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Telerehabilitation in speech-language therapy as exemplified by aphasic patients. A research review

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The present paper discusses application of telerehabilitation services in speech therapy management in aphasic adults. The author presents theoretical issues related to the specifics of therapeutic effects of at a distance approach and indicates its recipients, focusing on neurological patients with language difficulties. Further on, the author reviews the selected studies on telerehabilitation used in diagnoses and therapies of aphasic speech disorders.

KEY WORDS: aphasia, speech-language therapy, information technologies, telerehabilitation, speech disorders

Introduction

Speech therapy is today, undoubtedly, a very rapidly growing academic and practical field of study both in Poland and in the world. This incredible acceleration in its growth guarantees the development of new approaches to diagnostic procedures and speech disorder therapies. Some trends in contemporary speech therapy easily permeate into the practical sphere and gain approval of therapists, the others

become subjects of many disputes and objects of multiple controversies. The second trend is exemplified by application of a wide range of the latest technologies, not only in complementary relation to traditional speech therapy management[1] as well as, or perhaps most of all, as a substitute for the latter. Continuous progress of advanced technologies makes this substitute approach possible through application of telerehabilitation services in therapeutic processes.

Telerehabilitation and its possible applications in aphasic patients

Telerehabilitation is an innovative approach that refers to providing rehabilitation services at a distance using information and communication technologies. The first attempts at its definition were made in the late 90's in the USA. However, it is worth resorting to more recent and complete definition of The American Occupational Therapy Association that perceives telerehabilitation as: *clinical application of consulting, preventive, diagnostic and therapeutic services based on interactive telecommunication technologies*.[2] Such a wide scope of services may be provided in two major ways: synchronous one – based on a constant, real-time communication between a therapist and a patient and an asynchronous one – based on deferred communication, i.e. not requiring the presence of both parties at the same time. The tools aiding the first model include, among the others: chat rooms, audio and videoconference equipment, such as phones, Skype and Zoom. In case of the second approach this covers the instruments such as e-mails, messages and forums.[3]

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[1] In this paper traditional speech therapy approach refers to the therapy performed in person (at a therapist's surgery or a patient's house).

[2] M. Łukowicz, S. Śmigiel, M. Andryszczyk, *Telerehabilitacja*, Wydawnictwa Uczelniane Uniwersytetu Technologiczno-Przyrodniczego, Bydgoszcz 2015, p. 11.

[3] J. Jatkowska, *B-learning w diagnozie i terapii logopedycznej dzieci*, Grupa Wydawnicza Harmonia, Gdańsk 2019, p. 20.

M. Kuciapski, *Podstawowe technologie e-learningowe*, https://www.slideshare.net/mkuciapski/podstawowe-technologie-elearningowe-presentation [05 Aug. 2020].

Telerehabilitation services are dedicated to a wide range of recipients; both children and adults suffering from somatic diseases, consequences of accidents, mental disabilities, hearing difficulties and disorders requiring psychological supports or others including speech pathologies. In English-speaking countries telerehabilitation services are often referred to as *telespeech*. As it appears from literature review main recipients of these services are often aphasic persons.

The logopedic classification of speech disorders developed by Stanisław Grabias places aphasia in a group of disorders associated with the breakdown of communication system. Accordingly, aphasias are perceived as *disorders resulting from cortical damage of all types of competences, manifested by a complete or partial disintegration of all types of competences (sensory aphasia) and/or impairment of the ability to speak (motor aphasia)*.[4] This language deficit may result from many nosological aspects of neurological nature, such as ischemia and hemorrhagic stroke and craniocerebral injuries. However, these are not the only disorders inducing aphasic speech disorders and another group of pathogenic factors includes other brain changes such as tumours and neurodegenerative processes as well as intoxications related to ethyl alcohol or carbon monoxide.[5]

Traditional speech therapies directed at aphasic persons often rely on didactic aids such as workbooks and handouts.[6] First references to possibilities of expanding the existing rehabilitation methods in this group of patients by supplementing the therapeutic process with modern technologies go back to the 80's of the last century. At that time many scholars ventured their bold assumptions that in the near future computers will not only aid but *partially or even completely replace therapists in their work with patients*.[7] Although these predictions

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[4] S. Grabias, *Mowa i jej zaburzenia*, „Audiofonologia" 1997, no. 10, p. 34.

