Electrical response grading versus House-Brackmann scale for evaluation of facial nerve injury after Bell’s palsy: a comparative study

Bin Huang1, Zhang-ling Zhou1, Li-li Wang1, Cong Zuo2, Yan Lu3, Yong Chen3
1. Department of Acupuncture and Moxibustion, General Hospital of Chinese PLA, Beijing, China
2. Department of Microorganism, Center for Disease Prevention and Control, Zhoukou 466000, Henan Province, China
3. Department of Rehabilitation, Hainan Branch of General Hospital of Chinese PLA, Sanya 572014, Hainan Province, China

OBJECTIVE: There are no convenient techniques to evaluate the degree of facial nerve injury during a course of acupuncture treatment for Bell’s palsy. Our previous studies found that observing the electrical response of specific facial muscles provided reasonable correlation with the prognosis of electroacupuncture treatment. Hence, we used the new method to evaluate the degree of facial nerve injury in patients with Bell’s palsy in comparison with the House-Brackmann scale. The relationship between therapeutic effects and prognosis was analyzed to explore an objective method for evaluating Bell’s palsy.

METHODS: The facial nerve function of 68 patients with Bell’s palsy was assessed with both electrical response grading and the House-Brackmann scale before treatment. Then differences in evaluation results of the two methods were compared. All enrolled patients received electroacupuncture treatment with disperse-dense wave at 1/100 Hz for 4 weeks. After treatment, correlation analysis was conducted to find the relationship between electrical response and therapeutic effects or prognosis.

RESULTS: Checking consistency between electrical response grading and House-Brackmann scale: Kappa value 0.028 (P = 0.578). Correlation analysis: the two methods were correlated with the prognosis, and electrical response grading (rER = 0.789) was better than the House-Brackmann scale (rHB = 0.423).

CONCLUSION: Electrical response grading is superior to the House-Brackmann scale in efficacy and reliability, and can conveniently assess the degree of facial nerve injury. The House-Brackmann scale is suitable for the patients with mild facial nerve injury, but its evaluation quality for severe facial nerve injury is poor.

KEYWORDS: Bell’s palsy; facial nerve function; electrical response; House-Brackmann scale; acupuncture and moxibustion

http://dx.doi.org/10.1016/S2095-4964(14)60036-4

Received March 19, 2014; accepted June 3, 2014.
Correspondence: Prof. Zhang-ling Zhou; Tel: +86-10-66939213; E-mail: Zhouzhangling@sina.com
1 Introduction

Bell’s palsy, a common type of one-sided facial paralysis, can result from damage or trauma to the facial nerves, or from acute inflammation of the facial nerve that leaves the skull at the stylomastoid foramen\(^3\). Acupuncture is a common method used to treat Bell’s palsy, and there is a rich body of clinical experience on this subject\(^2\).

Currently, electroneurography (ENOG) and electromyography (EMG) are used for evaluation of facial nerve injury, and the House-Brackmann scale is used for motor function assessment\(^5,4\). Research has shown that ENOG and EMG are very useful in the qualitative and quantitative diagnosis of facial paralysis\(^3\), and also can be methods that help in guiding treatment and evaluating prognosis. However, these two kinds of electrophysiology diagnostic methods are invasive and uncomfortable for the patient. Moreover, very specific professional usage guidelines, complex operational procedures, and high testing costs result in poor patient compliance\(^6\). If ENOG and EMG are not used, however, there is a distinct lack of objective indexes, and physicians have to rely on clinical experience in order to assess the prognosis. It is therefore useful to develop a convenient method for evaluating the degree of facial nerve injury during a course of treatment.

Our recent study found that the electrical response of specific muscles can reflect the prognosis of patients with Bell’s palsy during treatment with electroacupuncture. And the facial nerve injury can be objectively assessed in the course of treatment, which helps clinicians to gauge the patient’s condition in a timely and accurate manner. Moreover, this method is more comfortable for patients than electrophysiological diagnostic methods. Based on our previous experiments and clinical experience, we developed a system called electrical response grading, and conducted this trial to compare its efficacy with the House-Brackmann scale.

2 Materials and methods

2.1 Case source

A total of 68 patients with Bell’s palsy were enrolled from the Out-patient Clinic of the Department of Acupuncture and Moxibustion, General Hospital of Chinese People’s Liberation Army, in Beijing, China from February 2009 to October 2011.

2.2 Diagnostic criteria

In accordance with the diagnostic criteria for Bell’s palsy published in Diagnostic Criteria for Internal Diseases\(^6\), the patients were confirmed to have Bell’s palsy. (1) Acute or subacute onset; (2) palpebral fissure, eyelids cannot close, weeping, disappearance of forehead wrinkles, cannot close, frown; (3) nasolabial groove becomes shallow or even, angle of mouth is low and veers toward the healthy side; (4) absent or decreased sense of taste in the front 2/3 of the tongue, auditory handicap, pain in the mastoid region, sensory disability in the external auditory meatus or auricle.

