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Technology in favor of continuous professional development in cochlear implant

A tecnologia a favor da educação continuada no implante coclear

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ABSTRACT

Purpose: To evaluate the teleconsultation synchronously in the mapping of the cochlear implant (CI) as an ongoing professional development tool in training programmes for audiologists. **Methods:** It was a prospective longitudinal study, in the form of clinical preceptor with teleconsultation in a synchronous way directed at assisting the mapping of CI users. Distance learning was offered to fellow audiologists in a hospital and the audiology tutor in the remote unit. The chosen platform allowed the tutor to view and perform interventions on the CI mapping screen. Three questionnaires covering teaching markers were applied; the quality and importance of teleconsultation; interaction between professionals; and self-assessment of confidence in carrying out the mapping steps before and after teleconsultations. **Results:** Seven audiologists participated; 268 consultations were analyzed over three years. The clinical markers showed, on average and individually, that there is a statistical correlation with a decrease in the number of total interventions, in the interventions of CI mapping and clinical reasoning throughout the sessions. The average of the scores of the importance of teleconsultation was 9.7 and the interaction with the tutor was 9.3. In the self-assessment, all audiologists responded that they were "not at all/not very confident" for the mapping steps before the intervention, and at the end of the course they responded "moderately/very confident" for the same steps. **Conclusion:** The use of synchronous teleconsultation was feasible and efficient as a teaching tool for audiologists. It was possible to observe the decrease in the number of interventions over time, evidencing the learning curve.

Keywords: Cochlear implantation; Remote sensing technology; Education distance; Deafness; Surveys and questionnaires

RESUMO

Objetivo: avaliar a teleconsulta de forma síncrona no mapeamento do implante coclear (IC) como ferramenta de educação continuada para fonoaudiólogos em capacitação e treinamento. **Métodos:** estudo prospectivo longitudinal, na modalidade de preceptorado clínico, com teleconsulta de forma síncrona direcionada ao atendimento de mapeamento dos usuários de IC. A educação continuada foi oferecida aos fonoaudiólogos aprimorandos em um hospital e o fonoaudiólogo tutor, em unidade remota. A plataforma utilizada permitiu ao tutor visualizar e realizar intervenções na tela de mapeamento do IC. Foram aplicados três questionários abrangendo os marcadores de ensino; qualidade e importância da teleconsulta; interação entre os profissionais e autoavaliação sobre a confiança na realização das etapas do mapeamento antes e após as teleconsultas. **Resultados:** participaram sete fonoaudiólogos e foram analisados 268 atendimentos, ao longo de três anos. Os marcadores clínicos mostraram, na média e individualmente, que houve correlação estatística com diminuição do número de intervenções totais, nas intervenções do mapeamento do IC e raciocínio clínico, no decorrer das sessões. A média das notas nas avaliações da importância da teleconsulta foi 9,7 e a interação com o tutor, 9,3. Na autoavaliação, todos os aprimorandos responderam que estavam "nada/pouco confiantes" para as etapas do mapeamento antes da intervenção e, ao final do curso, responderam "moderadamente/muito confiantes" para as mesmas etapas. **Conclusão:** o uso da teleconsulta síncrona foi viável e eficiente como ferramenta de ensino para fonoaudiólogos. Foi possível observar a diminuição do número de intervenções ao longo do tempo, evidenciando a curva de aprendizado.

Palavras-chave: Implante coclear; Tecnologia de sensoriamento remoto; Educação a distância; Surdez; Inquéritos e questionários

Study conducted at Grupo de Implante Coclear, Departamento de Otorrinolaringologia do Hospital das Clínicas, Faculdade de Medicina, Universidade de São Paulo – USP – São Paulo (SP), Brasil.

