ORIGINAL RESEARCH

STANDARDIZATION OF THE SPEECH TESTS USED WITH COCHLEAR IMPLANT PATIENTS

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ABSTRACT

Objective: The aim of our study is to standardize the speech tests used in our clinic for the implanted patients. We standardized eight different tests for two different purposes: Assessment of the speech perception abilities of the cochlear implant candidates and evaluation of the progress of the cochlear implanted patients.

Methods: Two groups of subjects (normal hearing and cochlear implanted) were given the eight different tests for standardization. The rate of correct answers of normal hearing and implanted groups was calculated and compared with "Instat" statistics program.

Results: The results of speech reception tests developed in this study showed that the words in the lists were within the knowledge of the implanted patients. Content validity of the test was controlled. Alternative test forms were developed after item analysis. By doing so, we aimed to exclude the learning factor to a great extent.

Conclusion: Standardized tests can be used for assessing the implant candidacy and evaluating the cochlear implantees' progress especially in the period following the implantation.

Keywords: Cochlear implant, speech tests, speech perception

KOKLEAR İMPLANT HASTALARINDA KULLANILAN KONUŞMA TESTLERİNİN STANDARDİZASYONU

ÖZET

Amaç: Bu çalışmanın amacı kliniğimizde koklear implant hastaları için kullanılan konuşma testlerinin standardizasyonudur. Sekiz farklı testi iki farklı amaç için standartlaştırdık: Koklear implant adaylarının konuşmayı algılama becerilerinin ölçülmesi ve koklear implantasyon sonrası gelişmelerinin değerlendirilmesi.

Metot: Normal işiten ve koklear implant kullanan iki grup deneğe standardizasyon için sekiz farklı test uygulandı. Normal işiten ve koklear implantli grubun doğru bilme oranları belirlenmiştir ve "Instat" istatistik programıyla karşılaştırılmıştır.

Sonuç: Bu çalışmada, konuşmayı anlama testlerinin sonuçları, listelerde yer alan kelimelerin koklear implant kullanan hastaların kelime bilgisi dahilinde olduğunu göstermiştir Testin içerik geçerliliği denetlenmiştir. Testlere madde analizi uygulanması sonucunda alternatif test formaları oluşturulmuştur.Böylelikle öğrenme faktörünü büyük ölçüde ortadan kaldırma amaçlanmıştır.

Tartışma: Standardize edilmiş testler koklear implant adaylığının belirlenmesinde ve koklear implantasyon sonrası, koklear implant kullanıcılarının gelişmelerinini değerlendirilmesinde kullanılabilir.

Anahtar Kelimeler: Koklear implant, konuşma testleri, konuşmanın algılanması

INTRODUCTION

Speech perception means inferring the language patterns as phonems, words, short sentences and sentences which are present in the spoken language. Inferences the perceiver makes depend not only on emotional data but also on the content [1].

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Although pure tone audiometry gives an idea about speech awareness and speech reception thresholds, it is impossible to determine the person's language perception capability depending on just hearing thresholds obtained in pure tone audiometry [2].

The effect of sensorineural hearing loss on the patient is best reflected on that person's speech perception ability [1]. Use of insufficient auditory input in higher cognitive processes differs from person to person, depending on the degree of hearing loss [3]. In order to show these interpersonal differences and to obtain realistic information about the person's speech perception level, speech perception tests are used. In these tests, speech sounds, words and sentences are used as stimuli [4].

The main purpose of the speech tests is to measure the auditory perceptual capability. These tests are used as criteria for the observations about how well and to what extent the listeners can understand the spoken language in everyday settings. Speech test materials are used for different purposes in different clinics and different researches [2].

One other area in which speech tests are used is for the evaluation of the outcome of cochlear implantation. Research in this area focuses on both the observed changes in patient hearing thresholds and on the development of their speech perception after cochlear implantation [5]. The aim of using speech tests in the implanted patients is to compare the patient's speech understanding ability between pre- and post-operative assessments and also between the post-operative programming sessions, and, to detect the development in the patient's receptive and expressive language ability [6-8].

Besides all these, speech tests are used as objective criteria in assessing the implant candidacy. Since receptive and expressive language ability depends heavily on hearing, it is accepted as the first criterion in determining the appropriate patient for implantation [9].

The purpose of our study is to standardize the speech tests used in our clinic for implanted patients. We believe this will help to decide the implant candidacy, to compare devices or processing, to monitor performance over time and to establish guidelines for rehabilitation.

PATIENTS AND METHODS

Subjects: The subjects were divided into two groups. The first group was subjects with normal hearing. The second group consisted of cochlear implanted subjects.

The first group consists of 50 subjects (29 female, 21 male) who have normal hearing according to pure tone average (0 –26HL). There were no thresholds below 25 dB between 250 Hz to 6 kHz range. The age of the group ranged between 10 to 61 years old.

In the second group, there were 17 implanted subjects (10 female, 7 male) who had been followed up in Marmara University, Faculty of Medicine, Audiology Clinic. All the subjects were postlingually deafened and they had used their implant for six months. The age of the group ranged between 16 to 69 years.

