TELEFITTING BETWEEN KAJETANY, POLAND AND ODESSA, UKRAINE FOR COCHLEAR IMPLANTS

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Abstract

Hearing implant fitting is a key component of postoperative patients’ healthcare, by providing the optimum auditory nerve electrical stimulation parameters. It often entails time consuming and long travel to a medical centre, with associated costs. In 2009, the Word Hearing Centre introduced the National Network of Teleaudiology to reduce the burden to patients, and it now consists of 21 co-operating centres in Poland and four abroad in the Ukraine (Odessa and Lutsk), Kyrgyzstan (Bishkek), and Belarus (Brest). The centre in Odessa is sufficiently equipped but programming of cochlear implants cannot be conducted by their team there due to a lack of trained specialists and limited experience. This study reports the use of the telefitting service between Kajetany in Poland and Odessa in the Ukraine. Methods: Specialists in Poland connect by videoconference with patients and support specialists via the Internet, and use remote desktop software to access a remote computer and perform fitting. On completion of telefitting, patients completed a questionnaire in which they compared the telefitting experience with face to face conventional fitting. Results: Supported by a local specialist, 316 patients in Odessa underwent remote telefitting by specialists in Kajetany. Over 95% of respondents were; satisfied with telefitting, found it a suitable alternative to standard fitting, felt that they had good contact by videoconference with the audiologist in Poland, and that it saved them time and money. Conclusion: The development of the telefitting model has increased accessibility to hearing care services in Odessa and opens new possibilities for patients.

Keywords: teleaudiology; telefitting; cochlear implant; telemedicine; videoconference

Introduction

A cochlear implant (CI) is a type of electronic auditory prosthesis that enables the perception of sound in people with total or partial deafness.¹² With direct electrical stimulation of the auditory nerve endings, it is possible to replace the function of the damaged organ, the cochlear receptor.² The cochlear implant system consists of two parts – an internal component, placed surgically in the niche of the temporal bone under the dural patch, and an outer component, carried behind the ear.¹ The internal part consists of a receiver and an electrical stimulator, i.e. implant capsules, and electrodes inside the cochlea. The outer part is a digital speech processor.¹⁴⁵ The principle of the cochlear implant is based on proper electrical stimulation of the auditory nerve endings. The function of the auditory cells, and exchange of sound on neural impulses, is replaced by the implant system. The speech processor microphone receives an acoustic signal and then converts it into an analogue electrical signal that is fed to the input of an analogue-digital converter and converted into a digital signal. This, in turn, is converted into an electric stimulus, and then transmitted via a transmitter to the internal part via a radio wave implant.⁶

Fitting of hearing implants is a key component of postoperative healthcare, by providing the optimum auditory nerve electrical stimulation parameters. A unique method of remote cochlear implant system fitting was developed and introduced in the clinical practice of the International Centre of Hearing and Speech. Using Internet communication and videoconferencing applications, the specialist can perform necessary tests and fitting sessions with a patient who visit the more convenient and suitably equipped clinic in Odessa.

Access to audiological services is a major problem in the Ukraine. The lack of adequately trained personnel and cost result in failure to diagnose hearing deficits in children and even adults. Parents may fail to perceive or detect a child’s
hearing problems. The majority of patients who have received a cochlear implant are unable to have the implant correctly fitted locally. This requires them to undertake a long trip to the cochlear implant clinic, which is both time consuming and costly. While the centre in Odessa is sufficiently equipped, programming of cochlear implants cannot be conducted there because of a lack of trained specialists and their limited experience. To overcome this problem, ‘telefitting’ has been proposed.

The Chornomorski Centre of Hearing and Speech Medincus in Odessa is the first foreign facility of the Centre of Hearing and Speech MEDINCUS. The Centre provides diagnostics and healthcare for patients within the scope of otorhinolaryngology and hearing and speech rehabilitation. Fitting and servicing of cochlear implants, as well as the selection, fitting and servicing of hearing aids, are provided in the Centre. A wide range of telemedicine is used in the Centre in collaboration with the Centre for Hearing and Speech Medincus in Kajetany.

