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Original Article

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Özgün Araştırma

EVALUATION OF RECOVERY BY STAPES REFLEX IN PATIENTS WITH PERIPHERAL FACIAL PARALYSIS

Periferik Fasiyal Paralizisi Olan Hastalarda Stapes Refleksiyle İyileşmenin Değerlendirilmesi

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ABSTRACT

Objective: The aim of this study was to investigate the acoustic reflex in different frequencies at the time of diagnosis, during the treatment and follow-up of patients with idiopathic peripheral facial nerve palsy and compare these results with House-Brackmann clinical scoring to determine the prognostic value of acoustic reflex in these patients.

Material and Methods: Thirty-three adult patients with idiopathic peripheral facial palsy (aged 18-77 years, 16 male, 17 female) were included in the study. All the patients were clinically graded with House-Brackmann clinical scoring and acoustic reflex test was performed at the time of diagnosis, 1st, 2nd, 3rd, 4th weeks, 2nd and 3rd month. Ipsilateral acoustic reflex thresholds were measured from both ears with impedance audiometry using a 226 Hz probe tone.

Results: Significant relation was observed between the presence of sequel and initial grade and absence of acoustic reflex at 0.5, 1, 2 kHz at time of diagnosis. In addition, after the 1st week, a significant relation was also detected at 4 kHz frequency during all the follow-up period. The risk of sequelae would increase more than 3 times as the initial grade value increased.

Conclusion: The present study revealed the relation between the sequel and initial high grade, the absence of acoustic reflex at 0.5, 1, 2 kHz at time of diagnosis in addition with high age. Statistics does not support the same relation at 4 kHz frequency at time of diagnosis. However, statistic reveals that only the initial grade can best predict the risk of sequel, in addition, the risk of sequel increases more than 3 times as the initial grade value increase.

Keywords: *Facial paralysis, acoustic impedance test, prognosis*

ÖZ

Amaç: Bu çalışmanın amacı idiyopatik periferik fasiyal paralizi olan hastaların tanı anında, tedavi ve takibinde farklı sıklıklardaki akustik refleksleri araştırmak ve bu sonuçları House-Brackmann klinik skorlaması ile karşılaştırarak prognostik değeri belirlemektir.

Gereç ve Yöntemler: Çalışmaya idiyopatik periferik fasiyal paralizi olan 33 yetişkin hasta (18-77 yaş arası, 16 erkek, 17 kadın) dahil edildi. Tüm hastalar House-Brackmann klinik skorlaması ile klinik olarak evrelendi ve tanı anında, 1., 2., 3., 4. hafta, 2. ve 3. ayda akustik refleks testi yapıldı. İpsilateral akustik refleks eşikleri, 226 Hz'lik bir prob tonu kullanılarak empedans odyometrisi ile her iki kulaktan ölçüldü.

Bulgular: Sekel varlığı ve başlangıç evresi ile tanı anındaki 0.5, 1, 2 kHz'de akustik refleksin olmaması arasında anlamlı ilişki gözlendi. Ayrıca 1. haftadan sonra tüm takip süresi boyunca 4 kHz frekansında da anlamlı bir ilişki tespit edildi. Başlangıç evresi arttıkça sekel riskinin 3 kattan fazla artacağı görüldü.

Sonuç: Bu çalışma, ilerleyen yaş ile birlikte tanı anında 0.5, 1, 2 kHz'de akustik refleksin olmaması ve başlangıçtaki yüksek evre ile sekel arasındaki ilişkiyi ortaya koymuştur. Ancak istatistiksel inceleme sekel riskini yalnızca başlangıç evresinin en iyi şekilde tahmin edebileceğini, ayrıca başlangıç evresi arttıkça sekel riskinin 3 kattan fazla artacağını ortaya koymuştur.

