Review

Facial Grading System: Physical and Psychological Impairments to Be Considered

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In the past half century, more than twenty facial grading systems have been developed to assess the facial nerve function after the onset of facial nerve paralysis and during rehabilitation. Patients' self-evaluation on disability caused by facial paralysis and its impact on quality of life are also useful information in planning treatment strategies and defining outcomes.

Traditional Facial Grading Approaches

To systematically evaluate facial nerve paralysis and to facilitate clinician communication, numerous systems for assessing facial function have been developed during the past half century.

House-Brackmann Grading System

In 1983, John House reviewed eight grading systems and categorized these scales as gross, regional or specific. Botman and Jongkees, May, and Peitersen proposed five-point gross scales which considered the overall facial function. They required the observers to give one grade that reflected the degree of paralysis and secondary defects at the same time. Janssen, Smith, Adour and Swanson, and Yanagihara designed several regional scales, by which independent scores of different areas of facial function were obtained. The regional scores were to be summed up by weighted or unweighted means. There was only one specific scale which was devised by Stennert. It asked the observer to give "yes" or "no" to questions about specific areas of the face. John House assessed the merits of each system and tested them for reliability, validity and interobserver consistency. He concluded that gross scales had advantages over the other types and proposed his own six-level gross system in 1983[1]. Each level in this scale was defined by descriptions of facial movement at rest and in motion as well as secondary defects. It added multiple grades to characterize moderate levels of function. House's gross scale was soon modified by Brackmann and Barrs. According to the original House scale, there were two categories of patients who qualify for Grade IV: those with obvious weakness and/or disfiguring asymmetry, and those with "synkinesis, mass action and/or hemifacial spasm severe enough to interfere with function" regardless of degree of motor activity. The latter stipulation was removed in the modified scale as well as the descriptions of second defects in Grades V and Ⅵ[2]. In addition, Brackmann and Barrs added a measurement scale, which was used to assess recovery of nerve function after acoustic neuroma surgery, to the original House scale. Two measurements were taken (the distance of movement of eyebrow and corner of mouth) and were given a value of 1 to 4, corresponding to 0.25 cm increments of movement in comparison with the unaffected side. The two values were then summed up (Table 1). Results from this scale

Table 1 Brackmann and Barrs' measurement scale

Grade	Description	Measurement	Function (%)	Estimated function (%)
Ⅰ	Normal	8/8	100	100
Ⅱ	Slight	7/8	76-99	80
Ⅲ	Moderate	5/8-6/8	51-75	60
Ⅳ	Moderately severe	3/8-4/8	26-50	40
Ⅴ	Severe	1/8-2/8	1-25	20
Ⅵ	Total	0/8	0	0

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can be easily converted to the six-point grading scale[3].

These modifications gave rise to the current six-point House-Brackmann scale. In 1984, the Facial Nerve Disorders Committee of American Academy of Otolaryngology-Head and Neck Surgery adopted this scales as universal standard for grading facial nerve recovery [2]. Since then, House-Brackmann grading system has became the most commonly used grading system by otorhinolaryngologists and neurologists. However, the HBGS has several unavoidable pitfalls that prevent it from becoming the perfect "gold standard". Firstly, the description of neural functional defects is subjective in nature, which may lead to significant interobserver inconsistency and may cause the HBGS to be prone to observer error. Secondly, in the modified HBGS, the weight of evaluation of the secondary defects on the overall grades has been decreased compared to the original House scale. In other words, secondary defects are not sufficiently assessed. Thirdly, too many items are encompassed by one grade, so much so patients may have dysfunction in one facial region that fits into one grade, yet fall into a different grade for another region. In addition, some of the descriptions in the moderate levels are ambiguous and overlapped. After all the HBGS is designed as a gross scale, which makes it fail to distinguish fine differences in facial nerve function impairment[4-7].

Grading systems beyond HBGS

Burres-Fisch system was introduced in 1986, which had three separate divisions. The patient's Global analysis is the patient's self-evaluation of his or her percent recovery since the initial paralysis. In the Physician's detailed analysis, judges scores five different facial expressions in percentages (0% as totally asymmetry, 30% as significant asymmetry, 70% as slight asymmetry, and 100% as symmetry). The scores of five expressions are then calculated for a weighted mean score: Rest, 20%; Forehead wrinkle, 10%; Eyes Closed Tight, 30%; Smile, 30%; and Whistle, 10%. The Physician's Global evaluation is a simple percentage based on the physician's general impression from the five principal facial positions and other common expressions the patient may have exhibited. The final score is the average calculated from the results of three parts [8]. The Burres-Fisch system provides a quantitative method to evaluate facial nerve function. It represents a continuous graded scale, thereby allowing finer distinctions of facial function compared to the HBGS. By Burres-Fisch system, attempt is made to minimize observer bias and subjectivity, but it does not change the subjective nature of this system. Another significant limitation of this system is the lack of evaluation of resting symmetry and secondary defects. In addition, the calculation of the score is truly a time-consuming process, which makes the scale unlikely to be a practical tool for the busy clinician. However, it should be highlighted that the Burres-Fisch system coordinates the patient's self-evaluation into the evaluation, which, as discussed later in this article, is an important consideration in evaluating facial nerve function.