[5] J. Panasiuk, *Afazja a interakcja. Tekst – metaTekst – konTekst*, Wydawnictwo Uniwersytetu Marii Curie-Skłodowskiej, Lublin 2013, pp. 58–67.

[6] M. Kręcichwost, Z. Miodońska, *Technologie informatyczne w procesie rehabilitacji logopedycznej na przykładzie terapii afazji*, „Edukacja – Technika – Informatyka" 2015, no. 3(13), pp. 339–344.

[7] M. Pąchalska, *Terapia chorego z afazją*, [in:] Logopedia. Pytania i odpowiedzi. Podręcznik akademicki, vol. 2, eds. T. Gałgowski, G. Jastrzębowska, Wydawnictwo Uniwersytetu Opolskiego, Opole 2003, p. 764.

Table 1. Review of selected studies on the use of telerehabilitation in aphasia

Study			Study description	Study results
Authors	Country	Study aim		
Anne J. Hill et al. 2009	Australia	Determination of the effects of aphasia on the possibility of evaluation of speech disorders via telerehabilitation services.	32 aphasic participants were simultaneously evaluated with two methods, i.e. telerehabilitation and direct one (face to face) based on BDAE and BNT. The first type of diagnostics, developed by the Queensland University, was provided by the system allowing for online evaluation. The subjects were grouped in accordance with the advancement of aphasic speech disorders and the analyses of the obtained data were performed by 22 evaluators.	The results showed that the grade of aphasia advancement did not significantly affect the accuracy of telerehabilitation assessment of the majority of BDAE battery (the exceptions were the attempts of naming and paraphasia evaluation). Moreover, the obtained results in direct and telerehabilitation modes were compared with regard to each grade of advancement.
Michela Agostini et al. 2014	Italy	Comparison of therapies for naming disorders in patients with aphasia of various types of speech therapy (traditional and at a distance).	The study included five of 32 patients who previously suffered from ischemic stroke of the left hemisphere and had speech difficulties. The studied patients had anomic deficits diagnosed by AAT and at the same time showed no other disorders with regard to attention focus or non-verbal intelligence. All participants received two types of therapies: direct (face to face with a therapist in the study) and "tele" one. Some patients started sessions in person, others online. Each type of a therapeutic program encompassed 8 equally long sessions. In each session the patients performed tasks based on naming objects or activities shown in pictures. There was	The evaluation performed directly after each cycle of therapy of naming deficits showed a significant improvement. No significant differences were found with regard to the type of performed activities. The authors of the study, considering the above, believe that telerehabilitation of post-stroke patients with aphasia is probably as effective as a conventional therapy performed face to face. Moreover, no participant reported major difficulties while using the video conference platform.

			a 3-week break with no therapies between both cycles.	
Yoon-Hee Choi et al. 2016	South Korea	Elaboration and efficacy evaluation of telerehabilitation program for chronic post-stroke aphasia on mobile devices.	Eight patients with chronic post-stroke aphasia were included in a 4-week inperson speech therapy program using iAphasia mobile application on an iPad. At the beginning, the participants were asked to take part in the test on a mobile device, designed based on Korean abridged version of FAST test. In order to evaluate the effectiveness of iAphasia program also, before and one month after the therapy, the exam based on WAB, Korean version, was performed. Telerehabilitation program included 6 therapeutic domains and encompassed: listening comprehension, reading comprehension, repeating, naming, writing and verbal fluency. Each domain included 6 levels of difficulty out of which a speech therapist, considering the results of the above studies, selected the most appropriate one for each subject. The subjects were asked to use the application as often and as long as possible.	After a 4-week therapy using iAphasia application the mean results of WAB were significantly higher in comparison with the results obtained before the program (the differences were observed in all 6 domains). One month after the therapy completion the performed evaluation confirmed the sustained improvement. Also, it has been proved that the time spent using the application highly correlated with the increased WAB scores.
Joël Macoir et al. 2017	Canada	Evaluation of telerehabilitation effectiveness performed in order to improve functional communication in aphasia.	Using telerehabilitation platform and software based on PACE approach 20 participants with chronic post-stroke aphasia underwent 9 speech therapy sessions in 3 weeks. The conducted activities relied on synchronous model and required the presence of a carer of an aphasic person. The study included only these persons that	A few week long PACE telerehabilitation led to improved functional communication manifested by better effectiveness of communication, shorter time of information exchange between speakers and increased usage of communication channels.