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INTRODUCTION

Tele-audiology consists in practising audiology mediated by Communication and Information Technologies (CITs), for the prevention, identification, evaluation, diagnosis, and intervention in human communication disorders. Amongst the activities of tele-audiology, are tele-education, also called distance education and tele-consultations[1]. Ongoing education refers to educational activities undertaken following graduation , to maintain, improve or adapt knowledge, abilities, attitudes and practices of healthcare professionals, with the aim of being able to continue to provide healthcare services in a safe and effective manner[2]. In its turn, tele-consultation, can bring the clinician and patient, two professionals, or even two professionals and a patient, together for the realization of training and teaching. In this manner, distance education and tele-consultations can be used as tools for ongoing education of professionals[3].

In the area of tele-audiology, both distance education and teleconsultations for the adjustments of hearing aid (HA)[4] are possible, as well as for the teleprogramming of the Cochlear Implant (CI)[5].

Teleprogramming is already well described in the literature as an efficient and viable tool, in comparison with face-to-face methods for assistance in programming the CI[6-8]. However, teleconsultation for the area of CIs, such as actions for clinical tutoring, is still scarce in the area of audiology[3]. In this modality, in one study, the authors showed, for remote verification with microphone probe in the HA, that the act of guiding, giving support, teaching and sharing experience can improve clinical competency and help the professional adapt to professional duties[9]. In this context, the tutor is mainly concerned with clinical competency or teaching-learning[10]. In another study, the authors showed the training for an adaptation software for distance HA, with audiologists[11].

Synchronous teleconsultation allows the clinician to undertake the consultation from a remote location, interacting with the patient in real time, through the use of video and audio equipment, or through the remote control of computer and apps. In the field of audiology, due to the use of different computerized equipment, the use of synchronous teleconsultation through remote control of software is facilitated[8].

The disadvantages of synchronous teleconsultations are associated with communication difficulties between professionals or professional/client in terms of loss of non-verbal information that is more noticeable in face-to-face consultations[4], as well as aspects related to internet connection quality[4]. On the other hand, synchronous teleconsultations are closest to traditional consultations (face-to-face)[12,13] and are most used in studies in tele-audiology.

The importance of continuing education has continued to grow significantly in recent decades, with the increase in the number of Brazilian speech therapists with doctorates and master's degrees, requiring the professional to keep up-to-date and, therefore, constantly improve their professional practice. In 2010, authors commented about the future regarding technological developments contributing to the professional knowledge updating who were geographically distant from important centers of learning. Many universities, scientific societies and teaching institutions are developing distance education programs and software specific for professionals[14].

This technology is of great value in considering the reduction of distance from the tutor and for the fellow in being able to offer adequate assistance to professionals and even more distant patients, who may be unable to travel.

Therefore, this study aimed to evaluate synchronous teleconsultation in mapping CIs, as an ongoing education tool for audiologists in capacitation and training.

METHODS

The present study is prospective, longitudinal, and was approved by the Research Ethics Committee of the Faculty of Medicine of the University of São Paulo with the process number 3.079.835, carried out in the Cochlear Implant Group at the Clinical Hospital. The teleconsultation, in the modality of clinical preceptorship for professional with professional, was realized in a synchronous manner, focused on carrying out mapping for CIs during the period from February 2018 to January 2021, for four hours weekly for each participant. All participants signed the Informed Consent Form (ICF). The tutoring audiologist had more than 14 years of clinical experience in CIs. The audiologist fellow who participated had a specialization in audiology and was enrolled in the second year of the Training course for Cochlear Implant Services. All of them had already completed the first year of the course, which included 40 hours of observation and clinical practice accompanying rounds with CI patients.

The synchronous teleconsultation included the reading of the medical records and planning the consultation process, the identification of adequate functioning of the speech processor, the realization of speech recognition tests, mapping of the CI, guidance regarding the speech processor and accessories, objective tests that aid the programming of the speech processor, instructions for the family and/or patient regarding questions related to the CI, and the drafting of reports related to the consultation.

