Original Investigation

Emerging vs Time-Tested Methods of Facial Grading Among Patients With Facial Paralysis

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IMPORTANCE Most rehabilitation specialists and many facial reanimation surgeons use the Sunnybrook Facial Grading System (FGS) to measure and detect changes in facial function. The eFACE, an electronic and digitally graded facial measurement scale, was recently created to provide similar information to the Sunnybrook FGS, but with scaling uniformity across all categories of facial function, graphical outputs, and easy-to-use visual analog scales.

OBJECTIVES To establish the correlation between the scores on the eFACE and the Sunnybrook FGS among patients with facial paralysis and to compare the reliability of the 2 scales.

DESIGN, SETTING, AND PARTICIPANTS A retrospective review of medical records identified 109 patients who were evaluated at a facial nerve center by physical therapists using the eFACE and the Sunnybrook FGS on the same day, between November 1, 2014, and May 31, 2015. The level of facial function predicted using the 2 scales was compared to study correlation between the scales. Data analysis was conducted from June 1 to September 1, 2015.

MAIN OUTCOMES AND MEASURES Correlation between the Sunnybrook FGS and the eFACE grading scale.

METHODS Two independent physical therapists evaluated patients using both the eFACE and the Sunnybrook FGS. Scores were compared and the Spearman rank correlation coefficient was calculated between the total scores and each of the 3 subscores, including static, dynamic, and synkinesis scores. The total Sunnybrook FGS synkinesis score (worst score, 15; perfect score, 0) and static score (worst score, 20; perfect score, 0) were normalized to a 100-point scale with the eFACE (perfect score, 100; worst score, 1).

RESULTS eFACE scores ranged from 48 to 100, and Sunnybrook FGS scores ranged from 0 to 100. Among 109 patients, there was a moderately strong correlation between eFACE and Sunnybrook FGS scores in both total and subcategory scores. The Spearman rank correlation coefficient of the total eFACE and Sunnybrook FGS was 0.75 ($r < 0.0001$). For the static scores, the correlation coefficient was −0.71 ($r < 0.0001$). The correlation coefficients for the dynamic and synkinesis scores were 0.77 ($r < 0.0001$) and −0.78 ($r < 0.0001$), respectively.

CONCLUSIONS AND RELEVANCE There is moderately good agreement between the Sunnybrook FGS and the eFACE. Given the ease of using the eFACE on mobile devices, as well as its additional functionality, it may represent a reasonable facial grading option across disciplines in the future.

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Facial movement disorders are associated with functional, aesthetic, and psychological consequences.[1-5] Facial nerve physicians lack consensus regarding tools to assess facial function. In the modern era, thorough assessment of patients with facial paralysis must include physician-graded scales, patient-reported outcome measures, and quantitative assessments of facial function.[6] Among the many published physician-graded scales of facial function, the House-Brackmann scale and the Sunnybrook Facial Grading System (FGS) are most widely used by the medical and surgical and rehabilitation communities, respectively.[2] The former was assigned as the criterion standard for grading of facial nerve recovery by the Facial Nerve Disorders Committee of the American Academy of Otolaryngology–Head and Neck Surgery.[3,7,8] However, the House-Brackmann scale was intended only to describe recovery after vestibular schwannoma surgery, and it lacks sensitivity to subtle but important changes in facial nerve function over time, insufficient classification of synkinesis, and inability to capture fluctuating or zonal facial paralysis.

The Sunnybrook FGS (**Figure 1**, A and B), first introduced in 1996 by Ross et al,[9] is a regional weighted system that rates the following 3 categories: resting symmetry compared with the normal side (static), the degree of voluntary muscle excursion compared with the normal side (dynamic), and the degree of involuntary muscle contraction (synkinesis) associated with each facial expression regionally. The scores are on different scales (20, 20, and 15 respectively), but a total final score of 0 to 100 is calculated, where 0 indicates total paralysis and 100 indicates normal function.[10] The interrater and intrarater reliability have been reported to range from 0.84 to 0.93.[11] A recent survey from the Sir Charles Bell Society revealed the Sunnybrook FGS to be the most widely used facial grading scale used by rehabilitation therapists.[2]