Anahtar Kelimeler: *Fasiyal paralizi, akustik direnç testleri, prognoz*

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INTRODUCTION

Idiopathic peripheral facial nerve palsy (Bell's palsy) is an acute peripheral facial palsy that presents with rapid onset of weakness on one side of the face (1). It is caused by the inflammation of the facial nerve of an unknown cause. Although the presenting symptom is facial weakness, usually dysfunction is seen in all the branches. Electrophysiological and topographic tests measure the function of these branches and are used to determine the prognosis. Acoustic reflex (AR) test is one of the topographic tests that is widely used (2). It is a part of an impedance audiometry test and it measures the lowest intensity level of audiologic stimulus at which the stapedius muscle contraction is detected, called the AR threshold. It can be measured for different frequencies and the physiological value of ART is 85 dBHL (2). Lack of AR is a sign of facial palsy and return of AR to normal is a sign of healing and good prognosis (3). There is further need for study regarding which frequency should be employed as the stimulation frequency for inducing stapedial reflex (3).

The aim of this study was to investigate the ARs in different frequencies at the time of diagnosis, during the treatment and follow-up of patients with idiopathic peripheral facial nerve palsy and compare these results with House-Brackmann clinical scoring to determine the prognostic value of AR in these patients. In addition, this study is performed to find the relationship between ARs and the presence of sequel at the end of the follow-up.

MATERIALS AND METHODS

Thirty-three adult patients with idiopathic peripheral facial palsy (aged 18-77 years, 16 male, 17 female) were included in the study. Patients were required to have no abnormal findings on otoscopic examination, normal pure-tone hearing thresholds (≤20 dB HL at 0.25, 0.5, 1, 2, 3, 4, 6, and 8 kHz), and no reported history of ear surgery, head trauma or neurological disorder. Other inclusion criteria were <3 days from onset of symptoms, no history of systemic disease, completing appropriate steroid therapy (1mg/kg methylprednisolone for 3 days, following reducing doses). All the patients were clinically graded with House-Brackmann clinical scoring and AR test was performed at the time of diagnosis, 1st, 2nd, 3rd, 4th weeks, 2nd and 3rd month.

Ipsilateral AR thresholds were measured from both ears with impedance audiometry (Inventis clarinet plus) using a 226 Hz probe tone (trains of 40 ms pulses). All patients had normal tympanometric results (middle-ear compliance 0.3–1.5 cm^3, middle-ear pressure –50 to +50 daPa, and ear canal volume between 0.6 and 1.5 cm^3). Calibration was performed before each test. For each patient 0.5, 1, 2 and 4 kHz pure tone presented ipsilaterally. The reflex threshold was identified as the lowest stimulus intensity resulting in a reduction in middle-ear compliance of ≥0.02 ml.

All patients gave informed written consent. The study was approved by Kirikkale University Clinical Research Ethics Committee (Number:2021.04-06) and supported by University of Kırıkkale Scientific Research Project Committee (no: 2021/073).

Statistical Analysis

Study data were analyzed and compared using SPSS version 20.0 (IBM, USA). *Kolmogorov-Smirnov* test was used to test the normal distribution of the data of the study. Parametric data were expressed as mean±standard deviation and categorical data as numbers (%).

Independent Samples T-test was used for comparison of parametric data ($p<0.05$). Categorical variables were analyzed using the *Pearson chi-square* test ($p<0.05$). *Wilcoxon Signed Ranks* test was used in the analysis of re-measured data ($p<0.05$).

Spearman's rho Correlation test was used to show the statistical correlation between the data ($p<0.05$).

ROC-curve analysis was performed to determine which study parameters could predict patient prognosis at the end of long-term follow-up. Cut-off values were obtained to determine the sensitivity and specificity ratios of the parameters. *Binary Logistic Regression* test was used to determine the best prognostic predictor parameter ($p<0.05$).

RESULTS

The distribution of gender, grade of facial palsy, the presence of AR and sequel according to the follow-up periods are presented in Table 1.