EQUIPMENT

The teleconsultation was performed in two different locations: the Face-to-face Unit (FU) with the fellow and the patient, and the Remote Unit (RU), from where the tutor audiologist gave remote synchronous assistance to map the cochlear implant (Figure 1).

The equipment necessary for both the RU and the FU was the same: a monitor and computer, remote access software – to allow remote assistance from the RU – a webcam with stereo speakers and headphones connected. Additionally, the FU required different software programs, interfaces, and program cables for each brand of CI.

In this study, the synchronous teleconsultation used the Team Viewer® software, with a commercial license, which allowed the tutoring audiologist to view the screen of the programming software, and, via remote access, carry out interventions directly on the computer of the FU, when necessary. Via the webcam, the tutoring audiologist monitored the behavioral responses of the patient by video and audio. In the first year of the study, Team Viewer®, version 13 was used, with updates being necessary

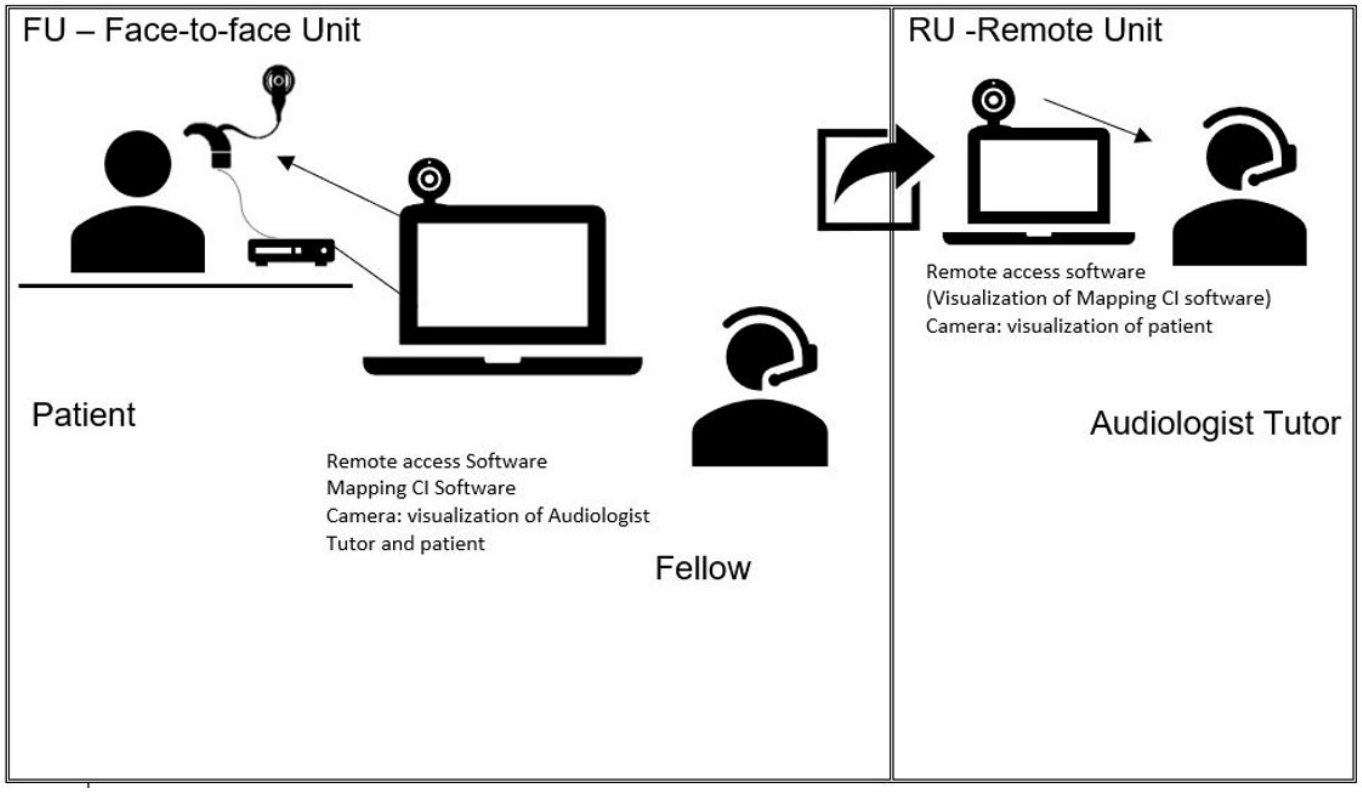

Figure 1. Face-to-face Unit (FU) and Remote Unit (RU)