This paper reports the use of telefitting between the Kajetany in Poland and Odessa in the Ukraine.

Methods

Three hundred and sixteen CI users scheduled for telefitting participated in the study. The participants ranged in age from 12 to 86 years, mean age was 34.5±16.9 years. All patients were experienced users of the CI system, and had been using the system for an average of 56.5±31.8 months.

Each patient first underwent a teleconsultation procedure developed for CI and introduced into clinical practice in the National Network of Teleaudiology (NNT) and completed a clinical questionnaire. The purpose of the procedure was to closely emulate the standard procedure used during face-to-face visits in the Institute Psychology and Pathology of Hearing (IPPH). This was followed by remote fitting – an engineer from the IPPH discussed with the patient and the support speech specialist the results of the questionnaire. The telefitting was carried out in accordance with the previously described procedure.

After a remote fitting the patient completed another questionnaire in which they were asked about the quality of the audio-video connection, the quality of their interaction with the specialist from IPPH, how this compared to face-to-face consultation, their satisfaction with telefitting, whether telefitting was an alternative to conventional fitting and if telefitting saved them time and money.

The methods used during telefitting included: telemetric measurement of the internal part of the cochlear implant system, examination of the auditory nerve response, stapedius reflex testing (eSR), and programming of electrical stimulation parameters to the patient's speech processor. In order to carry out all of the described tests during teleconsultations, it was necessary to combine computers in two cooperating centres. For telefitting a computer with the appropriate software, an Internet connection and a system that allows the two centres to connect together was used. The Internet allowed specialists from Poland to set up a teleconference for audio and video contact with the patient and support specialist in Odessa, and allowed remote desktop software to access a computer and perform fitting. Every node was equipped with teleconference terminals from Polycom Inc. with LCD screens and Polycom cameras with pan tilt and zoom capability connected to a system with symmetrical Internet connections. There was also a personal computer equipped with clinical interface boxes with appropriate fitting software. The ‘Logmein.com’ application is used for remote control.

The technology allowed specialists the option of remote testing but the local medical personnel, specialists and assistants lacked the necessary computer skills and knowledge of the computer programme to effectively perform the tasks required of them. These included the appropriate placement of: headphones for audiometric testing; the measuring probe in the case of otoacoustic emission tests (OAE); electrodes when the auditory brainstem responses (ABR) measurement is performed; and connecting the speech processor to the computer. As staff should be prepared both technically and in terms of general knowledge about telemedicine training for medical personnel in the Ukraine facility was therefore a priority and several training courses were held for them in Poland, as the first step in remote telefitting.

Procedure of telefitting

In the Institute Physiology and Pathology the hearing teleconsultation procedure included ENT examination, a preparation stage and telefitting. During the preparation stage, a support specialist conducted a structured interview with the patient concerning hearing benefits, communication skills, and usage schemes in daily life, followed by psychoacoustic measurements. The last step of preparation was consultation with a local speech therapist.

Four remote computers were used for the remote fitting method: two with the patient and two with the specialist. On both sides, webcams, microphones and speakers were used for communication between patients and specialist. One of the computers on the patient’s side was equipped with clinical interfaces ensuring communication with the speech processor and the implant.

The patient’s speech processor was connected to the clinical interface on a remote computer in the polyclinic. The equipment specialist, working on a computer at the World Hearing Centre, used the remote desktop application, and took control of the computer via the Internet connection. The specialista could then start telefitting. The remote site in Kajetany was connected to Odessa using a synchronous exchange, i.e., remote fitting with videoconferencing, during the entire process.

Patients could participate in a telerehabilitation service during postoperative care. Telerehabilitation was used for
both children and adults, who were diagnosed with partial deafness, and who had qualified for cochlear implant treatment. Based on our experience, this form of rehabilitation is suitable for most patients with the following needs or problems: limited reception, differentiation and recognition of subject and speech sounds; receiving verbal messages with visual support; mastering the appropriate speech and language for their developmental age with limited phonological awareness of the language and problems with the application of grammatical rules that organise the statement; disturbances in terms of pronunciation of sounds, especially from the high frequency area and disturbance of speech prosody while maintaining or developing verbal communication.