All subjects were literate and, unfamiliar with the test materials. The groups were homogeneous in terms of socioeconomic status and education level.

Routine audiological evaluation was carried out in standard soundproof booths (Industrial Acoustic Company), using Interacoustics AC 40 audiometer and Interacoustics AZ 7 Immitancemeter. The subjects were given eight different speech tests in soundproof boots. The experimental conditions were the same for each subject. The tests were administered by the same tester, at the same normal loudness level for speech, at a distance of one meter with 0° azimuth. The subjects were given three seconds to respond. During the administration of the tests, to eliminate the risk of lipreading, the tester hid her lips from the subject.

Test 1: Pattern Perception Test: This test consists of 4 parts (A to D), each part contains the most frequently used words and includes 10 items.

Subtest A : There are two words in each item, one of them is monosyllabic, the second word

is trisyllabic. The task of the patient is to perceive the difference between monosyllabic and trisyllabic words.

Subtest B: There are two words in each item, one of them is monosyllabic, the second word is disyllabic. The task of the patient is to perceive the difference between monosyllabic and disyllabic words.

Subtest C: There are two words in each item, one of them is disyllabic, the second word is trisyllabic. The task of the patient is to perceive the difference between disyllabic and trisyllabic words.

Subtest D: There are two words in each item, both of them are disyllablic. The task of the patient is to perceive the difference between two disyllabic words.

For each item, the tester reads the word that has to be detected by the subject from the answer sheet of this test and the subject is asked to discriminate between the two words.

Test 2: Phoneme Recognition Test I (Closed-set). The task in this test is to discriminate the consonant at the beginning of the monosyllabic word. There are 85 items in this test, each of which has 3 choices. The choices are the same monosyllabic words; but only the consonant at the beginning of the words are different. The tester reads the word; the subject is expected to discriminate and to detect the word from the three choices on the sheet.

Test 3: Phoneme Recognition Test II (Closed-set). The task in this test is to discriminate the consonant at the end of the monosyllabic word. There are 125 items in this test. All the phonemes in the words are the same except the consonants at the end of the words. The subject is asked to choose the word he is expected to discriminate, from the three choices written in front of him.

Test 4: Phoneme Recognition Test III (Closed-set). The task is to discriminate the consonant at the beginning of the multisyllabic word. There are 54 disyllabic words. The phonemes were the same except for the first consonant.

Test 5: Phoneme Recognition Test IV (Same – Different Test). This test has 54 items. There are monosyllabic two words in each item. The subject is expected to differentiate whether the two words the tester reads are different or same.

Test 6: Vowel Recognition Test (Open-set). There are eight items consisting of monosyllabic words in this test. The first and last phonemes of the monosyllabic word in each item are the same, only the vowel in the middle is different. These words are read by the tester and the subject is asked to repeat them.

Test 7: Intonation Test (Open-set). This test measures the suprasegmental aspect of speech, the subject is asked to repeat the intonation pattern of the tester. The subject‘s ability is scored by the tester.

Test 8: Everyday Sentence Test for the Adults (Open-set). The test consists of the 75 most frequently used sentences in everyday language. The subject is expected to repeat the sentence the tester has read to him, without any mistake. Subject‘s answer is recorded by the tester.

Synthetic scoring is used in the interpretation of all the tests. The subject was given one point, for a right answer and no score for a wrong answer or when he could not answer at all. The scores were classified according to subject’s group and their statistical analysis was made.

Statistical Analysis: The ratio of the correct answers given by the subjects was calculated. The ratio of correct answers for each test was analyzed for each item. As a result, if normal hearing subjects gave faulty answers for an item with a rate of 5 %, in order to make the test homogeneous, this item was omitted .

Short test forms were developed from the tests with more items.

The items which were accepted but had given faulty answers with a rate less than 5%, were placed equally in the new test forms to balance the degree of difficulty.

In the second part of the statistical analysis , the rate of correct answers from normal hearing subjects and implanted groups were compared . For this comparison, the " Instat " statistics program was used. The rate of correct answers for the test items of the two experimental groups were analyzed by "chi – square test" for independence .

RESULTS

Test 1:

Item analysis: Normal hearing subjects gave correct answers to all of the items, so no item was omitted.

Statistical analysis: Cochlear implantees made a mistake on only one item, but there was no statistical difference between the groups. ($p < .05$)

Test 2:

Item analysis: Normal hearing subjects gave faulty answers for 10 items with a rate of %5. These items were omitted. The omitted items are shown in Table I. Three different test forms were composed with the remaining 75 items. Each alternative form had 25 items.

Statistical analysis: There was statistically difference in all items between the groups. ($p < .05$).

Test 3:

Item analysis: Normal hearing subjects gave faulty answers for 5 items with a rate of %5. These items were omitted. The omitted items are shown in Table II. Six alternative forms each consisting of 20 items were composed.

Statistical analysis: There was statistical difference in all items between the groups ($p < .05$).