over time for both the computers of the FU and RU to prevent connection problems.

Patients were informed regarding the teleconsultation and signed the ICF, being made aware that despite the distance learning, their consultations would remain face-to-face with the audiologist of the FU.

QUESTIONNAIRES

With the aim of determining clinical markers for the evolution of improvement during the sessions, evaluate the quality and importance of the teleconsultation and the self-evaluation of the learning experience, three questionnaires were developed based on the literature and the experience of the professionals of the cochlear implant team.

Questionnaire 1 – Evaluation of the tutor audiologist in the Remote Unit (RU).

The questionnaire was developed based on the results of two theses in the area of teleconsultation [3,6] (Supplementary Material Appendix 1). Initially, the questionnaire was developed in the pilot project during one year of distance training, with two audiologists in the CI team of the hospital. After this experience, a survey of the main topics for care of CI patients based on the literature [15,16] was realized and analyzed by two audiologists with more than ten years of experience in the area.

Questionnaire 1 was divided into three parts: the first part contained the patient identification and procedures realized in that session, as well as the consultation time. The second part was made up of clinical markers that were considered interventions and separated according to the topics of periodical follow-ups with CI patients[17]: guidance for the patient; verification of the functioning of the speech processor, guidance related to aspects of the speech processor and/or connection with software; doubts or instructions for programming; use of software tools; guidance regarding the evaluation of the performance of the map being used; guidance for the realization of audiometry; guidance for objective tests: research for the Electrically Evoked Stapedial Reflex (eSRT) or research for the Electrically Evoked Compound Action Potential (eCAP); outlines for the elaboration of the report for rehabilitation/school; clinical reasoning.

The tutoring audiologist listed the number of interventions necessary for each procedure realized during each session and whether the instructions were applied.

For the identification of the adequation requirements for programming of the map used by the CI patient, the performance evaluation can be accompanied by the audiologist of the RU through the possibility of realizing the procedures by the Auditory Speech Sounds Evaluation (A§E®, © PJ Govaerts, Antwerp, Belgium) software, connected to the Otocube, acoustic box, which substituted the sound proof booth for the realization of tests with the speech processor [18]. In this manner, it was possible to remotely monitor the realization of tests.

In the third part, the quality of the connection, possible problems, the possibility of their resolution and if there were any liabilities for the fellow/patient were documented.

Questionnaire 2 – Evaluation by the fellow of the Remote Unit (RU)

The questionnaire that dealt with the teleconsultation was the same as that used in the dissertation of Paiva[3] (Supplementary Material Appendix 2). There were five (5) questions with a scale from 0 to 10 (poor to excellent), which referred to audio and video quality and to the day-to-day learning experience in general, from the perspective of the fellow. There was also a discursive question for general comments regarding the teleconsultation.

Questionnaire 3 – Self-evaluation of the fellow in the Face-to-face Unit (FU)

The questionnaire was developed based on literature [19]. The questions consider basic and advanced aspects related to mapping the CI, with the aim of evaluating the learning experience of the fellow for specific aspects [15,16]. After the survey, the chosen topics underwent an evaluation step by two audiologists with more than ten years-experience (Supplementary Material Appendix 3). The questionnaire contained 21 questions using the 5-point Likert Scale, regarding how confident the fellow was in carrying out the procedures related to the mapping of the speech processor for the four different brands of cochlear implant.