			showed the features of anomy, were critical towards their own limitations regarding speech and did not use traditional speech therapy.	
Qiumin Zhou et al. 2018	China	Evaluation of effectiveness of combined speech therapy and cognitive training in aphasic patients using telerehabilitation.	The study involved 40 patients, including 20 hospitalized and 20 discharged ones. In both groups the subjects were randomly allocated either to a study subgroup or a control subgroup (10 persons in every group). Each of the 4 subgroups had a different therapy: • hospital study group – computerized combination of speech therapy and cognitive training for 14 days; • hospital control group – routine therapy 2 times a day for 14 days; • discharged study group – everyday 30-minute communication practice on family related topics combined with a 30-minute speech therapy telerehabilitation and cognitive training for 30 days; • discharged control group – everyday communication practice on family related topics 2 times a day for 30 minutes for 30 days. Speech therapy mode included tasks of listening comprehension, reading comprehension, repetition, naming and writing. Cognitive mode involved the tasks related to attention, memory and executive functions.	Combination of speech therapy and cognitive training improved general scores related to verbal speech, and consequently, everyday communication skills. Therapeutic program including hospitalized study group also proved effective when it was implemented in telerehabilitation mode for discharged study group (persons who had been already discharged home). The authors of the study conclude that a computerized speech therapy with cognitive training, either performed in a hospital setting or as telerehabilitation in in-home setting, may successfully support the process of recovering from aphasia.

Stephan Moreno Gerber et al. 2019	Switzerland	Application evaluation: *Bern Aphasia* in telerehabilitation of aphasic persons.	11 speech therapists and 15 aphasic patients were included in the study based on adaptative and multimodal *Bern Aphasia* application evaluation for a tablet. It is composed of two basic parts: patient's interface and therapist's interface. It enables the patients to do language tasks autonomously in a home setting and therapists to allocate personalized task remotely in an easy and time-saving manner, as well as to follow the progress of patients and to create new tasks. Patients and therapists, with the use of questionnaires, assessed the application for its usefulness and motivation.	Regarding its usefulness the patients evaluated the application as perfect and the therapists, as good. The patients stressed that they liked doing tasks and both groups emphasized that the application is user-friendly. The authors of the study note that the function of difficulty gradation allows for usage of applications in aphasic patients at varied levels of advancement. Therefore, it may complement a traditional speech therapy.

Source: own work on the basis of the analyzed papers.

have not come true entirely there is an indisputable fact that is worth stressing showing that more and more often these tools are used by speech therapist during sessions with patients. The studies of Joanna Gruba prove that in 2008 almost 90% therapist used a computer during therapies.[8] It might be assumed that today this percentage is even higher. This concerns high-technology applications that complement a traditional speech therapy procedure carried out in person.

Alarmingly increasing numbers of patients suffering from aphasia[9] imply decreasing availability of rehabilitation centers offering comprehensive care of speech therapists. Thus, scholars are continuously searching for new strategies that are aimed at providing care to people with speech difficulties by ensuring proper diagnostics and therapies in home settings. This type of activities appear to allow for two above-described models of telerehabilitation. However, in order to implement such unconventional type of care dedicated to aphasic patients its value should be first properly and scientifically proved.

Faced with the above the review of selected papers was performed concerning the applied rehabilitation at a distance in this group of recipients. The analyzed material is collected in the table below.

