Insight view of Outcome Evaluation Tools for Early Facial Nerve Repair

Ahmed Mohamed Ahmed Elsayed [1]; Mohamed Salah Awad [1]; Yehia Zakaria Awwad [1] ; Mahmoud Saber Elbasiouny [2]; Tarek Ahmed Amer [3]

[1] Plastic and Reconstructive Surgery Department, Faculty of Medicine, Zagazig University, Egypt.
[2] Plastic Surgery and Medical applications of lasers National Institute of Laser Enhanced Science, Cairo University, Egypt.
[3] Plastic and Reconstructive Surgery Department, Faculty of Medicine, Cairo University, Egypt.
Corresponding author: **Ahmed M. Elsayed**, Amaelsayed@medicine.zu.edu.eg

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ABSTRACT

Facial nerve injury is common occurring as a result of mechanical, chemical, or ischemic damage caused either by trauma, tumor, or iatrogenic injury. In as many as 75% of patients with facial palsy, the cause is idiopathic paralysis or Bell's palsy. Although peripheral nervous system axons have a high regenerative capacity, complete functional recovery is rarely achieved. There exists a critical time window after nerve injury during which the damaged facial nerve can be augmented through connection to another intact nerve. This allows for reinnervation of the native facial muscles but requires sacrifice of an alternate cranial nerve.The high incidence of peripheral nerve involvement and the lack of consistent functional recovery warrant the need for new interventions to improve these injuries, as well as Low-level laser therapy (LLLT) or photobiomodulation (PBM) is a technique involving cell manipulation through the photonic energy of a non-ionizing light source. Therefore, this study aimed to review the outcome of repair of early facial nerve injuries.

Keywords: Early Facial Nerve Repair ; Outcomes ; Evaluation Tools

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INTRODUCTION

The face is considered psychologically the most important part of the body and an important component of self-concept and body image **(1).**

The facial nerve provides motor innervation for the muscles of facial expression. Subsequently, facial nerve injury may cause detrimental effects on communication, social interaction, and quality of life **(2).** In addition, patients with unilateral or bilateral facial paralysis have difficulties eating, drinking, and speaking, which subsequently leads to impairment in daily activities **(3).**

Also, low-level laser therapy (LLLT) is a modality of non-invasive, non-thermal phototherapy, where the laser light transmitted into the body tissues used in the process of regeneration and functional recovery of peripheral nerves. Research studies have shown that LLLT produces both local and systemic effects that can enhance nerve regeneration **(4).**

Literatures show that the rate of absorption of low-level laser energy by the nervous tissues is high compared to the other soft tissues. Moreover, laser improves recovery of the injured peripheral nerve as it enhances axonal growth and myelination and decreases post-traumatic retrograde degeneration of neurons **(5).**

LLLT refers to a tissue uptake by photoreceptors, thus activating the intracellular signaling pathways of nucleic acid synthesis, protein synthesis, enzyme activation and cell cycle progression **(6).**

Outcome Evaluation Tools

Accurate and reliable estimation of facial nerve function is a challenge, considering the complex physiology of the facial nerve, its control of various functions, and its extensive motoric function **(7).**

Facial function can be assessed by subjective or objective measures. Subjective methods depend on patients, doctors or both. Objective methods depend on computer assisted photographic analysis during both resting and dynamic states which could be as the gold standard measurement of facial function in facial paralysisy patients **(8).**

- **Patient-based outcome measurement tools:**

Subjective patient-based evaluation relies on patient-reported outcome measures (PROM), which are questionnaires that quantifiably measure the quality of life (QOL) and other metrics from the patients' perspective. Patient satisfaction after surgical and non-surgical treatment in facial palsy patients is highly influenced by patient self-perception. Therefore, it is important to address the patients' social disability and psychological factors to optimize the quality of care **(9).** Many questionnaires were developed over time but the Facial Clinimetric Evaluation Scale (FaCE Scale) and the Facial Disability Index (FDI) are the only established PROM that meet the criteria required for development and validation of psychosocial of facial paralysis **(10).**

The FaCE Scale is a facial palsy specific 15-item instrument (5-point Likert scale and visual analogue scale), which assesses 6 thematic domains: facial movement, facial comfort, oral function, eye comfort, lacrimal control and social function. The scores are calculated on a scale from 0 (worst) to 100 (best) to assess facial function **(11)**.