Questionnaire 1 was filled out during the teleconsultation by the tutoring audiologist, while Questionnaire 2 was filled out anonymously by the fellow soon after the teleconsultation. Questionnaire 3 was filled out by the fellow after the first and last teleconsultation sessions, for self-evaluation regarding the learning experience for the practical element.

The data were qualitatively analyzed and included the Spearman's correlation analysis between the consultation times throughout the year and the total number of interventions realized. The Analysis of Variance (ANOVA) test was realized for comparison between the fellows. The paired t-test was applied to compare the self-evaluation between the subjects. The $p > 0.05$ was considered significant.

RESULTS

The synchronous teleconsultations of seven fellows were monitored from the start of 2018 to Jan 2021. Table 1 presents the number of consultations and the characteristics of the patients attended by the assisted professionals.

Questionnaire 1 – Evaluation of the tutoring audiologist in the Remote Unit (RU)

Consultation time

Total consultation time was considered from reading the medical records, the consultation plan and from the reports elaborated about the consultations. Due to the large number of unilateral CI patients, the average was considered only for this type of consultation. Another analysis included the time spent only in mapping the speech processor.

Therefore, the average total consultation time for the fellows varied from 1 hour and 32 minutes to 1 hour and 44 minutes, being very similar to each other. The time spent only on mapping the speech processor varied from 28 to 35 minutes.

Clinical markers/interventions realized in the teleconsultation

In relation to the interventions undertaken by the tutoring audiologist throughout the sessions of the course, the data were quantitatively analyzed for each type of intervention. It was found that interventions related to the mapping for the CI and

Table 1. Data for consultations for each fellow

Fellow (A)	A1	A2	A3	A4	A5	A6	A7
Number of consultations	61	42	32	38	24	28	43
Number of supervision hours during the year	244	168	128	152	96	112	172
Average age of patients (in years) (min.-max.)	32 (2 - 76)	26 (1 – 78)	27 (1-71)	33 (3-85)	26 (3-69)	29 (4-83)	25 (3-83)
Average time of use of the CI (months) (min.-max.)	57 (3 - 180)	43 (1 - 180)	67 (1-192)	58 (1-216)	70 (1-168)	72 (1-192)	68 (3-192)
Brand of CI *Advanced Bionics*® (Valencia, CA, USA)	12	7	4	6	5	4	6
Cochlear® (Sydney, NSW, Australia)	24	19	14	15	8	12	15
Med-El® (Innsbruck,Tyrol,Austria)	15	9	10	8	8	5	14
Oticon Medical® (Vallauris, Alpes-Maritmes France)	10	4	4	9	3	7	8
CI Unilateral	58	36	24	32	20	24	34
Bilateral	3	6	8	6	4	4	9

Subtitle: min. = minimum; max. = maximum; CI = cochlear implant

clinical reasoning were the most frequent in distance education, for all fellows. Following this, it varied from one fellow to another, respectively: guidance for the patient and instruction during the evaluation of the map; use of software tools and elaboration of the report for other professionals or for the report within the team; instructions related to the speech processor and instructions for the realization of the eSRT; instructions for free-field audiometry with CI and for the realization of eCAP.

The statistical analysis of the interventions, considering all fellows as well as individually analyzing them, showed that there was a statistical correlation with the reduction in the total number of interventions, in interventions for mapping of the speech processor (Figure 2), and clinical reasoning, throughout the sessions (Figure 3). The ANOVA test analyzed the reduction in interventions between the fellows and showed that there was no difference, considering that each participant presented a different number of supervision hours.

Connection quality

In relation to the analysis of the connection during the consultations, no consultation was rendered unviable, however, from 4.8% to 16.7% of the sessions were interrupted for short periods by connection problems.