Nottingham system, which was developed in 1994, was designed on the concept of objective measurements. This grading system is performed in three distinct steps. First, two distances (supraorbital point to infraorbital point, and lateral canthus to angle of mouth) are measured bilaterally at rest and at maximum effort during three motions: eyebrow raising, tight eye closure, and smiling. The differences between the measurements during rest and maximum efforts are summed up for either side. Then the value of the affected side is expressed as a percentage of the contralateral side. The second step is documenting absence (A) or presence (P) of any of the following secondary defects: hemifacial spasm, contractures, and synkinesis. The third step is recording absence (N) or presence (Y) of gustatory tears, dry eyes, or dysgeusia [9]. Because of its objectivity, subjective bias and interobserver variability are minimized. According to the authors of the system[9], this scoring system can be quickly implemented (within 3 minutes) and correlates well with the HBGS. Because facial function is presented as a ratio of the affected side to the opposite side in this system, the major drawback is its inability to assess bilateral facial nerve impairment. In addition, letters assigned to secondary defects can not be incorporated into the overall score and serve as descriptive items only. The quantitative evaluation value of this system is therefore limited.

The Sunnybrook scale was proposed by Ross et al. in 1996. It is a regional weighted scale based on evaluation of different regions including resting symmetry, symmetry of voluntary movement and severity of synkinesis to form one single composite score from 0 to 100. Firstly, the physician assesses the symmetry of the eye, cheek (nasolabial fold) and mouth at rest. Choices under each item are provided to be assigned a value of 0-2, and the sum is assigned a weighted factor of 5. Secondly, the physician is asked to rate facial movements during five standard facial expressions on a scale of 1-5 (1 = no movement, 2 = slight movement, 3 = mild excursion, 4 = near normal movement, and 5 = normal movement). The values are added together and multiplied by 4. In the third step, the physician is to grade the severity of synkinesis on a four-point scale (1 = none, 2 = mild, 3 = moderate, and 4 = severe) during the five expressions as in the second step. The sum of synkinesis score is given the weighted factor of 1. An overall score is the weighted sum of the three parts [10]. Similarly to Burres-Fisch system, this scale evaluates the facial function through quantitative scoring instead of gross description, which enables the scale to distinguish fine changes of facial function. Moreover, it coordinates symmetry at rest and secondary defects into the scale. However, the only secondary defect considered by the scale is synkinesis. This may lead to underestimation of facial dysfunction in patients with secondary defects other than synkinesis. Again, this approach remains a subjective scale and may not completely eliminate interobserver inconsistency as with the HBGS.

Computer-assisted grading

More recently, facial nerve function assessing systems aided by computer analysis have been developed.

Landmarks systems

Johnson et al. developed a facial function assessment system based upon recording movements of dots corresponding to facial landmarks. In this system, facial images at rest are compared with those during certain facial expressions. A grid is placed over the images and displacement of selected dots is recorded [11]. One advantage of this system is that the physician can select large number of dots of interest to increase measurement precision, as compared to manual approaches. Pitfalls of this approach include the time-consuming nature of the measurement and inability to assess movements as a function of time.

After that, numerous approaches involving landmarks measurement have emerged. These approaches generally employ video-computer systems to record and analyze trajectories of selective landmarks. These systems are able to provide detailed information on complex facial movements, but require significant investment of time and specialized equipment and software [4].

Obviously landmarks tracing and analyzing are not novel inventions by these new systems. Similar approaches can be seen in the Nottingham system. The primary purpose of developing a facial assessment system is to group patients with facial paralysis into communicable and interpretable categories. In this regard, grading systems do not have to be excessively precise and complex. With careful selection of landmarks and measurement, manual approaches may provide satisfactory assessment without the high cost of digital equipment. But even manual landmark measurement can be time-consuming, and its error margins and how they may affect assessment results need to be further studied.

Subtraction method

Neely and Cheung developed a facial function assessment method based on the concept of pixel subtraction, termed Facial Analysis Computerized Evaluation (FACE). Photographs of a patient's face at rest, and then at sequential times during motion, are converted into digital images composed of pixels. The motion images are then "subtracted" from the reference at rest image. Those pixels that remain static are canceled out, whereas pixels that have moved over a threshold amount are amplified. After image enhancement, the computer quantifies the enhanced pixels. Greater subtraction corresponds to higher degree of paralysis [12]. This method has been validated against scores by human observers and found to correlate well with the House-Brackmann ratings.