2.3 Inclusion criteria

The patients were enrolled according to the following inclusion criteria: (1) meet the first three diagnostic items mentioned above; (2) aged 12 years or older, and can make the appropriate facial expressions on the affected side, no matter of the degree of facial nerve injury; (3) are able to follow through with a course of acupuncture treatment; (4) have not received any treatments before enrollment; (5) eligibility was confirmed by a senior acupuncturist who had been trained in the study procedures; (6) written informed consent was obtained.

2.4 Exclusion criteria

The patients were excluded from the trial for any one of the following reasons: (1) secondary facial paralysis caused by cerebrovascular disease, brain tumor, Guillain-Barre syndrome or parotitis; (2) otogenic facial paralysis such as otitis media and mastoiditis; (3) sequelae of previous facial paralysis; (4) children under 12 years of age.

2.5 Electrical response grading

Acupuncture needles were inserted into the frontalis, orbicularis oculi, levator labii superioris and orbicularis oris on the patients’ affected sides. HANS electroacupuncture apparatus (WQ1002 Han multifunction electric acupuncture apparatus, Medical Technology Co., Ltd., Nanjing Jisheng) was used with low frequency, disperse-dense wave, at a transition frequency of 1 Hz (disperse wave) and 100 Hz (dense wave). The activity of facial muscles on the affected side was observed. Electrical response was assigned according to the amplitude of muscle contraction, and was classified into four grades: excellent, moderate, poor and no response\(^7\).

2.6 Treatment methods

Perpendicular or oblique needling was conducted\(^8,9\) at Yangbai (GB14), Taiyang (Extra), Xiaguan (ST7), Quanliao (SI18), Heliao (LI19) and Jiachengjiang (Extra), at a depth of 15–20 mm. Positive and negative electrodes of three groups of output wires of KWD 808-II electrostimulator (Electronic Instrument Co., Ltd., Changzhou INTI) were connected to the needle handles at the above-mentioned acupuncture points. Disperse-dense wave at 1/100 Hz was selected. The output button was slowly rotated until the maximum tolerated value was reached. The needles were retained for 20 minutes, during which warm infrared ray irradiation was performed behind the ear. After five times, the patients had two days of no treatment, and then the treatments were continuous. There was no limit to the course of treatment; however, if the patients no longer responded after 4 weeks of consecutive treatment, then...
they stopped receiving treatments. All included patients received the same treatment.

2.7 Evaluation criteria
The degree of facial nerve injury in patients with Bell’s palsy was assessed by the House-Brackmann scale and electrical response grading\(^7\) respectively. The evaluation, performed on the first day when patients were included, was carried out respectively by two nurses who had been trained through two evaluation methods\(^{10}\).

2.7.1 Criteria of electrical response grading
Electrical response grading may be divided into 4 grades according to the muscle-specific response to electroacupuncture\(^7\). Excellent: at the intensity of 4 mA, facial muscle twitching is observed at disperse wave; motion of facial muscle reaches or exceeds normal motion at dense wave. Moderate: output intensity is between 4 and 6 mA; muscle twitching appears at disperse wave; slight contraction is visible at dense wave, but does not reach the normal range of motion. Poor: output intensity is > 6 mA; slight muscle twitching is observed at disperse wave; no contraction is seen at dense wave. No response: output intensity is > 6 mA; no muscle activity.

2.7.2 House-Brackmann scale
In accordance with the six-grade classification of the House-Brackmann scale\(^3\), facial nerve injury was graded: normal, mild, moderate, moderate-severe, severe dysfunction and complete paralysis.

2.7.3 Evaluation of therapeutic effects
Therapeutic effects were evaluated using a motor function assessment scale which is commonly applied to evaluate facial paralysis as a standard. There were four grades\(^3\): complete recovery, significant recovery, mild-moderate recovery (moderate sequela), and no response (severe sequela).

2.8 Statistical methods
The data were analyzed using SPSS 17.0 software. Qualitative data were described using percentage (%). Ranked data were analyzed using Kruskal-Wallis rank sum test and Kendall rank correlation. The consistency of the two methods was compared using Kappa test. A value of \(P < 0.05\) was considered statistically significant.

3 Results

3.1 Results of case grouping
A total of 68 patients were included in the final analysis. There were 38 males and 30 females, with an age range of 14 to 85 years old. There were 39 patients with left facial paralysis and 29 patients with right facial paralysis. The shortest course of disease was 7 days, and the longest course of disease was 21 days. Forty-two of the patients were in the acute phase, and other 26 were considered to be in the recovery phase. The flow chart of this trial is shown in Figure 1.