Questionnaire 2 – Evaluation of the fellow audiologist regarding the Remote Unit (RU)

The evaluations of the teleconsultations and the interaction of the tutoring speech therapist showed high scores, as well as for interaction between professionals. Some sessions received lower scores due to audio and video quality (Table 2).

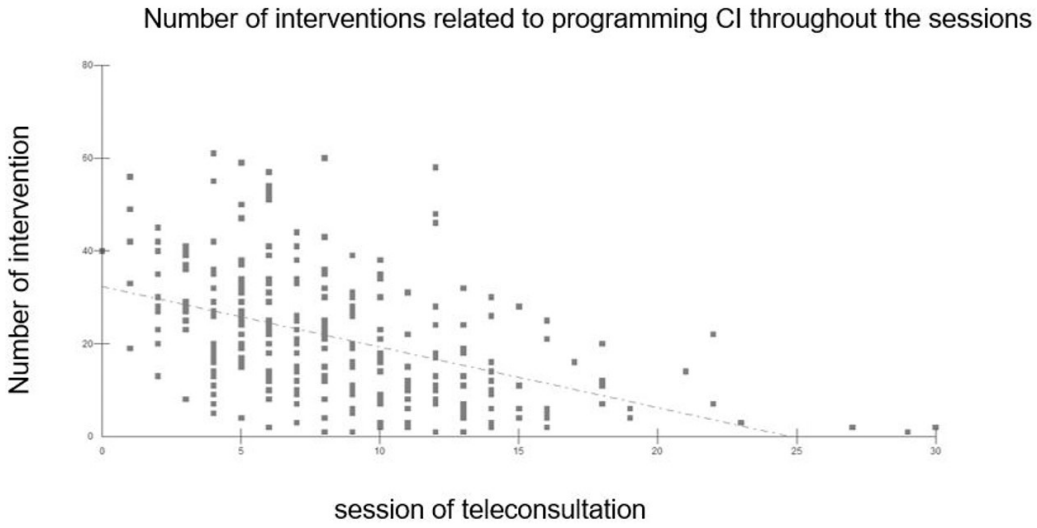

Figure 2. Total number of interventions throughout teleconsultations with Spearman's Coefficient test (*p < 0.0001)

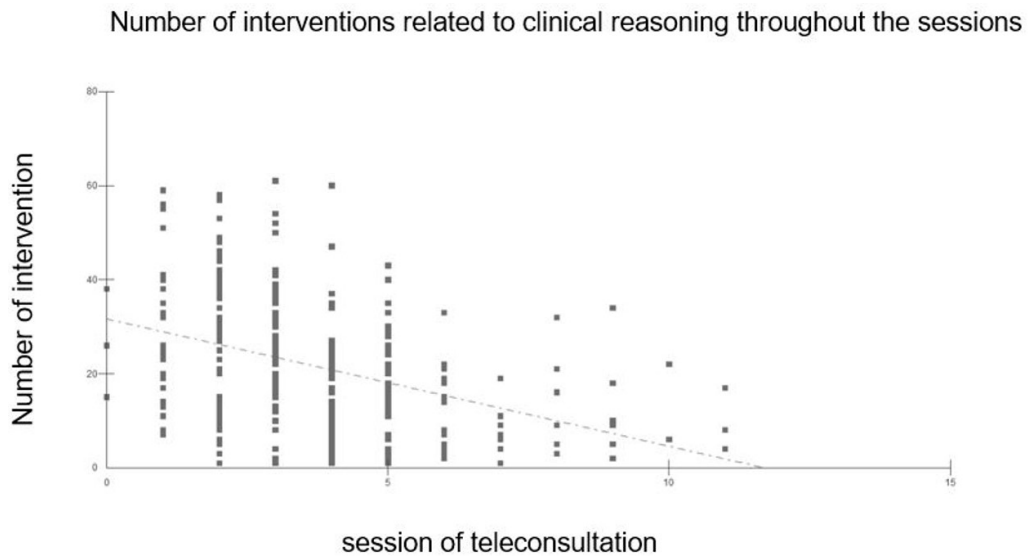

Figure 3. Total number of interventions in clinical reasoning throughout teleconsultations with Spearman's coefficient test (*p < 0.0001)

