Remote Fitting of Cochlear Implant System

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Objectives

The fitting procedure of the cochlear implant system introduced in the International Center of Hearing and Speech requires repeated fitting sessions that take place from 3 to 12 times per year, depending on the experience of cochlear implant recipient. Very often patients' visits involve traveling considerable distances. Patients, especially small children, are tired when arriving to the Center, which limits their ability to perform well during measurements and fitting sessions. This, in turn, limits the probability of achieving optimal stimulation parameters and delays the hearing rehabilitation progress. Travelling long distances also involves considerable costs, that may be a large burden for many families. Moreover, limited information flow between specialists in the field and in the implantation clinic makes coherent rehabilitation care a difficult task. The use of field measurement results for cochlear implant fitting is also very limited.

Experience of the team of the Institute of Physiology and Pathology of Hearing in providing care for cochlear implant recipients, and the development of IT tools in recent years, has made a vision of creating telerehabilitation network possible. A new system of using an Internet connection to provide services for patients near their home area was developed and introduced into clinical practice. Experienced specialists from the Institute are now able to perform measurements, cochlear implant system fittings and rehabilitation tasks for patients in polyclinics spread around the country.

Aims of the telerehabilitation network:

- Versatile care for patients after cochlear implantation using a program of complex postoperative hearing rehabilitation matched to the individual needs of every patient
- Coordination of the hearing rehabilitation process that is necessary for development of sound perception and interpretation abilities, and, through systematic training, making speech communication with other people possible
- Realization of social, educational and professional development programs based on knowledge and experience of the multidisciplinary team of specialists in the Institute of Physiology and Pathology of Hearing.
- Spread of knowledge about cochlear implants and the rehabilitation process of implanted patients.

Development of the telerehabilitation network was possible thanks to the new technology of remote fitting of cochlear implant systems, introduced in the International Center of Hearing and Speech. Research. Development of this method started in 2005 and included identification of suitable IT hardware and software, preparation of necessary setups, development of dedicated clinical procedures and analysis of patients' and specialists' accepting of the new method as an alternative to standard, face-to-face fittings.

This paper describes the remote fitting method and presents some results of a remote fitting study that was performed in 2007 and 2008 to check our patient's appreciation of the new method.

Method

Four PC computers are used for the remote fitting method: two on the patient's side (**B**) and two on the specialist's side (**A**). On both sides, internet cameras, microphones and loudspeakers are used to provide communication between the patient and the specialist. One of the computers on patient's side is equipped with clinical interfaces to provide communication with the speech processor and the implant (Figure 1.).

The patient's speech processor is connected to the clinical interface on computer **B** at the distant polyclinic. The fitting specialist, working on computer **A** in the International Center of Hearing of Speech, using a remote desktop application, takes control of computer **B** via an Internet connection. It is now possible to start fitting the software and to perform any actions necessary for measurements and fittings.

The communication between the specialists and the patient is secured by the use of an audio-video connection over the Internet between computer **A'** and **B'**. On the patient's site there are also support specialists - speech therapists etc., providing help for the patient in the process of communication with the specialists. Commercially available software is used for the remote desktop and audio-video system.

During remote fitting session it is possible to perform:

- Telemetric measurements to check the internal part of the system
- Psychophysical measurements, including amplitude growth function
- Objective measurements: Electrically elicited compound action potentials
- Programming new electrical stimulation parameters into the patient's speech processor
- Activation of the speech processor in "live' mode
- Consultation about ways to use new settings in the speech processor

After the session, the support specialist disconnects the processor from the interface and gives the patient a new processor with the programs

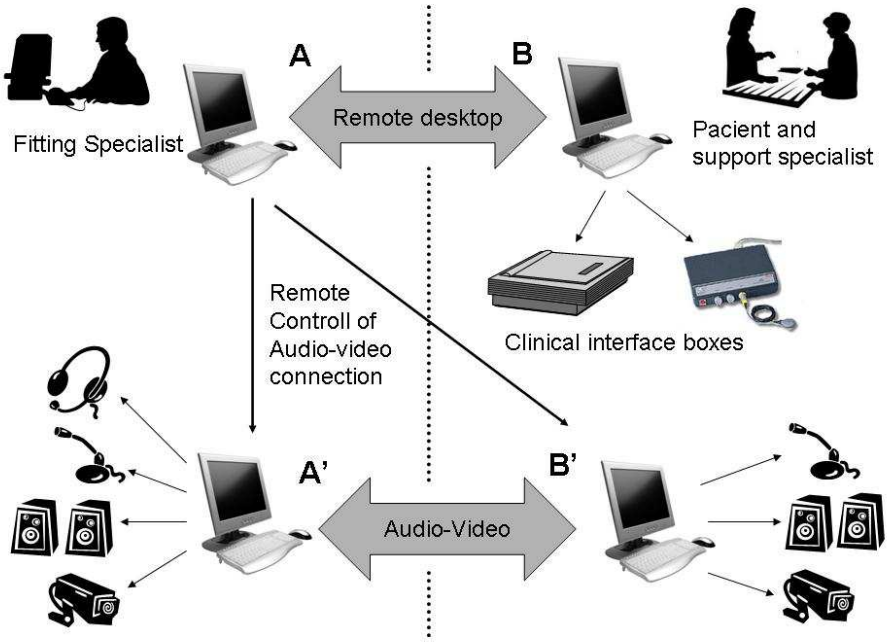

Figure 1. Remote fitting of the Cochlear implant speech processor: hardware used in the method

Patients' appreciation of the new method was verified during a remote fitting study with 30 adult patients, age from 18 to 63 years. In 29 cases the study protocol was successfully conducted, in one case, due to severe facial nerve stimulation (FNS), the specialist decided to stop the measurements.

Two sessions: local and remote were performed during the same day one after another. In both sessions the same starting baseline parameter set was used and fitting was performed according to a similar fitting protocol. Questionnaires for patients were presented after each session, for audiologists and support specialists after the remote fitting session. Responders were asked about the quality and reliability of audio and video communication, performance and time effectiveness of the remote fitting method, comfort during sessions and possible time, effort and cost reduction in daily life. A Likert scale was used for assessment.

Results

The results for a few questions are presented; these include the most important, in the authors' opinion. For the majority of patients, the remote fitting method is an efficient alterative for standard, face-to-face fitting sessions (9 strongly agree, 17 agree, 3 undecided), and this new technology would make life easier (10 strongly agree, 15 agree, 3 undecided, 1 strongly disagree). The results of the remote session were satisfactory for 25 patients, with 3 undecided; 1 disagreed.

The fitting specialists' responses showed that remote measurement was safe for the recipient (20 strongly agree, 9 agree), and usually comparable to a face-to-face session (14 strongly agree, 11 agree, 4 undecided). It was also easy to use (15 strongly agree, 14 agree).

Conclusions

The results of this study, including subjective feedback from recipients, audiologists and monitoring clinicians, suggest that a remote fitting procedure as used in the Institute of Physiology and Pathology of Hearing is a viable alternative to the normal fitting routine. Most recipients felt comfortable in the remote fitting setup and the remote session results were as satisfactory as local fitting results. In one case, due to severe FNS on many electrodes the decision to interrupt the study protocol was made.

Based on the results of this study and several years' experiences, our remote cochlear implant system fitting was accepted as a very useful and safe technology, appreciated both by patients and specialists. It was introduced into clinical practice in polyclinics cooperating with the Institute of Physiology and Pathology of Hearing, and was a base for development of the telerehabilitation network program, introduced into clinical practice in 2008 and awarded with gold medals on Brussels Innova 2008 and Concours Lepine 2009.