

Value of electrophysiological testing in unilateral facial palsy

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Objective

The aim of this study was to assess the value of facial nerve temporal recording in the diagnosis and prognosis of facial nerve palsy.

Patients and methods

The study was conducted on 42 patients with acute unilateral Bell's palsy (patients' group) and 43 healthy volunteers who served as a control group. All patients and controls were subjected to clinical examination in the form of history taking and full general and neurological examinations, clinical scoring system using House–Brackmann facial nerve grading system (performed for the patients' group only), electrophysiological assessment, which included electro-neuronography (ENoG) and facial nerve temporal recording.

Results

The amplitude of the facial nerve temporal recording was significantly lower in the patients' group compared with that in the control group, and there was statistically significant increase of the amplitude of facial nerve temporal recording, regaining its normal triphasic waves; as regards correlation study between the percent of degeneration of ENoG and the amplitude of the diseased facial temporal recording, there was positive correlation between them, and it was not reaching the level of statistical significance.

Conclusion

Facial nerve temporal recording detects the degenerative changes that occur in the intratemporal segment of the facial nerve; hence, it should be considered as a complementary tool for the ENoG test for early diagnosis and follow-up of Bell's palsy.

Keywords:

electroneuronography, facial nerve temporal recording, House–Brackmann facial nerve grading system

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Introduction

Bell's palsy accounts for more than half of all cases of idiopathic facial palsy. It is considered to be a diagnosis of exclusion after ruling out all other possible causes [1]. For many patients, the questions about whether their facial function will return to normal or not and how long it would take are what they are mostly concerned about. Evaluation of the prognosis of facial nerve palsy is useful for counseling of patients and guiding further management [2].

Since the 1970s, prognostication has been based mainly on various electrophysiologic tests such as electromyography, electroneuronography (ENoG), maximal nerve excitability testing, and facial motor nerve conduction testing [3]. Abnormal findings from these tests are obtained after the degeneration process extends to the extratemporal segment of the facial nerve with a 1–2-week delay [4].

The facial nerve antidromic-evoked potential (FNAEP) was first described by Bumm *et al.* It was the only method to represent the intratemporal facial

nerve function and had the possibility to diagnose nerve degeneration during the early stage of paralysis. The prognosis of Bell's palsy is good, but the proportion of patients with poor outcomes may reach 30%.

Patients and methods

We conducted our study on 42 patients with acute unilateral Bell's palsy (patients' group) and 43 healthy volunteers who served as a control group. Informed written consent was obtained from all patients and volunteers.

All patients and controls were subjected to clinical examination by history taking and full general and neurological examination with emphasis on the facial nerve examination, clinical scoring system using House–Brackmann facial nerve grading system

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(performed for the patients' group only), electrophysiological assessment in the form of ENoG, and facial nerve temporal recording.

ENoG compares the neurophysiologic response of the normal side to the abnormal side to determine the prognosis and whether surgical intervention is needed or not. The tests depend on side-to-side comparison of the amplitude of the motor response to determine the percentage of denervation fibers of different branches of the diseased facial nerve [5].

Before applying the stimulator, the ENoG procedure was fully explained to patients. All our patients agreed to the discomfort of electrical stimulation. Before beginning the ENoG procedure, as is customary with all electrophysiologic diagnostic tests, the necessary supplies were carefully assembled (e.g. tape, skin-abrading material, conducting paste, cup electrodes). The skin was prepared for the stimulus, and recording cup electrodes were applied for recording the response; interelectrode impedance was checked for all electrode combinations [6].

The stimulator was applied at (or near) the stylomastoid foramen with measurements of the supramaximal compound muscle action potentials using cup recording electrodes. The cathode was pointing toward the recording electrode.

The active recording electrode (also known as G1) was placed at the motor points of the frontalis, nasalis, and orbicularis oris muscles; the reference electrode (also known as G2) was placed over the forehead or the chin, and the ground electrode was placed around the patient's/volunteer's neck [6]. The normal side was evaluated first; the abnormal side was tested second.

As for the facial nerve temporal recording, before the test, the auricle was cleared; the ground electrode was placed around the neck. Two discoid electrodes with a little conductive paste were located at the ventral surface of the auricle (recording electrode or G1) and the earlobe (reference electrode or G2). The facial nerve was stimulated at (or near) the stylomastoid foramen; the current was slowly increased from a baseline 0 mA, usually by 5–10 mA increments. Data consisting of baseline to peak amplitudes and latencies were statistically analyzed in the control group and were compared with the patients' group [7].