An emerging electronic facial assessment scale, eFACE, first introduced in 2015 by Banks et al,[1] comprises a physician-graded visual analog scale that rates 15 facial features: 4 static parameters (brow position, width palpebral fissure, depth of nasolabial fold, and oral commissure position), 7 dynamic parameters (brow elevation, gentle eye closure, full eye closure, oral commissure movement with smile, depth of nasolabial fold with smile, orientation of nasolabial fold with smile, and lower lip movement), and 4 synkinesis parameters (ocular, midfacial, mentalis, and platysmal). These parameters cluster to form 3 subset scores and 1 total score, ranging from 1 to 100, where 100 represents normal function. In addition, zonal scores from all 3 domains are reported, so accurate periocular, midface and smile, or lower face and neck scores can be clustered and viewed. The domains on the eFACE scale were chosen based on decades-long experience treating 3000 patients with facial paralysis, and in contrast with the Sunnybrook FGS, exclude assessment of the voluntary motion termed a *snarl*, to limit assessment to the most clinically relevant expressions. The eFACE includes an assessment of lower lip movement, based on its strong relevance to the aesthetics and function of smiling and speaking. The eFACE measurements can be easily recorded on a mobile application using a smartphone or tablet computer or on a desktop computer, and are documented using a sliding scale (Figure 1, A and C). The final output of the eFACE is depicted graphically in **Figure 2**. The interrater and intrarater reliability scores on the eFACE are high, with an intraclass correlation coefficient of 0.97.[1] The objective of our study was to understand the correlation between scores on the Sunnybrook FGS and the eFACE among patients with facial paralysis.

Key Points

Question How closely do the scores agree when comparing a time-tested facial nerve grading scale to a new, electronic, visual analog scale?

Findings There was moderately strong agreement between a time-tested facial nerve grading scale, the Sunnybrook scale, and the modern eFACE scale.

Meaning Physicians interested in using the modern electronic eFACE scale can be assured that it correlates well with the time-tested Sunnybrook scale for facial grading.

Methods

A retrospective review of medical records was performed to identify all patients who were evaluated at our facial nerve center by 2 independent physical therapists (M.R. and J.B.) using the eFACE and the Sunnybrook FGS on the same day, between November 1, 2014, and May 31, 2015. Patients with peripheral unilateral facial palsy of unspecificed duration, who were English speakers and had intact cognitive function, were included. Patients with bilateral facial palsy were excluded from the study. One hundred nine patients were included. Patients underwent both Sunnybrook FGS scoring and eFACE scoring as part of routine clinical care by 1 of 2 independent physical therapists. Patients were scored using both the Sunnybrook FGS and the eFACE in alternate fashion in person at the beginning of the physical therapy session. The therapists were blinded to the total scores of each measurement tool to minimize measurement bias. The Sunnybrook FGS was administered with the patient in the seated position in the physical therapy clinic room. Resting symmetry, voluntary movement, and associated synkinesis were measured as described by Ross et al[9] and simultaneously recorded in a Microsoft Excel (Microsoft Corporation) spreadsheet. Two to 3 minutes of rest was provided between application of the instruments. The eFACE was administered under identical circumstances, using the application on an iPad (Apple Inc). Sunnybrook FGS scores and eFACE scores were then entered into a database for analysis with SAS, version 9.4 (SAS Institute Inc).

The Massachusetts Eye and Ear Infirmary Institutional Review Board approved this study. Patients provided written informed consent.

Data analysis was conducted from June 1 to September 1, 2015. The Spearman rank correlation coefficients between the Sunnybrook FGS and eFACE were calculated for the total scores and the 3 subscores using SAS, version 9.4. A scatterplot analysis was used to assess how the total eFACE scores correlated

Figure 1. Scoring for the Sunnybrook Facial Grading System and the eFACE

A Facial synkinesis

B Sunnybrook Facial Grading System

Resting Symmetry

Compared to normal side

Eye (choose one only)
- normal 0
- narrow 1
- wide 1
- Eyelid surgery 1

Cheek (naso-labial fold)
- normal 0
- absent 2
- less pronounced 1
- more pronounced 1