Discussion

The development of advanced technologies and informatization of societies lead to revolution of the hitherto existing forms of rehabilitation practices. In many highly-developed countries providing services at a distance using telecommunication devices more and more often refers to doctors and physiotherapists as well as speech

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[8] J. Gruba, *Technologia informacyjna w logopedii*, Wydawnictwo Komlogo, Gliwice 2009.

[9] J. Rosińczuk, M. Kazimierska-Zając, A. Kołtuniuk, *Diagnoza i terapia logopedyczna pacjenta z afazją mieszaną*, „Forum Logopedyczne" 2016, no. 24, pp. 139–151.

therapists. Therefore, it is natural that scholars are interested not only in verifying the effectiveness of already implemented telerehabilitation tools for speech pathology therapies but also in developing new programs and applications for patients with speech difficulties.

The above-described studies focused on a possible application of speech therapy telecommunication techniques in post-stroke patients with aphasia. As part of each approach the patients were involved in distant therapeutic intervention and in some cases also in diagnostic evaluation. The authors of the studies stress the greatest assets of this type of approach, such as the elimination of inconveniences related to transportation to a therapeutic centre and related savings of time and costs, as well as the limited number of specialists needed near a patient's location. It is also a good alternative for persons who have walking difficulty due to motor disability. When analyzing the results of all six studies telerehabilitation should be also perceived as beneficial with regard to therapeutic effects. However, very small groups of study subjects (mostly consisting of a few or several persons) raise certain objections. They are referred to by the very scientists who advocate performance of further, deeper studies, including more subjects.

Despite certain features highlighting positive effects of telerehabilitation on people with aphasia this approach carries certain limitations. In author's opinion, the most critical one is the lack of direct contact with a patient as it affects to therapy success. Similar attitude is represented by Monika Stepnowska, Kinga Leszczyńska-Iwanicka and Dorota Piotrowska.[10] Although these scholars refer to psychological consultations provided at a distance the author of this paper deeply believes that an identical reservation concerns speech therapy at a distance, including aphasia telerehabilitation. In case of aphasic disorders language deficits are often revealed in the sphere

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[10] M. Stepnowska, K. Leszczyńska-Iwanicka, D. Piotrowska, *Wsparcie psychologiczne w telerehabilitacji*, [in:] Telerehabilitacja, eds. R. Piotrowicz, E. Piotrowicz, Wydawnictwo Tekst, Warszawa 2011, pp. 70, 74.

of speech production. It is when non-verbal communication is very important in the relation between a patient and a therapist as it helps to convey information through mimic, gestures, eye contact, posture and body movements and touch. Therefore telerehabilitation hinders, particularly in an asynchronous model, this form of communication.

Another objection raises application of telerehabilitation in speech therapy management for diagnostic purposes. This is exemplified in case of combination of aphasic speech disorders with other deficits related to peripheral nerve palsy, which requires a polysensory attitude from a therapist, who will employ sight, hearing and touch, for evaluation of articulation and swallowing. Inability to use the last of the above-mentioned senses may result in many difficulties and thus, in incomplete or improper diagnostics.

Here it needs to be stressed that the presented doubts and remarks are not meant to undermine telerehabilitation methods or techniques applied in speech therapies of aphasic persons or others who need support of a therapist. It is very important to realize, though, that there are certain limitations which hinder the comprehensive exploitation of telerehabilitation potential of speech therapy.

Conclusion

It appears that regardless of critical opinions, even the ones that are convincing and well-grounded, the overall balance of pros and cons of telerehabilitation speech therapy is positive. Thus, it might be expected that soon it will become a popular form of speech therapy management; perhaps not an alternative yet, but surely a complementary approach to a traditional method. Nevertheless, even today in certain cases it is the only available option that has been particularly highlighted by COVID-19 pandemic. Faced with limited access to medical care facilities and speech therapy offices many patients have a difficult decision to make of either choosing a speech therapy at a distance or no therapeutic approach at all.

This choice appears obvious but it depends not only on the access to modern technologies but also, perhaps above all, on psychophysical abilities of a patient.

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