The relationship between the presence of AR (for each frequency and the follow-up periods) and prognosis of facial palsy was investigated by dividing the population into two groups, as follows: completely recovered and recovered with sequel. Significant relation was observed between the presence of sequel and initial grade and absence of AR at 0.5, 1, 2 kHz at time of diagnosis. The data are presented in Table 2.

In addition, after the 1st week, a significant relation was also detected at 4 kHz frequency during all the follow-up period. The data including the relation between the presence of sequel and grade and AR at 1st week, 2nd and 3rd month are presented in Table 3, 4 and 5.

According to the findings at the time of diagnosis, positive correlations were detected between sequel and age (r=0.355, p=0.043) and grade (r=0.531, p=0.001). Negative correlations were detected between sequel and 0.5 kHz AR (r=-0.380, p=0.029), 1 kHz AR (r=-0.356, p=0.042) and 2 kHz AR (r=-0.356, p=0.042) responses. At 1st week, positive correlations were detected between sequel and age (r=0.355, p=0.043) and grade (r=0.361, p=0.039).

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Table 1: The distribution of variables according to the follow-up periods

Variable		Diagnose	1. week	2. week	3. week	4. week	2. month	3. month
Age (year)		45.21±17.77						
Gender	Male n(%)	16 (48.5)	-	-	-	-	-	-
	Female n(%)	17 (51.5)	-	-	-	-	-	-
Grade		-	-	4 (12.1%)	13 (39.4%)	23 (69.7%)	26 (78.8%)	27 (81.8%)
		5 (15.2%)	12 (36.4%)	20 (60.6%)	14 (42.4%)	6 (18.2%)	4 (12.1%)	5 (15.2%)
	3	13 (39.4%)	15 (45.5%)	6 (18.2%)	3 (9.1%)	1 (3.0%)	3 (9.1%)	1 (3.0%)
	4	9 (27.3%)	3 (9.1%)	-	2 (6.1%)	2 (6.1%)	-	-
	5	2 (6.1%)	2 (6.1%)	3 (9.1%)	1 (3.0%)	1 (3.0%)	-	-
	6	4 (12.1%)	1 (3.0%)	-	-	-	-	-
0.5 kHz AR	Absent n(%)	20 (60.6)	12 (36.4)	700 (21.2)	5 (15.2)	4 (12.1)	4 (12.1)	4 (12.1)
	Present n(%)	13 (39.4)	21 (63.6)	26 (78.8)	28 (84.8)	29 (87.9)	29 (87.9)	29 (87.9)
1 kHz AR	Absent n(%)	21 (63.6)	11 (33.3)	6 (18.2)	5 (15.2)	4 (12.1)	4 (12.1)	4 (12.1)
	Present n(%)	12 (36.4)	22 (66.7)	27 (81.8)	28 (84.8)	29 (87.9)	29 (87.9)	29 (87.9)
2 kHz AR	Absent n(%)	21 (63.6)	13 (39.4)	8 (24.2)	7 (21.2)	5 (15.2)	4 (12.1)	4 (12.1)
	Present n(%)	12 (36.4)	20 (60.6)	25 (75.8)	26 (78.8)	28 (84.8)	29 (87.9)	29 (87.9)
4 kHz AR	Absent n(%)	23 (69.7)	18 (54.5)	0 (0.0)	11 (33.3)	7 (21.2)	5 (15.2)	5 (15.2)
	Present n(%)	10 (30.3)	15 (45.5)	33 (100)	22 (66.7)	26 (78.8)	28 (84.4)	28 (84.4)
Sequel	Absent n(%)	-	-	-	-	-	-	27 (81.8)
	Present n(%)	-	-	-	-	-	-	6 (18.29)

AR: Acoustic reflex

Table 2: Relation between the presence of sequel, grade and AR at time of diagnosis