Test 4:

Item analysis: Normal hearing subjects gave faulty answers for 4 items with a rate of %5. These items were omitted. The omitted items are shown in Table III. Two different forms each consisting of 25 items were composed as alternative forms.

Statistical analysis: There was statistical difference in all items between the groups ($p < .05$).

Test 5:

Item analysis: Normal hearing subjects gave faulty answers for 4 items with a rate of %5. These items were omitted. The omitted items are shown in Table I. Two different test forms, each consisting of 25 items, were composed with the remaining 50 items.

Statistical analysis: There was statistical difference in all items between the groups ($p < .05$).

Table 1: Omitted item for Test 2

Item29	PİL-NİL-MİL	Right Answer: MİL	Item60	KAY-TAY-SAY	Right Answer: TAY
Item34	PUL-KUL-DUL	Right Answer: DUL	Item67	ZİL-BİL-ÇİL	Right Answer: ÇİL
Item42	JEL-GEL-YEL	Right Answer: JEL	Item68	KİL-DİL-MİL	Right Answer: MİL
Item55	TER-SER-YER	Right Answer: SER	Item69	KUM-RUM-MUM	Right Answer: RUM
Item58	SAL-ŞAL-NAL	Right Answer: NAL	Item70	ÇOK- YOK ŞOK	Right Answer: ŞOK

Table 2: Omitted items for Test 3

Item7	ÇAN-ÇAP-ÇAM	Right Answer: ÇAM	Item71	SİL-SİM-SİN	Right Answer: SİM
Item13	CAM-CAN-CAZ	Right Answer: CAN	Item103	ZAM-ZAR-ZAN	Right Answer: ZAN
Item14	RAB-RAY-RAF	Right Answer: RAB	Item104	SIK-SIR-SIĞ	Right Answer: SIĞ
Item19	PUS-PUT-PUL	Right Answer: PUT	Item105	TOK-TON-TOP	Right Answer: TOP
Item64	LAV-LAF-LAZ	Right Answer: LAV			

Table 3: Omitted items for Test 4

Item 1	KİLİM-DİLİM-BİLİM	Right Answer: BİLİM
Item 2	KARA-PARA-TARA	Right Answer: KARA
Item 19	ŞEKER-TEKER-ÇEKER	Right Answer: ÇEKER
Item 26	BAKLA-TAKLA-SAKLA	Right Answer: SAKLA

Table 4: Omitted items for Test 5

Item 1	BEL-DEL	Answer: Different	Item 38	ŞAL-ŞAL	Answer: Different
Item 7	DAR-DAR	Answer: Aynı	Item 40	SAL-FAL	Answer: Different
Item 16	PEK-PEK	Answer: Aynı	Item 47	KUM-KUM	Answer: Different
Item 35	RAY-LAY	Answer: Different	Item 54	MİL-NİL	Answer: Different

Test 6:
Item analysis: Normal hearing subjects gave correct answers to all of the items, so no item was omitted.
Statistical analysis: There was statistical difference in all items between the groups ($p < .05$).

Test 7:
Item analysis: All normal hearing subjects successfully repeated the intonation task.
Statistical analysis: Cochlear implantees failed in the task. There was statistical difference between the groups ($p < .05$).

Test 8:
Item analysis: All items were answered correctly, so no item was omitted. Three test forms were composed. Each of them were made up of 25 items.
Statistical analysis: There was statistical difference in all items between the groups ($p < .05$).

DISCUSSION

The results of the speech perception tests developed in this study showed that the words in the lists were within the knowledge of the implanted patients. Content validity of the test was controlled.

Pattern Perception Test seems to be the easiest test, because for every item, the rate of correct answers was very high for the implanted group. Only in one item, we observed a difference between the groups, but it was not statistically significant. Based on these results, Pattern Perception Test can be regarded as the easiest for the implanted group as it is for the normal group. However, it should be noted that the implanted group subjects in this study were experienced in implant use. For new implantees, we can infer that the Pattern Perception Test can be useful for evaluating their progress especially in the period following implantation. Our observations in our clinic support this issue.

In the closed-set tests, the difference between the groups was statistically highly significant, indicating that criteria validity was also high. When administered to normal hearing and cochlear implanted groups, different results were obtained. These differences are statistically significant which is an indicator of the test‘s specificity.

In the open-set tests, and especially in the Sentence Test, the rate of correct answers was very low in the implanted group. The performance of the cochlear implant

recipients on the open set speech tests was found to be lower than the closed set speech performance in the literature [10,11]

Analysis showed that intonation was the hardest task for cochlear implanted group. Almost all of the subjects in this group were unsuccessful in the intonation test. Peng et al. and Evans et al. mention about similar findings [12,13].

We standardized eight different tests for two different purposes: Assessment of the speech perception abilities of the cochlear implant candidates, and, evaluation of the progress of the cochlear implanted patients.

The speech tests given to the patients before implantation and during each programming session after the implantation, were used for the evaluation of the progress. If we administer the same word lists to the patients, the test results will inevitably be affected from the learning factor. Therefore alternative test forms were developed after item analysis. By doing so, we aimed to exclude the learning factor to a great extent.

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