The FDI contains 10 Likert-type questions, which evaluate 2 domains: physical and social function. Physical function scores range from 25 (worst) to 100 (best) and social function scores from 0 (worst) to 100 (best) (**12).**

Unfortunately, Patient-based assessment of social function did not correlate with degree of facial nerve impairment. Social function assessed with both the Facial Disability Index and the Facial Clinimetric Evaluation Scale did not correlate with facial grading scores in many literatures who studied quality of life in patients suffering from facial palsy **(13).**

- **Observer-based assessment of facial function :**

Despite development of multiple facial function grading scales, the lack of a universally accepted grading system impedes the management progress of facial nerve reconstruction prompted the creation of more precise scales. Despite presence of several evaluation scales and systems like the House and Brackmann grading scale (HBGS), the Sunnybrook facial grading system, the Sydney Facial Grading System, the Burres–Fisch system and The Nottingham system, only (HBGS) and the Sunnybrook facial grading system are more commonly worldwide used **(14).**

Ever since its introduction in 1983 and endorsement by the Facial Nerve Disorders Committee of the American Academy of Otolaryngology, the House and Brackmann grading scale (HBGS) had become the golden standard for describing the degree of facial nerve function **(15).**

The House and Brackmann grading scale is a comprehensive scale assigning patients to 1 of 6 grades on the basis of their degree of facial function **(Table 1)** (grade I = normal function to grade VI = complete paralysis plus gross asymmetry at rest) **(16).**

However, the House- Brackmann grading scale has its limitations, given that the obtained score represents the overall function of the face and does not consider different levels of function associated with particular parts of the face such as the forehead, eye, midface, and mouth **(17).**

Table (1): The House- Brackmann grading scale [16].

SCORE	DEFINITION
I	Normal symmetrical function in all areas
II	Slight weakness noticeable only on close inspection Complete eye closure with minimal effort Slight asymmetry of smile with maximal effort Synkinesis barely noticeable, contracture, or spasm absent
III	Obvious weakness, but not disfiguring May not be able to lift eyebrow Complete eye closure and strong but asymmetrical mouth movement with maximal effort Obvious, but not disfiguring synkinesis, mass movement or spasm
IV	Obvious disfiguring weakness Inability to lift brow Incomplete eye closure and asymmetry of mouth with maximal effort Severe synkinesis, mass movement, spasm
V	Motion barely perceptible Incomplete eye closure, slight movement corner mouth Synkinesis, contracture, and spasm usually absent
VI	No movement, loss of tone, no synkinesis, contracture, or spasm

Furthermore, the manifestation of even the mildest synkinesis requires the assignment of grade II, despite the fact that the function in all the facial nerve branches could be otherwise normal. Lastly, the significant subjectivity associated with HBGS results in high observer variability **(18).**

The Sunnybrook facial grading system is based on the evaluation of resting symmetry, degree of voluntary excursion of facial muscles, and degree of synkinesis associated with specified voluntary movement **(Figure 1)**. This scale examines separately different regions of the face by using five standard expressions. All the items are subsequently evaluated on point scales, and a cumulative composite score is obtained **(19).**

A large number of reconstructive surgeons prefer the Sunnybrook scale over the House-Brackmann scale due to its detailed assessment of specific regions of the face and their dynamics **(20)**. However, the main shortcoming of the Sunnybrook facial grading scale itself is the inconsistency of user-given scores. Biases in the Sunnybrook facial grading scale have been reported, which can affect the results **(19).**