Statistical analysis

Statistical presentation and analysis of the present study was conducted and analyzed using the mean,

standard deviation, student *t*-test, Paired *t*-test, Chi-square, by SPSS program (Statistical Package for Social Sciences) software version 17. The level of significance was taken at *P*-value less than 0.01; otherwise, it was considered nonsignificant. Correlation studies were carried out using the Pearson correlation test (*r*); *P*-value less than 0.01 was considered significant.

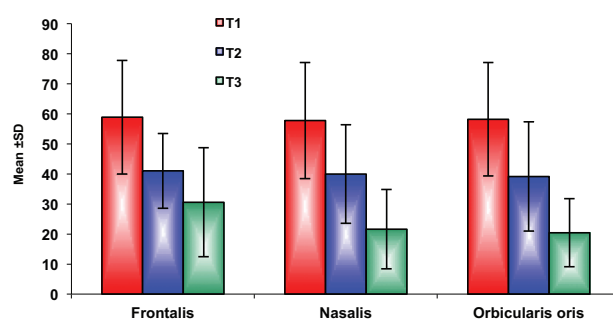
Results

The control group included 18 men and 25 women. Their ages ranged from 23 to 59 years with a mean of 43 years. The patients' group included 17 men and 25 women. Their ages ranged from 18 to 60 years with a mean of 43 years. Twenty four patients had right facial palsy and 18 had left facial palsy. None of the patients had bilateral or recurrent facial palsy.

In the ENoG test in the patients' group, the mean percentage of degeneration with recording from the frontalis muscle was 58.8%. Recording from the nasalis revealed mean percentage of degeneration of 57.7%. Recording from the orbicularis oris revealed a mean percentage of degeneration of 58.1% (Fig. 1).

In the patients' group the FNAEP were recorded from the external auditory canal (EAC) in three patients; in the remaining 39 patients the FNAEP was recorded by temporal recording from the auricle. In the control group the FNAEP was recorded from the EAC in five volunteers; in the remaining 38 volunteers, FNAEP was recorded by temporal recording from the auricle. The mean latency in the response of the temporal recording on the diseased side in the patients' group was 2.7 ms; the mean amplitude in the response of the temporal recording on the diseased side in the patients' group was 1.2 mV.

Figure 1



ENoG (% of degeneration) recording from frontalis, nasalis and orbicularis oris muscles in patients group. There was statistical significant difference in the percentage of denervation in the form of reduction in the percentage of denervation recording from frontalis, nasalis and orbicularis oris muscles.

Correlating the amplitude of facial nerve temporal recording in the diseased side in the patients' group with the House–Brackmann grading scale, there were positive correlations, and they were statistically nonsignificant (Table 1). Correlating the amplitude of the facial nerve conduction study in the diseased side in the patients' group with the House–Brackmann grading scale, there were positive correlations, and they were statistically significant (Table 2). Correlating the percent of degeneration of the ENoG in the patients' group with the amplitude of facial nerve temporal recording in the diseased side in the patients' group, there were positive correlations, and they were not reaching the statistically significant level (Table 3).

There was a statistically significant difference in the percentage of denervation in the form of reduction in the percentage of denervation recording from the frontalis, nasalis, and orbicularis oris muscles (Fig. 1).

Discussion

In our study, we initially followed the antidromic-evoked potentials technique adopted by Zhang *et al.*

[7]. Zhang *et al.* [7] used bipolar stimulators, discoid electrodes, and needle electrodes. They placed the recording electrode on the posterior wall of the external auditory canal and the reference electrode on the earlobe. They stimulated the nerve at the stylomastoid foramen using the bipolar stimulator with a stimulus intensity of about 30 mA. Their technique elicited a response in all their patients. However, in our study we could elicit a response using Zhang's technique in only five volunteers (out of 40 volunteers) and three patients (out of 42 patients). Accordingly, we adopted a modified approach in recording; after several trials, a response could be best elicited by placing the recording electrode on the auricle.

A possible explanation of the failed elicitation of a response using the Zhang technique is the high electrical impedance of the skin and the subcutaneous tissue, which require relatively large electrical currents and may have produced large stimulation artifacts that may have masked the antidromic facial nerve response [8]. Zhang *et al.* [7] avoided this problem by using needle electrodes, and also Nakatani *et al.* [9] introduced a method of stimulation of the facial nerve via Stensen's duct at a depth of 5 cm from the orifice of the external auditory canal.