Variable		Sequel (-) Mean ± SD/ N (%)	Sequel (+) Mean ± SD/ N (%)	t/ X^2	p
Age		42.37±17.51	58±13.68	-2.396*	0.050
Grade	1	-	-	14.514†	**0.006**
	2	5 (15.2)	0 (0.0)		
	3	13 (39.4)	0 (0.0)		
	4	6 (18.2)	3 (9.1)		
	5	2 (6.1)	0 (0.0)		
	6	1 (3.0)	3 (9.1)		
0.5 kHz AR	Absent	14 (42.4)	6 (18.2)	4.767†	**0.029**
	Present	13 (39.4)	0 (0.0)		
1 kHz AR	Absent	15 (45.5)	6 (18.2)	4.190†	**0.041**
	Present	12 (36.4)	0 (0.0)		
2 kHz AR	Absent	15 (45.5)	6 (18.2)	4.190†	**0.041**
	Present	12 (36.4)	0 (0.0)		
4 kHz AR	Absent	17 (51.5)	6 (18.2)	3.188†	0.074
	Present	10 (30.3)	0 (0.0)		

*: t value, Independent Samples t-test, †: X^2 value, Pearson chi-square test, $p<0.05$, AR: Acoustic reflex

Table 3: Relation between the presence of sequel, grade and AR at 1st week

		Sequel (-)	Sequel (+)		
Variable		**N (%)**	**N (%)**	**X^2**	**p**
Grade	1	-	-	15.186	**0.004**
	2	11 (33.3)	1 (3.0)		
	3	13 (39.4)	2 (6.1)		
	4	3 (9.1)	0 (0.0)		
	5	0 (0.0)	2 (6.1)		
	6	0 (0.0)	1 (3.0)		
0.5 kHz AR	Absent	6 (18.2)	6 (18.2)	12.833	**<0.001**
	Present	21 (63.6)	0 (0.0)		
1 kHz AR	Absent	6 (18.2)	5 (15.2)	8.250	**0.004**
	Present	21 (63.6)	1 (3.0)		
2 kHz AR	Absent	8 (24.2)	5 (15.2)	5.930	**0.015**
	Present	19 (57.6)	1 (3.0)		
4 kHz AR	Absent	12 (36.4)	6 (18.2)	6.111	**0.013**
	Present	15 (45.5)	0 (0.0)		

X^2 value, Pearson chi-square test, $p<0.05$, AR: Acoustic reflex

Table 4: Relation between the presence of sequel, grade and AR at 2nd month

		Sequel (-)	Sequel (+)		
Variable		**N (%)**	**N (%)**	**X^2**	**p**
Grade	1	25 (75.8)	1 (3.0)	19.814	**<0.001**
	2	2 (6.1)	2 (6.1)		
	3	0 (0.0)	3 (9.1)		
	4	-	-		
	5	-	-		
	6	-	-		
0.5 kHz AR	Absent	0 (0.0)	4 (12.1)	20.483	**<0.001**
	Present	27 (81.8)	2 (6.1)		
1 kHz AR	Absent	0 (0.0)	4 (12.1)	20.483	**<0.001**
	Present	27 (81.8)	2 (6.1)		
2 kHz AR	Absent	0 (0.0)	4 (12.1)	20.483	**<0.001**
	Present	27 (81.8)	2 (6.1)		
4 kHz AR	Absent	0 (0.0)	5 (15.2)	26.518	**<0.001**
	Present	27 (81.8)	1 (3.0)		