Questionnaire 3 – Self-evaluation of the fellow audiologist in the Face-to-face Unit (FU)

Improvement in confidence was observed in all areas for the realization of procedures, in addition to statistical difference in the averages for the pre- and post-teleconsultation scores, for all fellows (p<0.0001). Initially, all fellows responded that they were "unconfident" or "little confident" for CI mapping and evaluation procedures while they responded "moderately confident" and "very confident" for the same procedures at the end of the course (Table 3).

DISCUSSION

In Brazil, ongoing education is hampered by the inequality of educational institutions found throughout the country, amongst other factors. In the field of audiology, an interactive educational model is recommended that involves the relations between the student/professional, and the tutor and the university in the clinical context. The model provides a foundation for optimized patient care, individualized experience, a focus on clinical practice, the education of autonomous professionals, and the application, communication and integration between teaching and service, amongst other aspects [20].

In the literature, there are studies in tele-education for primary health care, with widespread acceptance by the professionals involved and contributions to professional capacitation [21-23]. Indeed, ongoing education can improve the capacitation of professionals. The authors underscore that this initiative aligned with other technologies and measures, such as tele-education, tends to propagate in a more effective manner, training healthcare professionals to respond more quickly to situations that require greater agility in decision making [23]. In this manner, further research is necessary in different areas of audiology, using ongoing education mediated by communication and information technologies so that it can be strengthened and improved.

This study showed that the use of synchronous teleconsultation for ongoing education can be a very promising tool, both for audiology, and for CI centers, in addition to permitting distance education in real time for practical elements, as well as highlighting the importance of using tools to evaluate the learning experience. In this manner, the literature already showed that amongst the advantages of applying this procedure are the decentralization of auditory healthcare services, the training and capacitation of professionals and the systematic monitoring of implanted patients [5].

Teleprogramming for CIs is described as effective and widely accepted by patients and professionals [6]. A study that developed an online training platform combined with synchronous teleconsultation for verification of the HA, showed that teleconsultation was found to be highly advanced and of great importance, despite not having generated an impact on student learning [3].

Additionally, the possibility of attending from young children to the elderly, as well as the great variability for the time of use of the CI, enriched the training of the fellows for clinical reasoning and the choice of evaluation protocol for each age and auditory experience. Despite the number of consultations varying between fellows, due to the hospital calendar and the course timetable changing annually due to student numbers, there was no difference in the characterization of patients nor in the interventions performed.

Despite not being validated, the questionnaires developed were useful and easy to apply during the consultations and allowed for the quantification of the types of interventions to better analyze the clinical markers in the evaluation of the synchronous teleconsultation.

In the service in question, the consultation time reserved for each patient is one hour and 30 minutes, including the tests, programming, and evaluation of results. The average for the teleconsultations was similar to the time for face-to-face attendance for all fellows, which shows that even at a distance, supervision did not interfere in the total attendance time, as was observed in one study with CIs [24] and in the remote verification with microphone probe [19].

Table 2. Mean of the analysis of teleconsultations by all fellow in all sessions throughout the year

	Score (0 a 10) (Mean (minimum-maximum))
Audio quality	8.5 (0 -10)
Video quality	8.4 (0 - 10)
Importance of teleconsultations in training	9.7 (6 - 10)
Importance of teleconsultations to resolve doubts	9.8 (5 -10)
Quality of interaction with the tutor	9.3 (4-10)

Table 3. Self-assessment of fellows at the beginning of the training program and after a year of follow-up with teleconsultation for each procedure in the cochlear implant programming with scores on a scale from 1 to 5