Another method based on pixel subtraction, called Objective Scaling of Facial Nerve Function Based on Area Analysis (OSCAR), was developed by Scriba and Meier-Gallati et al. In this method, images of three facial areas including forehead, eye and mouth are digitized at rest and after movement. The images after movement are subtracted from the image at rest. Changes in luminance of the face yield regional and global symmetry indices [13].

Besides the need for special, proprietary computer equipment, a major drawback of the subtraction system is its inability to perform vector analysis.

Moiré Topography

Moiré Topography is a technology of three-dimensional morphometry in which contour maps are produced from the overlapping interference fringes created when an object is illuminated by beams of coherent light issued from two different point sources. Moiré topography of the face involves using a special camera to project an array of optical stripes on the subject's face to produce a facial contour map. By detecting and analyzing the bending of these optical stripes in vertical and horizontal dimensions, subtle differences in facial contour can be recorded and quantified [14]. Same as other computer-assisted methods, the Moiré topography also requires specialized equipment and the assessment process is time-consuming.

Computer analysis can yield quantifiable and reproducible data and improves measurement precision. However, its requirement of specialized equipment and associated investment of time and high cost limit its use in the clinic.

The generally accepted standards of an ideal facial nerve grading system are: (1) well-calibrated, accurate, universal and reproducible with low interobserver variability; (2) reflecting the fact that different areas of the face contribute to facial paralysis to different extents; (3) incorporating assessments of secondary defects of facial nerve dysfunction; and (4) easy to use at a low cost with minimal time and equipment requirement [4, 7]. By these standards, we are still a long way from having a "gold standard" grading system.

Disability and psychosocial issues caused by facial paralysis

Otolaryngologists, neurotologists and physiotherapists reporting on facial nerve outcomes tend to focus on specific facial movement dysfunction, but not on issues encountered by patients in daily life, including problems with eating and drinking, changes in the production of emotional expression, psychosocial disorders, and impairment on patient's quality of life.

Studies have shown that most patients with facial nerve paralysis have a reduced quality of life in comparison with the healthy population. However, a clinician's assessment of facial nerve paralysis outcomes can differ from the patient's perception of the outcome [15, 16]. Guntinas-Lichius et al. conducted a descriptive study on quality of life after facial nerve repair. Forty-nine patients with benign or malignant facial nerve disease were included in the study and all of them underwent successful facial nerve repairs. The patients were assessed for postoperative quality of life through questionnaires as

Table2 Comparison of different facial nerve grading systems

Name of systems	Nature of scale	Weighting of different areas	Secondary defect assessment*	Major drawbacks
H-B grading system	Subjective	Not included	Ambiguous	-Inability to distinguish between finer grades of dysfunction -Interobserver inconsistency
Burres-Fisch system	Subjective	Included	Not included	-Lacking evaluation of resting symmetry and secondary defects -Time-consuming calculation process
Nottingham system	Objective	Not included	Included, but reported separately from the overall score	-Inability to assess bilateral facial nerve impairment -Inability to incorporate letters assigned to secondary defects into the overall score
Sunnybrook scale	Subjective	Included	Included, but only the synkinesis is considered	-Insufficiency in evaluating secondary defects -Interobserver inconsistency
Computer-assisted methods	Objective	Not included	Mostly not included	-Requirement for specialized equipments -Considerable investment of time and money

*Includes: synkinesis, contracture, hemifacial spasm, hyperacusis, dysgeusia and crocodile tears well as facial function impairment through traditional facial grading systems. While facial nerve grading by clinicians indicated satisfactory facial nerve function after repair surgery, most patients reported reduced quality of life compared with healthy population. In addition, results obtained from traditional grading systems, such as the HBGS, showed no significant relation with patients' quality of life [17].

Eating and drinking problems

A significant number of patients with facial nerve paralysis who have visited our hospital report difficulties in eating and drinking as the major factor that affects their quality of life. Swart et al. has also reported the eating and drinking problem encountered by patients with unilateral peripheral facial paralysis. Disorders relating to dysphagia reported in the literature include loss of food and impaired bolus control during the oral stage. However, Bert et al. indicated that patients with facial paralysis had more problems with eating and drinking than normal individuaols, including residue of food, choking and coughing, and biting cheek or lips. These patients were also assessed for facial function using Sunnybrook system. A decrease in problems and their impacts was seen as the paralysis duration increased, but there were no correlations between extent of recovery and the grading level. Some patients accomplished improved functions with no change in the Sunnybrook grading level, while others were indicated to have significant recovery of facial nerve function but their problems remained unchanged. This may be partly explained by the conscious or unconscious compensation behavior adopted by patients after the onset of facial paralysis, such as using hands during eating and drinking, slowing down the speed of eating and drinking, adapting head posture, removing the residue food and liquid, and compensating with the tongue[18].