Mouth
- normal 0
- corner dropped 2
- corner pulled up/out 1

Total 0

Resting symmetry score: Total × 5 = 0

Patient's name

Dx

Date

Symmetry of Voluntary Movement

Degree of muscle EXCURSION compared to normal side

Standard Expressions	Unable to initiate movement/no movement	Initiate slight movement	Initiate movement with mild excursion	Movement almost complete	Movement complete	
Forehead Wrinkle (FRO)	1	2	3	(4)	5	4
Gentle eye closure (OCS)	1	2	3	4	(5)	5
Open mouth smile (ZYG/RIS)	1	(2)	3	4	5	2
Snarl (LLA/LLS)	1	2	(3)	4	5	3
Lip Pucker (008/001)	1	2	3	(4)	5	4

Gross Asymmetry	Severe Asymmetry	Moderate Asymmetry	Mild Asymmetry	Normal Asymmetry	
					Total 18

Voluntary movement score: Total × 4 = 72

Synkinesis

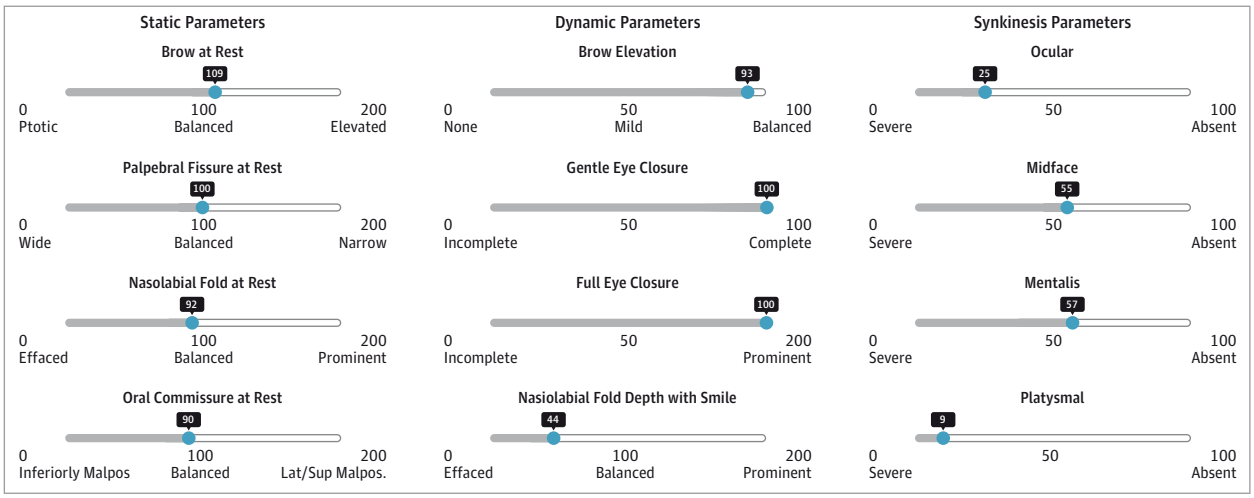
Rate of degree of INVOLUNTARY MUSCLE CONTRACTION associated with each expression

Standard Expressions	NONE: No synkinesis or mass movement	MILD: Slight synkinesis	MODERATE: Obvious but not disfiguring synkinesis	SEVERE: Disfiguring synkinesis/ Gross mass movement of several muscles	
Forehead Wrinkle (FRO)	0	(1)	2	3	1
Gentle eye closure (OCS)	0	(1)	2	3	1
Open mouth smile (ZYG/RIS)	0	1	(2)	3	2
Snarl (LLA/LLS)	0	1	(2)	3	2
Lip Pucker (008/001)	0	1	2	(3)	3