Fellow/ Self-assessment	F1	F2	F3	F4	F5	F6	F7
Mean score pre	1.81	1.85	1.76	2.24	1.90	1.38	2.00
Mean score post	4.28	3.67	3.33	3.28	3.57	3.62	4.44
P -value	$p < 0.0001$*	$p < 0.0001$*	$p < 0.0001$*	$p < 0.0001$*	$p < 0.0001$*	$p < 0.0001$*	$p < 0.0001$*

*t paired statistical test
Subtitle: F= fellow

The greater number of interventions by the tutor during the synchronous teleconsultations occurred for mapping of the speech processor, as expected, given that it is the main objective of the learning experience during teaching. The second most frequent intervention was for clinical reasoning, allowing for an eminently practical learning experience. The most common discussions were the reasoning of the relationship of patient performance and the impact of mapping parameters; and the interpretation of result evaluations for speech recognition and discussion of more complex cases. The statistical analysis showed that all the fellows presented a reduction in the number of interventions during mapping, throughout the teleconsultation sessions.

Guidance for the patient was also characterized by numerous interventions. During consultation, it was necessary to realize orientations for the patient and/or family for aspects related to explaining results, or alterations in mapping, guidance which required clinical experience.

Interventions for evaluation protocols were also more frequent. The majority were related to the choice of test for the protocol in each case and specific instructions for application of the questionnaires. The largest number of interventions were related to the psychoacoustic tests available on the A§E®, both to explain the instructions, and to interpret patient responses [17].

In relation to the evaluation protocols for children, various instructions were given for the selection and application of questionnaires for each age and time of use of cochlear implant. The use of questionnaires to observe the performance of small children with CIs is indispensable [17] and knowing how to analyze the responses to make modifications in the mapping makes the consultation more efficient.

Based on the orientations for the use of tools of the programming software, it was found that the fellows already understood various tools necessary for basic programming, due to prior learning. However, advanced or time saving tools to facilitate the consultation required supervision to be located. The objective eSRT and eCAP tests presented few interventions, since they are tests that were not realized in all consultations.

Generally, synchronous teleconsultation contributed to the learning of practical and advanced situations that are taught amongst more experienced professionals, as occurs with face-to-face clinical tutoring.

Analysis of teleconsultation and self-evaluation

The Team Viewer® software was found to be a relatively unproblematic tool providing significant access to visualize the computer screen, as well as the possibility of visualizing the patient responses via the camera, as with another study [19], which reported the importance of the camera for better guidance between professionals. Generally, the problems encountered seem to have been resultant from the broadband internet signal; other studies also mentioned connection quality [25,26]. On average, 12.3% of sessions presented some communication difficulty, with its being necessary to change computer, or the tutoring speech therapist needing to use written messages for communication, which limited the instructions for the fellows.

In the self-evaluation of the fellows, the statistical analysis showed an improvement in confidence for all parameters considered, reflecting the learning acquired during training and showing that, even in the case of a distance supervisor, the interaction between professionals required an adaptation period. A study which evaluated audiologists in the adaptation and verification of HA also found that the professionals who received help remotely perceived an improvement in their ability to carry out procedures [19].

One of the limitations of this study is related to the unvalidated questionnaires, however, they were important to meet the study objectives and exemplify the extent to which the synchronous teleconsultation as an ongoing teaching tool can be used by cochlear implant centers.

CONCLUSION

The use of synchronous teleconsultation was a viable and efficient tool for ongoing teaching for audiologists. It was possible to observe a reduction in the number of interventions over time, demonstrating a learning curve with directed questionnaires.

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Supplementary Material

This article is accompanied by the following supplementary material.
Appendix 1 – Evaluation of the tutor speech therapist in the Remote Unit (RU)
Appendix 2 – Evaluation of the fellow speech therapist for the Remote Unit (RU)
(EVALUATION OF THE TELECONSULTATIONS, Paiva, 2015)
Appendix 3 – Self-evaluation of the learning process of the fellow speech therapist in the Face-to-face Unit (FU)

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