Difficulty in producing facial expressions

Ekman proposed that there were six primary emotions, e.g. happiness, disgust, surprise, anger, sadness and fear, for which the facial expressions were universally characteristic of the human species. All of these six expressions need multiple groups of facial muscles to work coordinately. Failure of movements in the forehead, eyebrow, cheek and angle of mouth caused by facial paralysis apparently will influence patients' facial expression. Facial expression plays a key role in social communication. Abnormal facial appearance caused by facial paralysis has a profound negative influence on an individual's social activity. Stuart et al. suggested that facial asymmetry might be an independent indicator of psychological, emotional, and physiologic distress. The long-term sequelae of facial nerve paralysis have been underestimated by clinicians compared to the patient's self-evaluation[19]. In another study by Ekman on facial expressions and quality of life in patients with facial paralysis, patients were asked to rate their ability to produce each of the six primary emotions. They were assessed for facial function using the Sunnybrook system and HBFS and asked to complete the SF-36 survey at the same time. Half of the patients classified themselves as ineffective at expressing one or more of the six emotions. The SF-36 quality-of-life survey revealed decreased social functioning relative to physical functioning in these patients. The Sunnybrook Facial Grading System was found to be sensitive to changes in facial movements of expression, showing significantly less vulnerable movement and more severe synkinesis for the ineffective than the effective patients. The HBGS showed poor correlations with changes in emotional facial expressions[20].

Psychological disorders

Similar to results in some aforementioned studies, the authors have found that abnormal appearance, difficulties in daily life and disrupted communication in patients with facial paralysis can result in numerous problems in personal and work relations, participation in social activities and sometimes secondary illness. A significant number of patients with facial paralysis develop psychological disorders of various severities. Jia et al. assessed 39 patients with Bell's palsy for mental well-being. They concluded that various psychological disorders existed in these patients, ranging from anxiety, social isolation and somatization disorder [21].

Self-report instruments

Merely adding items such as eating and drinking problems, facial expressions and psychosocial problems to the grading system is unlikely to effectively correct bias associated with the physician-administered grading scales. As mentioned above, clinicians are prone to underdetermine the sequelae of facial paralysis compared to patients' self-evaluation. Therefore it is important to incorporate the patient-evaluation into the facial nerve function assessment in facial nerve paralysis.

Facial Disability Index(FDI), proposed by Van Swearingen et al. in 1996, is a disease-specific, self-report instrument for the assessment of disabilities of patients with facial nerve disorders. It is designed to provide the clinician with information about the disability and related social and emotional well-being of patients with facial nerve disorders. The FDI is composed of physical function (PF) subscale and social/well-being function (SWF) subscale. The author analyzed the index for reliability and validity in 46 patients. He concluded that FDI subscales produced reliable scores. The PF subscale has a good construct validity demonstrated by a correlation with the clinician's physical examination of facial movement. In addition, the FDI shows a better relationship between physical impairments, disability and psychosocial status compared with SF-36 survey. However, its test-retest reliability and the correlation between its SWF subscale and physical impairment are yet to be established [22].

Kahn et al. introduced the Facial Clinimetric Evaluation(FaCE) scales in 2001. the FaCE is a 15-item, patient-based system to measure impairment and disability in facial paralysis. It is composed of six domains, e.g. facial movement, facial comfort, oral function, eye comfort, lacrimal control and social function. The authors confirmed the FaCE scales' reliability and validity. The FaCE score correlates well with the HBGS and is more sensitive in reflecting patient quality of life concerning the disease-specific issues than global health status instrument, such as SF-36 survey. The major shortcoming of FaCE is the insufficiency in describing secondary defects[23]. More recently, Metha et al. proposed the Synkinesis Assessment Questionnaire (SAQ). It is a simple, patient-graded instrument designed to assess facial synkinesis. Instrument analysis suggested that it was reliable and valid[24].

The authors of this article have translated the FaCE scale into Chinese and administered it in 8 patients with facial paralysis see at the Department of Otolaryngology Head and Neck Surgery, Peking Union Medical College Hospital between February to April of 2008. Patient feedback opinions were collected about the scale. The most common comments included: (1) several items in the scale were ambiguous to understand; (2) Some items were redundant; and (3) certain aspects of facial dysfunction were not included, including asophia, headache, ear discomfort, dysgeusia and swallow disorder.

This review of current facial nerve grading systems indicates a need to integrate evaluation by both the clinician and patient for improved treatment planning and intervention. Patient self-evaluation of the impact and outcome of facial paralysis is useful information in planning individual-specific treatments and management strategies. Inclusion of patient's perspective in the overall treatment approach will help address clinician underestimation of long-term impact of facial nerve paralysis.

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