Synkinesis score: Total 9

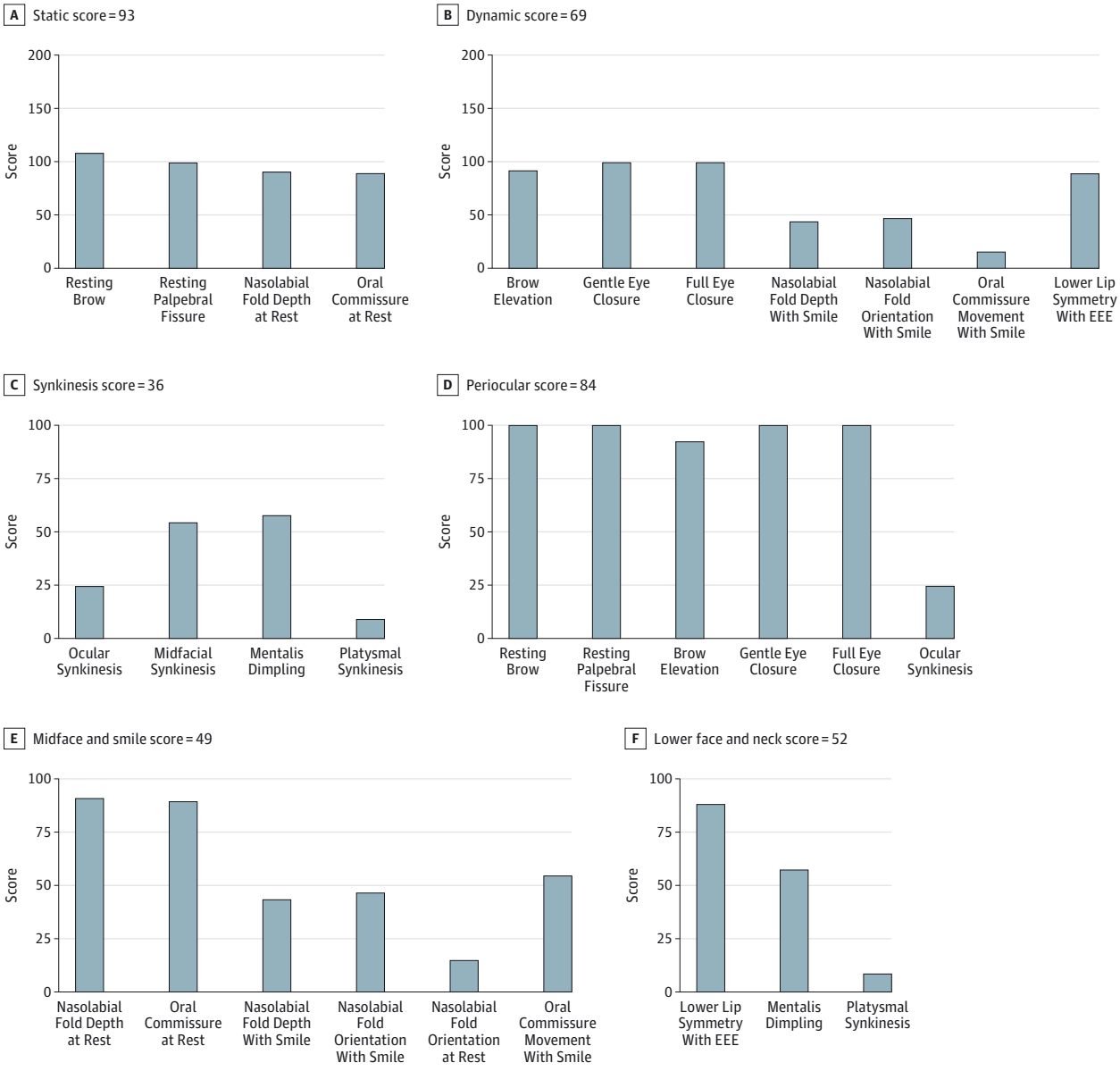
Vol mov't score 72 − Resting symmetry score 0 − Synk score 9 = Composite score 63

C eFACE



A, The patient developed facial synkinesis with movement restriction following Bell palsy (left to right: rest, brow elevation, gentle eye closure, full eye closure, gentle smile, full-effort smile, lip pucker, lip depression or snarl). B, Sunnybrook Facial Grading System resting, voluntary movement (Vol mov't), and synkinesis (Synk) parameters are entered by hand for the patient shown in panel A and scores manually calculated (reproduced with permission from Ross et al[9]). C, eFACE static, dynamic, and synkinesis parameters are entered for the patient shown in panel A using a touchscreen graphical user interface (GUI) with visual analog scales (VAS), with scores automatically calculated and displayed in a separate GUI window.