The waveforms that were obtained in our study match the waveform changes that were observed in the study by Nakatani *et al.* [9], which included 109 patients with Bell's palsy evaluated within 7 days after the onset of paralysis. They divided their patients into three groups

Table 1 Correlation study between amplitude of facial nerve temporal recording and the House–Brackmann grading scale

	HB scale			Pearson's test	
	Grade IV	Grade V	Grade VI	<i>r</i>	<i>P</i> -value
Temporal recording amplitude in the diseased side (mV)					
Mean	1.263	1.245	1.225	0.024	0.977
SD	0.414	0.308	0.486		

HB, House–Brackmann.

Table 2 Correlation study between amplitude of facial nerve conduction study and the HB grading scale

Amplitude (mv) of facial nerve conduction study diseased side		HB scale			ANOVA	
		Grade IV	Grade V	Grade VI	<i>F</i>	<i>P</i> -value
Amplitude of NCS disease side	Mean	0.975	0.727	0.267	44.290	<0.001*
	SD	0.116	0.193	0.172		
	Mean	1.850	1.468	0.583	33.567	<0.001*
	SD	0.411	0.329	0.415		
	Mean	2.163	1.627	0.592	67.708	<0.001*
	SD	0.220	0.299	0.392		

ANOVA, analysis of variance; HB, House–Brackmann; NCS, nerve conduction study. *Significant.

Table 3 Correlation study between the percent of degeneration of the electroneuronography in the patients' group with the amplitude of facial nerve temporal recording in the diseased side in the patients' group

	ENoG% of degeneration				Pearson's test	
	Grade II	Grade III	Grade IV	Grade V	<i>r</i>	<i>P</i> -value
Temporal recording amplitude in the diseased side (mV)						
Mean	2.800	2.285	2.289	2.256	0.358	0.783
SD	0.000	0.439	0.523	0.541		

ENoG, electroneuronography.

according to the severity using the 40-point Japanese grading system and by the House–Brackmann grading system. Group A included patients with mild paralysis with no synkinesis. Group B included patients with moderate paralysis and mild synkinesis. Group C included patients with severe paralysis and severe synkinesis. The waveform of the evoked potential differed among groups. The waveform was triphasic in group A, biphasic in group B, and flat line in group C. Our results and Nakatani's results denote that the waveform varies with the severity and thus may be used as a criterion for abnormality.

In this study the amplitude of facial nerve temporal recording on the normal side of the patients' group showed no statistical significant difference ($t=2.1$, $P=0.22$). The amplitude of facial nerve temporal recording on the diseased side of the patients' group showed a statistically significant increase ($t=3.4$, $P\leq 0.001$), denoting improvement and reinnervation.

Zhang *et al.* [7] study found that the amplitude of the FNAEP and the clinical results were matching than that between latency and the clinical results. Our study and the Zhang study revealed that lower amplitude of the FNAEP indicates poor clinical results, and increase in the amplitude indicates clinical improvement of the cases; in our study we reached this conclusion by the positive correlation between the amplitude of facial nerve temporal recording and the House–Brachmann grading scale [10].

In our study, we found positive correlation between the amplitude of facial nerve temporal recording of the diseased side in the patients' group and the House–Brackmann grading scale. This result is related to the clinical severity and thus may be useful in the prediction of the patient's prognosis.

In our study, we found a positive correlation between the amplitude of the facial nerve temporal recording of the diseased side in the patients' group and the House–Brackmann grading scale ($r=0.358$), which was not reaching a statistically significant value. This result is related to the clinical severity and thus may be useful in prediction of the patient's prognosis.

Moreover, in our study, we found a positive correlation between the amplitude of facial nerve temporal recording of the diseased side in the patients' group and the percent of degeneration by the ENoG, which was not reaching a statistically significant value. This result indicates that both the electrophysiological tests, the ENoG, and the Facial nerve temporal recording assess the conduction along a different part of the nerve. The ENoG assesses the extratemporal part, and the temporal recording assesses the conduction along the intratemporal part of the facial nerve.

Conclusion

Facial nerve temporal recording detects the degenerative changes that occur in the intratemporal segment of the facial nerve; hence, it should be considered as a complementary tool for the ENoG test for early diagnosis and follow-up of Bell's palsy.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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