Results

Ninety-five percent or more of respondents agreed or strongly agreed that they were satisfied with telefitting, found it a suitable alternative to standard fitting, that it saved them time and money and felt that they had good contact, by videoconference, with the audiologist in Poland. (Table 1)

<table>
<thead>
<tr>
<th>Table 1. Results of the questionnaire.</th>
<th>Strongly agree</th>
<th>Agree</th>
<th>Neither agree nor disagree</th>
<th>Disagree</th>
<th>Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quality of audio-video connection is good</td>
<td>180 (57%)</td>
<td>124 (39.2%)</td>
<td>4 (1.3%)</td>
<td>6 (1.9%)</td>
<td>2 (0.6%)</td>
</tr>
<tr>
<td>I had good contact with audiologist</td>
<td>115 (37%)</td>
<td>156 (50.2%)</td>
<td>14 (4.5%)</td>
<td>16 (5.1%)</td>
<td>10 (3.2%)</td>
</tr>
<tr>
<td>I felt safe and secure during telefitting</td>
<td>151 (47.8%)</td>
<td>150 (47.5%)</td>
<td>7 (2.2%)</td>
<td>7 (2.2%)</td>
<td>1 (0.3%)</td>
</tr>
<tr>
<td>I'm satisfied with the course and effects of telefitting</td>
<td>162 (51.3%)</td>
<td>142 (44.9%)</td>
<td>4 (1.3%)</td>
<td>5 (1.6%)</td>
<td>3 (0.9%)</td>
</tr>
<tr>
<td>Telefitting is an alternative for standard fitting</td>
<td>154 (48.9%)</td>
<td>145 (46%)</td>
<td>12 (3.8%)</td>
<td>3 (1%)</td>
<td>1 (0.3%)</td>
</tr>
<tr>
<td>Telefitting allowed for saving in time and money</td>
<td>233 (74%)</td>
<td>76 (24.1%)</td>
<td>4 (1.3%)</td>
<td>1 (0.3%)</td>
<td>1 (0.3%)</td>
</tr>
</tbody>
</table>

Discussion

Patients responded positively to telefitting. Over 95% of patients were satisfied with the videoconference quality and telefitting, and would be happy for it to replace routine control visits to Kajetany. Only 8% indicated that contact with a clinical engineer was not as good as during a traditional visit to the IPPH in Kajetany. Telefitting also saved them time and money.

The traditional method of fitting requires a minimum of 8-10 visits to a medical centre during the first year of the implant and subsequently 1-2 visits a year during the initial period. This can be a significant burden for patients living far from fitting centres or without access to suitable transport. Medical consultations through telemedicine programmes are an attractive option for patients, especially those living in areas where there are no centres providing such services. What is important is that in order to obtain satisfactory effects of rehabilitation, especially in children, frequent contact with the speech therapist is necessary with ongoing adjustment of the processor settings based on their comments. By reducing costs and time, implementation of telefitting will increase access to specialists which will have a positive effect on the expected results.

The American Society for Speech, Language and Hearing defines telepractice as "the application of telecommunications technology to the delivery of speech language pathology and audiology professional services at a distance by linking clinician to client or clinician to clinician for assessment, intervention, and/or consultation". Telemedicine provides patients with access to medical services through telecommunications and Internet technology. This type of medical care has been dynamically developed over the past dozen or so years and now includes a wide spectrum specialties including cardiology, dermatology, paediatrics and audiology.

Telemedicine can also be a helpful tool in the process of fitting the cochlear implants. According to Lorens postoperative care after cochlear implantation should be based on the latest functional disability model, which was created for the needs of the International Classification of Functioning, Disability and Health - ICF. This model

assumes that disability is a holistic term, including damage, limitations of activity and restrictions on participation.