Figure 2. eFACE Graphical User Interface Output Screen



A, Static score. B, Dynamic score. C, Synkinesis score. Scores are automatically calculated, together with zonal subset scores. D, Periocular score. E, Midface and smile score. F, Lower face and neck score. Scores are for the patient shown in Figure 1. Total eFACE composite score = 64. EEE indicates a cue for the patient to say "Eee" to make the lower lip descend.

with the total Sunnybrook FGS scores for each category. The total score of each of the 3 categories of static, dynamic, and synkinetic symmetry and the total score of all 3 categories were plotted in a separate graphic. The total Sunnybrook FGS synkinesis score (worst score, 15; perfect score, 0) and static score (worst score, 20; perfect score, 0) were normalized to a 100-point scale with the eFACE (perfect score, 100; worst score, 1) by using the equation:

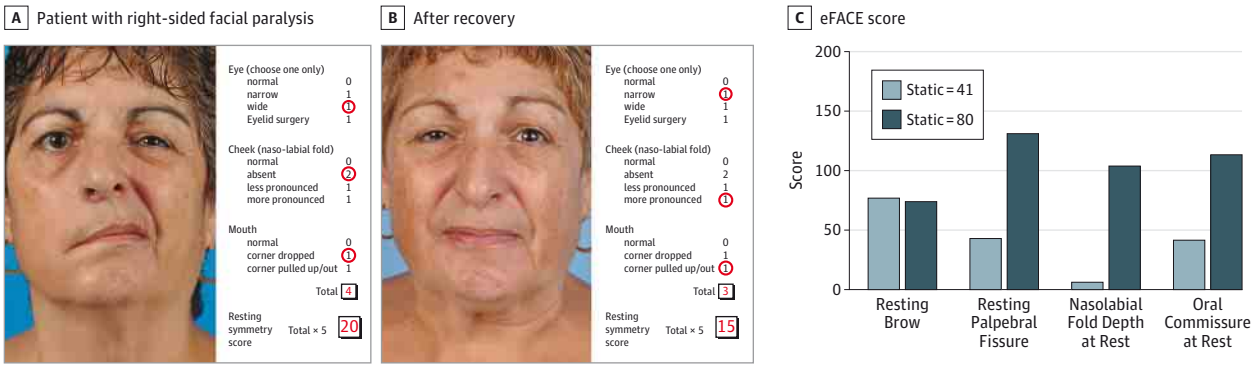
Modified Sunnybrook FGS static score = 100 - 5 × Sunnybrook FGS static score,

Modified Sunnybrook FGS total synkinesis score = 100 - (100/15) × Sunnybrook FGS total synkinesis score