X^2 value, Pearson chi-square test, $p<0.05$, AR: Acoustic reflex

Table 5: Relation between the presence of sequel, grade and AR at 3rd month

		Sequel (-)	Sequel (+)		
Variable		**N (%)**	**N (%)**	**X^2**	**p**
Grade	1	27 (81.8)	0 (0.0)	33.000	**<0.001**
	2	0 (0.0)	5 (15.2)		
	3	0 (0.0)	1 (3.0)		
	4	-	-		
	5	-	-		
	6	-	-		
0.5 kHz AR	Absent	0 (0.0)	4 (12.1)	20.483	**<0.001**
	Present	27 (81.8)	2 (6.1)		
1 kHz AR	Absent	0 (0.0)	4 (12.1)	20.483	**<0.001**
	Present	27 (81.8)	2 (6.1)		
2 kHz AR	Absent	0 (0.0)	4 (12.1)	20.483	**<0.001**
	Present	27 (81.8)	2 (6.1)		
4 kHz AR	Absent	0 (0.0)	5 (15.2)	26.518	**<0.001**
	Present	27 (81.8)	1 (3.0)		

X^2 value, Pearson chi-square test, $p<0.05$, AR: Acoustic reflex

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Negative correlations were detected between sequel and 0.5 kHz AR (r=-0.632, p<0.001), 1 kHz AR (r=-0.500, p=0.003), 2 kHz AR (r=-0.424, p=0.014) and 4 kHz AR (r=-0.430, p=0.012) responses. The AR at all frequencies were negatively correlated with sequel at 2nd, 3rd, 4th weeks and 2nd and 3th months (p<0.001).

At the end of the *ROC-Curve* analysis, it was thought that the following parameters could predict the possibility of sequel at the end of long-term follow-up: the age >51 (AUC=0.765, p=0.045, sensitivity=83%, specificity=70%), the grade value measured at baseline >3 (AUC=0.880, p=0.004, sensitivity=100%, specificity=75%), the absence of 0.5 kHz AR at the 3rd month (AUC=0.167, p=0.012, sensitivity=77%, specificity=100%), the absence of 1 kHz AR at the 3rd month (AUC=0.167, p=0.012, sensitivity=77%, specificity=100%), the absence of 2 kHz AR at the 3rd month (AUC=0.167, p=0.012, sensitivity=77%, specificity=100%) and the absence of 4 kHz AR at the 3rd month (AUC=0.083, p=0.002, sensitivity=83%, specificity=100%).

At the end of the *Logistic Regression* analysis which was applied to test which of these parameters could best predict sequelae in patients in long-term follow-up, only the initial grade was found to be the parameter that could best predict the risk of sequelae (B=1.335, Wald=6.988, p=0.008). In addition, considering the odds ratio values obtained at the end of this analysis, it was assumed that the risk of sequelae would increase more than 3 times as the initial grade value increased (Odds ratio=3.802, 95% Confidence Interval 1.412-10.234) (Table 6).

Table 6: Results of *ROC-Curve analysis* and *logistic regression* test for sequel and prognosis (*p*<0.05)

ROC-Curve analysis for sequel							
Variable	**AUC**	**p**	**Cut-off value**	**Sensitivity**	**Specificity**	**95% CI**	
						Lower	**Upper**
Age	0.765	**0.045**	>51	83%	70%	0.567	0.964
Initial Grade	0.880	**0.004**	>3	100%	77%	0.755	1.000
3th month Grade	1.000	**0.000**	>0	100%	100%	1.000	1.000
3th month 0.5 kHz AR	0.167	**0.012**	<1	77%	100%	0.000	0.403
3th month 1 kHz AR	0.167	**0.012**	<1	77%	100%	0.000	0.403
3th month 2 kHz AR	0.167	**0.012**	<1	77%	100%	0.000	0.403
3th month 4 kHz AR	0.083	**0.002**	<1	83%	100%	0.000	0.262
Logistic regression analysis for sequel							
						95% CI	
Variable	**B**	**Wald**	**df**	**p**	**Odds Ratio**	**Lower**	**Upper**
Initial Grade	1.335	6.988	1	**0.008**	**3.802**	1.412	10.234

DISCUSSION

Peripheral facial palsy is the most common cranial nerve palsy and the most common reason is idiopathic, so called Bell's palsy (4). The recovery rate of Bell's palsy without complication and sequel is about 85-94% with early steroid therapy (5,6). Compatible with the literature, the rate of recovery without sequel in our patients is 81.8%.