![Flow diagram of the study](Image)

3.2 Consistency of the two methods
We used kappa test to test the consistency between electrical response grading and House-Brackmann scale. The results are listed in Table 1. The consistency of electrical response grading and House-Brackmann scale in the patients with mild to moderate facial paralysis was high, but in the patients with above moderate-severe facial paralysis, the consistency was low. The two methods were not consistent.

3.3 Correlation analysis with prognosis
Correlation analysis between electrical response and

<table>
<thead>
<tr>
<th>Table 1 Comparison of consistency of the two methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>House-Brackmann scale</td>
</tr>
<tr>
<td>----------------------</td>
</tr>
<tr>
<td>Mild</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>Moderate-severe</td>
</tr>
<tr>
<td>Severe</td>
</tr>
<tr>
<td>Complete paralysis</td>
</tr>
<tr>
<td>Sum</td>
</tr>
</tbody>
</table>

Kappa value = 0.028 (\(P = 0.578 > 0.05\)).
therapeutic effects is displayed in Table 2. Of the 68 patients, 53 cases completely recovered, giving a complete recovery rate of 77.94%. Ten cases showed significant recovery, 3 showed mild-moderate recovery and 2 cases showed no response, with a total effective rate of 97.06%. Kruskal-Wallis rank sum test and Kendall test showed that results of electrical response grading were significantly associated with therapeutic effects ($H_C=32.67$, $P<0.001$). Better electrical responses correlated with better therapeutic effect (correlation coefficient $r_{ER}=0.789$, $P<0.001$). The results of House-Brackmann scale were correlated with therapeutic effects ($H_C=18.294$, $P<0.01$), with milder symptoms correlating with better therapeutic effects (Kendall rank correlation, correlation coefficient $r_{HB}=0.423$, $P<0.001$). Significant differences in therapeutic effects were detected among different grades of the two facial nerve function grading methods.

### 4 Discussion

Previous research on Bell’s palsy has shown that therapeutic effects are mainly correlated with the patient’s degree of facial nerve injury\(^7\). Therefore, accurate assessment of facial nerve injury is important for evaluating the prognosis and treatment course for Bell’s palsy in patients.

Historically, the assessment of nerve injury has been the limiting step in the clinical study of acupuncture. The gold standard for assessing neurological injury is the electromyogram. However, electromyogram induces severe pain and cannot be tolerated by most patients\(^8\). The House-Brackmann scale is based on clinical and subjective symptoms. We found in clinical practice that the House-Brackmann scale could accurately assess patients with mild injury, but had some shortcomings in the assessment of patients with severe injury. Additionally, the score of the House-Brackmann scale does not strongly correlate with the degree of nerve injury, which decreases its usefulness in both the clinical and scientific research\(^2\). This study used an electroacupuncture apparatus to assess the electrical response of specific facial muscles and to gauge the degree of facial nerve injury. This method is simple, practical, and useful in assessing the prognosis, and appears to be better than the House-Brackmann scale ($r_{HB}=0.789$ and $r_{HB}=0.423$). For example, the patients who were assessed at excellent and moderate electrical response gradings showed significant treatment effects and complete recovery; the patients with no response showed poor or no treatment response. In this comparative study, the results showed that electrical response grading was not consistent with the House-Brackmann scale. Clinical application and prognosis assessment of electrical response grading appeared to be better than that shown by the House-Brackmann scale.

We also found that electroacupuncture with disperse wave stimulation caused regional muscle twitching, and dense wave stimulation led to the whole muscle contraction. Different responses to electroacupuncture at disperse and dense waves also reflected the degree of injury. Excellent response: muscles perfectly respond to disperse wave; moderate response: muscles respond to dense wave; poor response: only regional muscle twitching and no muscle contraction when maximum tolerated value is reached; no response: no muscle twitching or muscle contraction is

### Table 2  Relationship of results of electrical response grading and House-Brackmann scale with therapeutic effects

<table>
<thead>
<tr>
<th>Clinical effect</th>
<th>Sum</th>
<th>Excellent</th>
<th>Moderate</th>
<th>Poor</th>
<th>No response</th>
<th>Mild</th>
<th>Moderate</th>
<th>Moderate-severe</th>
<th>Severe</th>
<th>Complete paralysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete recovery</td>
<td>53</td>
<td>44</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>15</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>Significant recovery</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Mild-moderate recovery</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>No response</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Sum</td>
<td>68</td>
<td>44</td>
<td>7</td>
<td>11</td>
<td>6</td>
<td>15</td>
<td>14</td>
<td>13</td>
<td>14</td>
<td>12</td>
</tr>
</tbody>
</table>
observed. These observations show that the reaction of the muscles under different waveforms can gauge the degree of facial nerve injury. This classification method is still in the initial stages of research and has some limitations, such as the direction and depth of the needles were not precise. Further study can help determine the effectiveness of this grading method in daily clinical practice.

5 Conflict of interests

The authors declare no conflict of interests.

REFERENCES