There are no significant clinical differences between the traditional method of fitting the cochlear implant and the telefitting method. This is confirmed by studies conducted by various authors who have assessed the possibility of using telemedicine in the care of patients after the implantation of the cochlear implants. Studies 2009 by Ramos et al. in 2009 indicated no significant differences between the most-comfortable loudness level (MCL) measurements performed using the standard method and using telemedicine programmes. There were also no differences between measurements of free field hearing thresholds and speech perception tests performed on the basis of fitting using both methods.

Mc Elveen et al. in 2010 compared the average hearing thresholds in pure tone audimetry before and after implantation and speech perception in two groups of patients.
(one of them participating in the traditional method of fitting implants and second using telefitting).

Wesarg et al. compared the level maps determined using the traditional method of fitting and using telefitting and found no clinically significant differences between the results of measurements made with both methods. In 2012, Hughes et al. compared telefitting and the traditional method of fitting cochlear implants, including such factors as: electrode impedance measurement, psychometric thresholds using adaptive methods, speech processor programmes and conducted speech perception tests. There were no statistically significant differences between impedance measurements of electrodes made with both methods. The study of speech perception via telefitting gave significantly worse results than the study of speech perception in a traditional way (probably due to the lack of audiometric cabins in telefitting centres).

Programmes for fitting cochlear implants using teleconferences were described by Polovoy and Franck. They draw attention to possible difficulties (for instance difficult contact with the patient, problems with the Internet connection, delay in transfer), but also emphasised the benefits of fitting the cochlear implants via teleconferencing (among others saving time, reducing costs, the opportunity to help more people). Franck also stated that fitting cochlear implants via telemedicine may not be possible in all patients. In small children, in whom it is important to observe their reaction, programming the implant during a teleconference can be very difficult. In 2003, Wesendahl indicated the need for a qualified and experienced hearing care professional in a telemedicine centre (in order to ensure adequate quality of services).

Campos et al. indicated that the total time of consultations with telemedicine was shorter or the same as the consultation time during a traditional visit to the doctor's office. However, the process of programming and verification of hearing aid programmes via teleconsultation required more time compared to the traditional method. However, there were no significant differences in the clinical practice.

The results of the current study, including subjective feedback from CI users, audiologists and clinicians, suggest that the telefitting procedure used in the IPPH is a viable alternative to the stationary fitting procedure. Most of the patients felt comfortable in the remote assembly settings, and the results of the remote session were as satisfactory as the results of the local fitting. Adaptation of the implant system is a problem-solving exercise aimed at reducing the negative effects of hearing loss by creating conditions for activity and restoring full participation in life situations. An unquestionable basis for fitting the implant system is the selection of appropriate electrical stimulation parameters to compensate for the loss of hearing loss.

National Network of Teleaudiology (NNT) suites use state-of-the-art software and videoconferencing equipment, which can be employed for the unique testing, measurement and selection procedures required of cochlear implant users. It enables the cooperation of specialists from many fields including clinical engineers, physicians, speech therapists, psychologists, and audiologists to provide the best postoperative care possible to patients with cochlear implants. Such a solution is extremely helpful to patients whose costs are minimised (and who also experience lower anxiety) by visiting local telemedicine centres instead of travelling long distances medical centres. NNT is providing a wide range of telehealth applications like telefitting, telediagnostics, telediagnosis, telediagnosis, telediagnostics, telerehabilitation, or tele-education.

**Conclusion**

This vision of NNT achieved through the efforts of the IPPH in Kajetany has resulted in the creation of an international space enabling fast and comfortable cooperation between scientists and clinicians, working together for the best possible quality of patients with different health burdens. It provides efficient services and has resulted in significant savings for both patients and doctors. The programme is still a leader in many applications of telemedicine and teleaudiology in the field of hearing protection, including tele-education, screening, diagnostics, hearing aids and cochlear implantation technologies. It is likely that these efforts will continue to grow both on a regional and international scale, aiming to service any customer anywhere, anytime.

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**Conflict of interest.** The authors declare no conflicts of interest.

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