Results

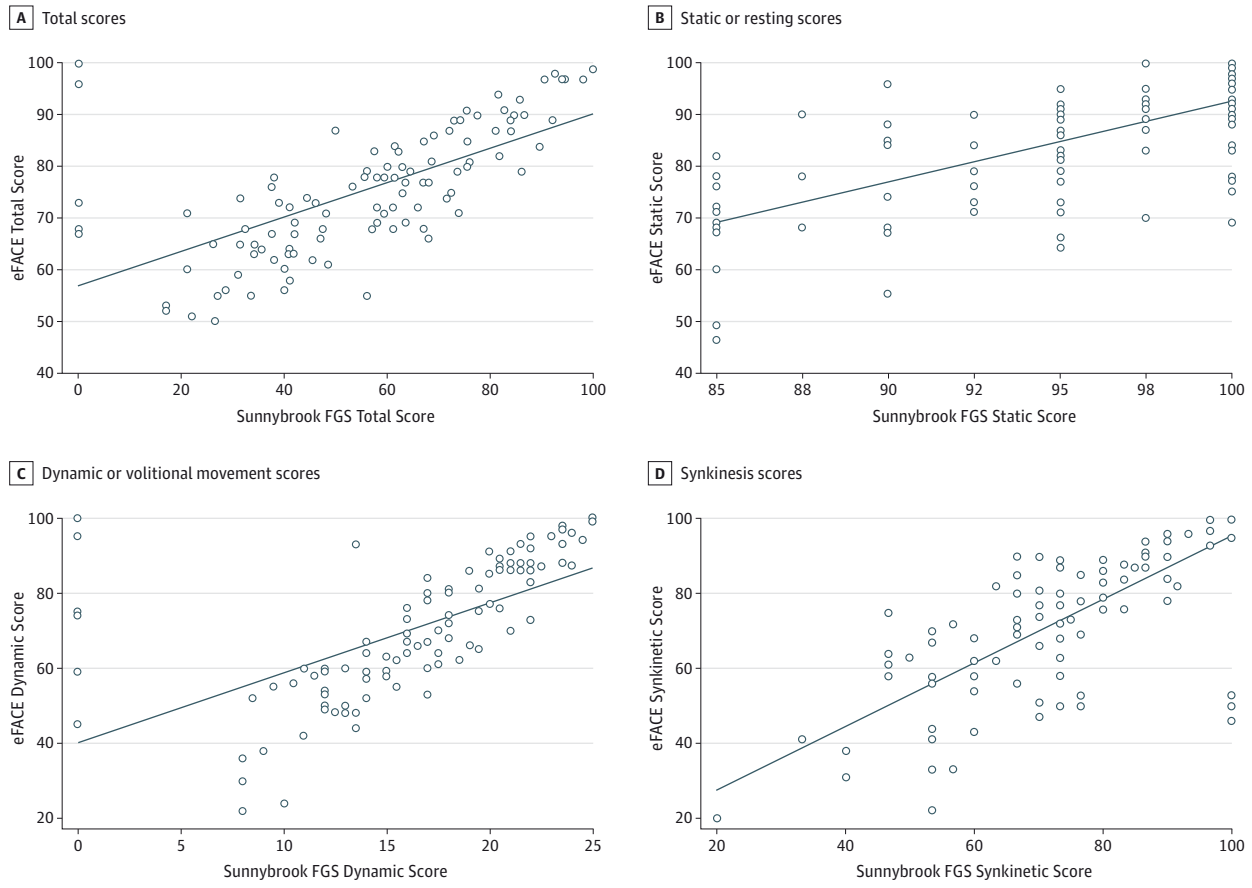
All patients were able to undergo scoring with both scales without difficulty. Sunnybrook FGS scoring (Figure 1B) took a mean of 3 minutes per patient to record, and with the aid of a macro in Excel, a total score was computed. The eFACE took a mean of 1.5 minutes to record, with immediate calculation of scores, subscores, and zonally relevant scores (Figure 2). The eFACE graphics also provided a visual depiction of how the affected side of the face differed from the healthy side, with scores representing flaccidity (increased palpebral fissure width,

Figure 3. Comparison of Static or Resting Scores Between the Sunnybrook FGS and eFACE



A, A patient with acute right-sided flaccid facial paralysis from Ramsay Hunt syndrome receives a score of 20 for resting facial symmetry on the Sunnybrook Facial Grading System (FGS). B, After aberrant recovery that results in right-facial contracture, the patient receives a score of 15 for resting symmetry on the Sunnybrook FGS. C, The same patient receives an eFACE static score of 41 in the flaccid state (light blue bar) and 90 in the hypertonic state (dark gray bar), with differences between the 2 states on static parameters such as resting palbebral fissure width and nasolabial fold depth immediately apparent from the outputted bar graphs.

Figure 4. Scatterplots With Linear Regression Lines Comparing eFACE and Sunnybrook FGS Subset Scores



A, Total scores. B, Static or resting scores. C, Dynamic or volitional movement scores. D, Synkinesis scores. FGS indicates Facial Grading System.

effaced nasolabial fold) clearly distinct on the other side of the "100" mark on the bar graph of scores from those indicating hypertonicity (**Figure 3**).

