

Figure 1: ESRT channel profiles of one subject

In this example only marginal changes in the shape of channel profile are observed, but the whole profile is shifted towards higher stimulation intensity after some time of implant use. In figure 2 the same data are plotted as a function of time. Thus the temporal development of ESRT for each single channel can be illustrated.

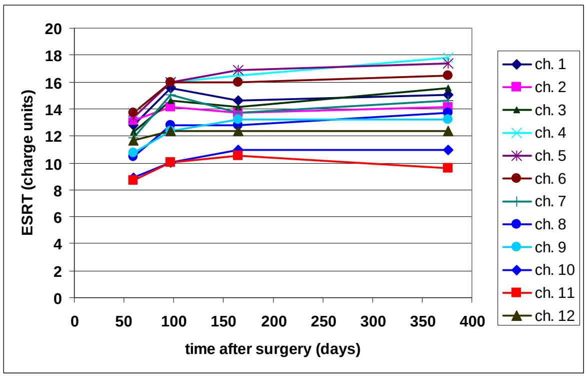

Figure 2: Temporal development of single channel ESRT (data: figure 1)

The nearly parallel location of time dependences of different channels indicates that there appears no major change of channel profile over time in this particular case. The largest changes of the whole ESRT profile occur during the first period of implant use.

The amount of change of the ESRT values over time (dQ/dt) is plotted in figure 3.

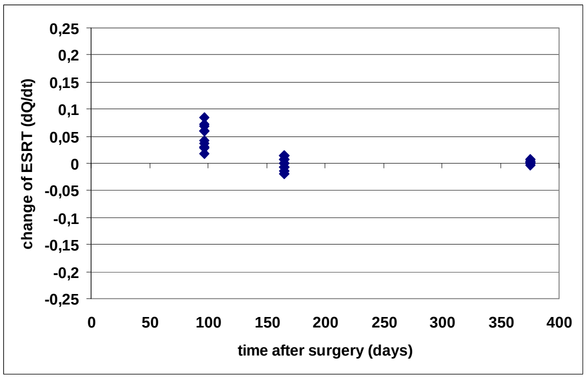

Figure 3: Change of ESRT (dQ/dt) for a single subject (data: figure 1)

Positive values indicate an increase of stimulation level over time, negative values a decrease of stimulation level at ESRT from one to the next fitting session. A value close to zero corresponds to a stable situation of ESRT in subsequent fitting sessions. The range of minimum to maximum dQ/dt indicates the change of channel profile shape over time. In this example less change is observed with longer time of implant use. Figure 4 shows the results for all subjects contributing to the study.

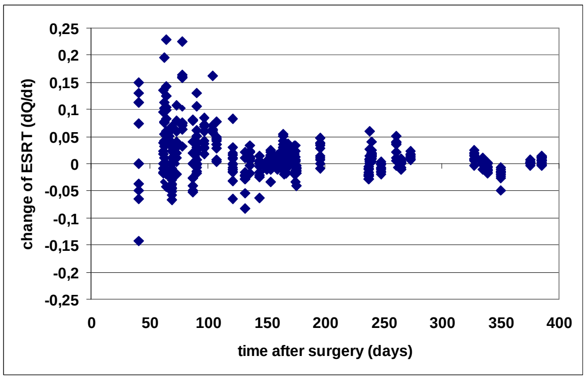

Figure 4: Change of ESRT (dQ/dt) for all subjects (n=16)

The data represent a collection of ESRT measurements of 58 fitting sessions including 696 tests. The change of ESRT values over time are largest in the first period of implant use, i.e. within the first 6 months. The higher number of data points for positive values show that in most cases there appears a trend of increasing ESRT over time. However, in some cases, also a decreasing trend and/ or a change in channel profiles was found. It is interesting to note, that even after one year of implant use still some minor changes may occur.

Conclusions

Repeated measures in the early stage of implant use are necessary and important for the reliable estimation of comfort levels of the CI. Application of such objective measures is particularly helpful for CI fitting in very young children in order to provide appropriate electrical stimulation within the first months of implant use. Changes of stapedius reflex threshold over time cannot be generalized for all patients or for specific electrodes.

Literature

Bresnihan M, Norman G, Scott F, Viani L (2001) Measurement of comfort levels by means of electrical stapedial reflex in children. Arch. Otolaryngol. Head Neck Surg. 127, 963-966

Hodges AV, Butts SL, King JE (2003) Electrically evoked stapedial reflexes: utility in cochlear implant patients. In: Cullington HE (Ed.) Cochlear Implants, Objective Measures.

Whurr Publishers, London, Philadelphia, 81-93

Spivak LG, Chute PM (1994) Programming the cochlear implant based on electrical acoustic reflex thresholds: patient performance. Laryngoscope 104, 1225-30

Stephan K, Welzl-Müller K (2000) Postoperative stapedius reflex tests with simultaneous loudness scaling in patients supplied with cochlear implant. Audiology 39, 13-18

Stephan K, Koci V, Welzl-Müller K (2005) Stapediusreflexmessungen bei der Sprachprozessoranpassung. Proceedings DGA 2005, Compact Disc ISBN 3-9809869-4-2