

Hearing Aid Fitting: Application of Telemedicine in Audiology

Theo Wesendahl

Mathias-Spital/auric Hörsysteme, Rheine, Germany

Abstract: Telemedicine is used as a tool for therapeutic performances with the aid of telematics. The term *telematics*, a compound of the words *telecommunication* and *informatics*, means (in general) electronic transfer of digital data. We describe an application of telemedicine in the field of audiology: the initial fitting, setup, fine tuning, and follow-up fitting of all kinds of digital programmable and digital signal-processing devices and the fitting of hearing aids in real soundscapes. Against a backdrop of limited resources and continuous innovations, telemedicine offers the possibility of increasing the efficiency of audiological methods and decreasing expenses at the same time.

Key Words: audiology; hearing aid fitting; real soundscapes; telemedicine

According to Prof. Hans-Peter Zenner of Tübingen, Germany (personal communication, 2000), approximately 20% of all Germans complain of a hearing loss, and only 20% of this group could be rehabilitated by an operation. The others (approximately 13.5 million people) are treatable by means of hearing devices. Of these, however, fewer than 25% have yet received hearing aids, and a number of those who have hearing aids do not use them.

Some important reasons for these circumstances are the stigma of wearing hearing aids, an unsatisfactory solution in contrast to the marketing promises of the prescribed device, the quality of fitting in artificial conditions rather than in real soundscapes, and the price. On-line telecommunication can be used to address these medical, audiological, technical, and financial issues and to integrate the ear, nose, and throat (ENT) doctor in the on-line fitting concept. Such technologies as telephone, fax, and e-mail already are being used to communicate with hearing-impaired persons, as are more sophisticated forms of telecommunication, such as interactive video and remote-control audiometry. In addition, especially over the last 15 years, hearing devices have evolved from behind-the-ear, in-the-ear, in-the-canal, and semi-implantable or implantable hearing

systems and their supportive technology through analog to digital devices. The latter typically have a digital control section, which stores the auditory parameters, and a signal-processing section, which may be analog in the digital programmable hearing aids or digital in the digital signal-processing devices. Hence, increasingly often the hearing devices are programmed on-line in a sound-protected fitting room using a computer and interface (Fig. 1).

The environment of the sound-protected fitting room in which a technician generally fits a hearing aid often is not relevant to actual soundscapes in which the patient experiences communication problems. This situation can be improved by on-line telecommunication, employing the audiological and technical competence of a highly experienced hearing aid technician in cooperation with an ENT doctor (Fig. 2). The figure shows the principal method of implementing the on-line telecommunication procedure. In the upper left portion of the figure is depicted the building housing the computer center in which the hearing aid technician is working. The upper right part of the figure shows the building in which the patient is located. The patient's hearing aid is remotely connected via a communication medium, in this case a telephone cable. However, wireless communication media (e.g., global system for mobile communications, general packet radio services, universal mobile telecommunications systems, and the Internet) may also be used. The set of auditory parameters of the individual patient can be stored in the programmable memory of the hearing aid. In this case, a modem and a

Reprint requests: Theo Wesendahl, Dr. med. Diplom Physiker, Osnabrücker Str. 2-12, 48429 Rheine, Germany. Phone: +49 (5971) 9699-40; Fax: +49 (5971) 9699-84; E-mail: t.wesendahl@t-online.de



Figure 1. Hearing aid technician in a sound-protected fitting room with a client.

personal computer with interfaces are on both sides of the communication media at the remote location. The changes in programming can be discussed via a second communication channel (e.g., by means of telephone or video conferencing). Thus, the patient can be contacted, and further information can be exchanged.

Programming at the remote location can be accomplished by means of a variety of hardware and software combinations, such as the special hand-held device in Figure 3 or a commercially available personal digital assistant, such as the Jornada 680 from Hewlett Packard (Hewlett Packard, Palo Alto, CA, USA).

The process starts with an investigation and prescription by the ENT doctor. Then impressions of the outer ears are made. The impressions and the audiological data are sent to the hearing aid manufacturer. The prescription and the impressions are reviewed according to quality assurance protocol, and hearing aid selection (e.g., behind-the-ear or in-the-canal) is confirmed. Then the hearing aids are built. At the next step in the process, the hearing aid technician calculates the auditory parameters of the particular patient's hearing deficiency and programs the hearing aids. The parameters of the hearing aids then are tested by an audio analyzer.