Results of statistical analysis revealed a moderately strong correlation between the Sunnybrook FGS and the eFACE in all 4 categories: total, static, dynamic, and synkinesis. The Spear-

Table. Facial Nerve Grading Instruments

Grading Scale	Source
eFACE	Banks et al,[1] 2015
Rough grading scale	Alicandri-Ciufelli et al,[12] 2013
Saito	Saito,[13] 2012
Facial Nerve Grading System 2.0	Vrabec et al,[14] 2009
Ruler	Manktelow et al,[15] 2008
MoReSS	de Ru et al,[16] 2006
Sydney	Coulson et al,[7] 2005
FEMA	Kim et al,[17] 1998
Sunnybrook Facial Grading System	Ross et al,[9] 1996
Nottingham	Murty et al,[18] 1994
Smith et al	Smith et al,[19] 1991
Linear measurement index	Burres and Fisch,[20] 1986
House and Brackmann	House and Brackmann,[21] 1985
Peitersen	Peitersen,[22] 1977
Stennert	Stennert,[23] 1977
Yanagihara	Yangihara,[24] 1977
Adour and Swanson	Adour and Swanson,[25] 1971
May	May,[26] 1970
Botman and Jongkees	Botman and Jongkees,[27] 1955

Abbreviations: FEMA, Forehead, Eye, Mouth, and Associated defect scoring; MoReSS, Movement, Rest, Secondary defects, and Subjective scoring.

man rank correlation coefficient of the total eFACE and Sunnybrook FGS scores was 0.75 ($r < 0.0001$). The correlation coefficients for the total static scores, dynamic scores, and synkinesis scores were 0.71 ($r < 0.0001$), 0.77 ($r < 0.0001$), and 0.78 ($r < 0.0001$), respectively. The scatterplots together with linear regression lines are presented in **Figure 4**, and demonstrate this moderately strong agreement among all subscores.

Discussion

Comprehensive assessment of facial nerves in patients with facial movement disorders includes a combination of physician-graded scales, objective measurements, and patient-reported outcome measures. Lack of consensus regarding a physician-graded facial nerve instrument was recently reported by members of the Sir Charles Bell Society.[2] Although multiple scales were cited (**Table**),[1,7,9,12-27] the Sunnybrook FGS was determined to be the most comprehensive and useful, providing objectivity and uniformity of reporting.[3] Despite this assessment, drawbacks of the Sunnybrook FGS are that it is time consuming to calculate, not easily accessible electronically, has not yet been converted to a digital or graphic format, and involves 3 different scales with different ranges. The recently introduced eFACE rating tool possesses many advantages of the Sunnybrook FGS, but it has the added benefit that it is rapid to administer; offers sliding scale zonal detail; provides static, dynamic, synkinetic, and total facial function scores all on a uniform scale; and has been shown to demonstrate superior interrater reliability compared with the other scales.[1] The visual analog scaling results, with 15 items, take approximately 1 minute to obtain in experienced hands. The advantages of such an application are that it is easy to download, executable on any mobile device or the desktop computer, and it provides immediate visual representation of facial function data, including whether elements of flaccidity or hypertonicity dominate.

One explanation for lack of even stronger correlation between the eFACE and the Sunnybrook FGS is that slightly different variables are being measured by each scale. The eFACE measures lower lip depression and nasolabial fold orientation, which many consider important features of facial expression not measured by the Sunnybrook FGS. The Sunnybrook FGS measures the pucker or protrusion of the lips, which some believe represents an important functional component for eating, drinking, and speaking. Variability among physician perceptions, and the lack of utility in patients with bilateral facial paralysis, represent important limitations of both the eFACE and the Sunnybrook FGS rating scales.

Conclusions

There was a moderately strong correlation between the Sunnybrook FGS and the newly introduced digital eFACE grading scale. Based on this association and the potential advantages and ease of using the eFACE, the new instrument has the potential to become a widely used facial grading scale across all facial nerve disciplines. The accessibility of the scale on mobile devices, the incorporation of a commonly used 100-point scale, and the digital and graphical outputs make it attractive to the surgical community, while the detailed zonal and subcategory data regarding synkinesis continue to make it an attractive option for physical and occupational therapists. The demonstration herein that the eFACE correlates well to the Sunnybrook FGS is intended to increase the comfort level of those using the Sunnybrook FGS to try the similar eFACE for its specific advantages. Ongoing investigations demonstrating the sensitivity of eFACE to change, and the relative contributions of each eFACE variable will further define the utility of the instrument.

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Study concept and design: Gaudin, Robinson, Banks, Hadlock.
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