The differential diagnosis of middle ear disease is important in the management of peripheral facial palsy. Impedance meter indicates middle ear compliance and pressure and a normal impedancemetric examination almost excludes the middle ear disease. AR test is an important objective test that is measured with a clinical impedance meter as a part of routine audiologic evaluation. It is a non-invasive, easy to do and reliable test that shows the function of the nerve in compatible with the clinical scores in almost all frequencies (0.5, 1, 2 and 4 kHz). It indicates the function of stapedial muscle that is innervated by the facial nerve. The AR thresholds can be determined for ipsilateral and contralateral stimulation for both ears. The ipsilateral AR threshold is lower than the contralateral stimulation by 2-14 db (2). As mentioned by Kopala et al, ipsilateral AR threshold can be stimulated easily at a lower intensity of stimulus when compared with contralateral stimulation. Hence, only ipsilateral stimulation is performed in the present study (2).

The clinical scoring of Bell's palsy, House-Brackmann scoring, is a subjective grading system and AR test is a complementary objective test in facial palsy. The AR response is present in about 40% of the patients with facial palsy (7). In these patients, the lesion is minimal and recovered early. In the patients where the reflex is absent, recovery occurs late and the time necessary for reflex reappearance is shown to be correlated with the severity of the lesion (7). In some patients, the AR is present only for certain frequencies (2). The AR thresholds at 0.5 and 1 kHz are found to be correlated with facial palsy scores (3). Portman indicated that an absent AR is a poor prognostic factor especially in patients Ramsey-Hunt syndrome. He also noted that present AR alone does not determine the prognosis (8). In the present study, significant relation is observed between the presence of sequel and initial high grade and absence of AR at 0.5, 1, 2 kHz at time of diagnosis.

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After the 1st week, a significant relation is also detected at 4 kHz frequency. Generally, no AR is detected in initially high grade patients (grade>3) especially at 0.5, 1, 2 kHz, hence both of these results are the signs of moderate to severe nerve damage.

The presence of AR is also a prognostic factor for recovery time. Ide et al. studied the relation between AR and recovery time of facial palsy and they observed a tendency towards complete recovery from paralysis within 3 months when AR occurred within two weeks from the onset of the paralysis (3). Treatment, grade, electromyography (EMG) evaluation are presented as the prognostic factors estimating the recovery time from Bell's palsy (8). The AR test is also proposed to be of prognostic value (9). Together with a present AR, absence of spontaneous muscle activity on needle EMG are presented as the best indicators of a good prognosis (8). The present study revealed the relation between the sequel and initial high grade, the absence of AR at 0.5, 1, 2 kHz at time of diagnosis in addition with high age. Statistics does not support the same relation at 4 kHz frequency at time of diagnosis. After the 1st week, the response at all frequencies are correlated with the presence of sequel. However, statistic reveals that only the initial grade can best predict the risk of sequel, in addition, the risk of sequel increases more than 3 times as the initial grade value increase.

The major drawback of our study was the inclusion of limited number of patients, as most of the patients were lost their follow-up or couldn't get the standard systemic therapy. Additionally, we only searched the correlation between AR test and sequel but did not present the EMG findings of the patients with sequel.

In the present study, the AR tests of 33 patients with Bell's palsy were compared with their facial function scores. The stimulus frequencies were 0.5, 1, 2 and 4 kHz for ipsilateral stimulus. The AR test at 0.5, 1, 2 kHz for ipsilateral stimulus at the time of diagnosis seemed to be useful for evaluating the sequel and prognosis of facial paralysis.

Conflict of Interest: The authors have no conflicts of interest to declare.

Researchers' Contribution Rate Statement: Concept/Design: EC, YT; Analysis/Interpretation: EC, YT; Data Collection: EC, YT; Writer: EC, YT; Critical Review: EC, YT; Approver: EC, YT

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