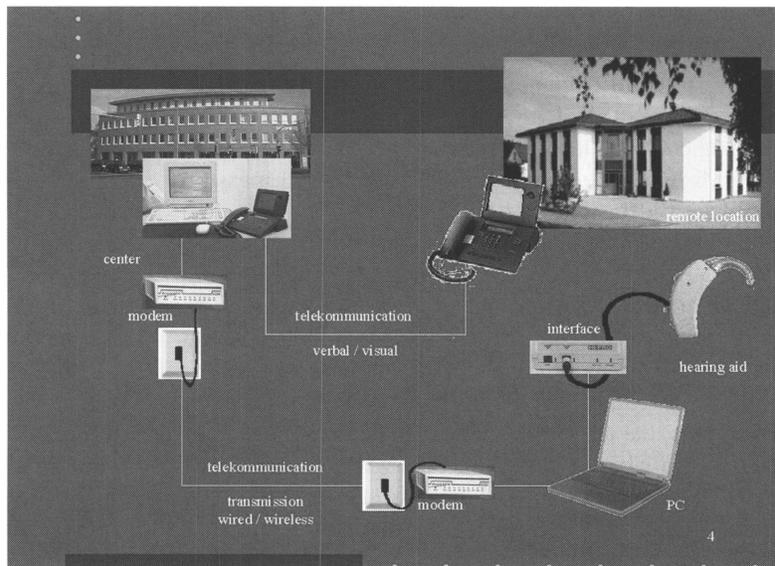


Figure 2. Principal method of on-line telecommunication between a hearing aid technician and an ear, nose, and throat doctor.

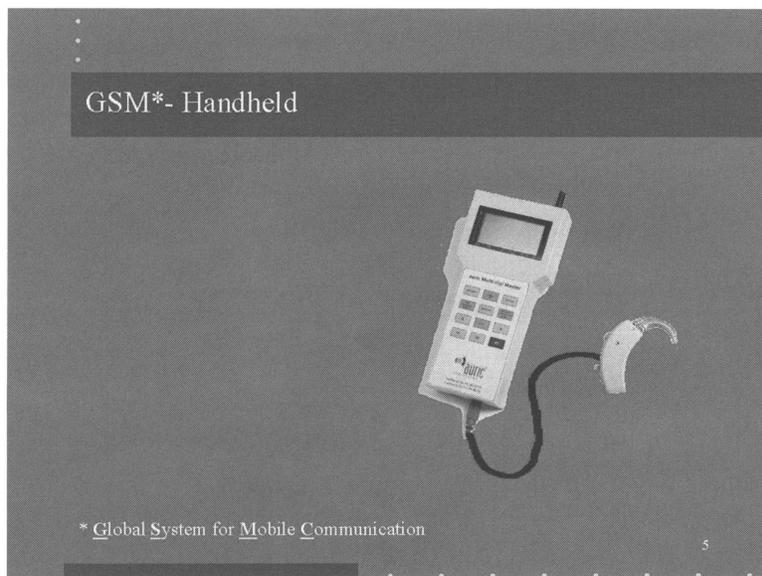


Figure 3. Hand-held device: combination of a cellular phone and hearing aid programmer.



Figure 4. Fine tuning of the hearing aid in noisy surroundings, such as an automotive repair shop.

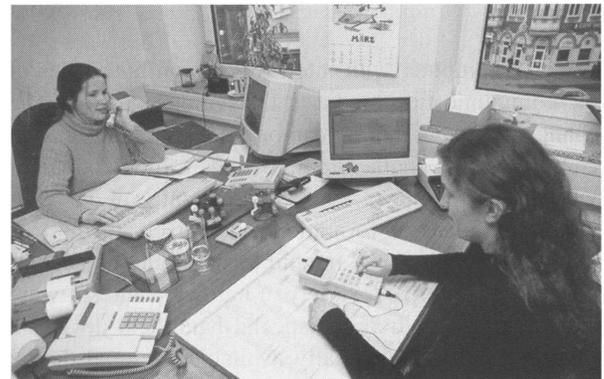


Figure 5. Fine tuning of the hearing aid in an office.

The results are documented, and the hearing aids are sent to the ENT doctor.

At the remote location, the patient receives the hearing aids and undergoes a first hearing test, to measure the achieved benefit and to determine whether a fine tuning by telecommunication is required. In the ensuing days or weeks, further fine adjustments of the hearing aid parameters are made, and a follow-up fitting may be performed on the basis of the feedback obtained on a patient questionnaire and the results of hearing tests.

One advantage of the on-line telecommunication concept is that a highly experienced hearing aid technician is available to remote centers without restrictions of time and location. The hearing aid technician is trained in the latest technical developments and programming procedures. Another advantage is that this

concept affords the ENT doctor who is responsible for the rehabilitation of patients with hearing loss an opportunity to understand and address the individual needs of patients in cooperation with the hearing aid technician. An additional benefit of this application of on-line telecommunication via the hand-held device shown in Figure 3 is that the wearer can be supported in the fine adjustment of the hearing aid in real soundscapes (Figs. 4, 5).

Such a system makes possible the initial fitting, setup, fine tuning, and after-care fitting of all types of digitally programmable and digital hearing aids. Against a backdrop of limited resources and continuous innovations, telemedicine offers an opportunity to increase the efficiency of audiological methods and decrease expenses simultaneously.