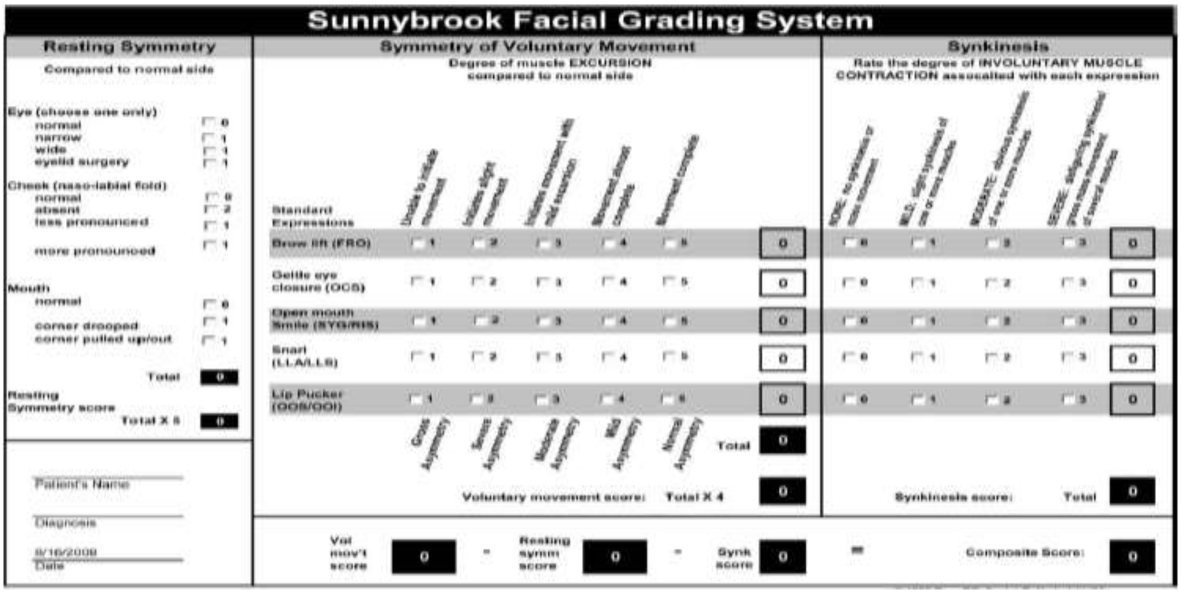

Fig.(1): The Sunnybrook facial grading system [19].

- **Objective assessment tools development:**

Comprehensive, objective assessment of facial harmony and function in patients suffering from facial movement disorders has eluded clinicians for decades. In the modern era of evidence-based practice, quantitative, validated outcomes measures are essential to assess severity of disease, to monitor progression over time, and to determine the effectiveness of different interventions **(21).**

A Clinician-graded electronic facial paralysis assessment scale was designed. The scale (termed the eFACE) is a 16-item instrument relevant to patients with facial nerve disorders. Similar to several other scales in use, the items were designated into one of three domains: static (five items), dynamic (seven items), or synkinesis (four items) **(22).**

Quantifying static facial features and displacements occurring with facial expressions is a promising technique for standardizing assessment in patients with facial paralysis. Computer-based techniques to quantify facial displacements are now widely employed **(23).**

Early approaches comprised manual identification of facial landmarks on digital images within specialized software called FACEGRAM, from which relevant distances and angles could be readily calculated. Although such techniques enabled retrospective assessment of facial function, manual tagging of digital images is resource intensive and error prone **(24).**

Machine learning (ML)-based computer vision algorithms enable rapid and fully automated tracking of facial displacements from digital images and videos recorded under typical conditions with consumer-grade cameras. Such facial landmark detection algorithms are usually trained using databases of manually annotated facial photographs **(25).**

Once trained, these ML algorithms can predict the position of facial landmarks in a new photograph without human intervention, with high accuracy. ML algorithms for facial landmark localization are increasingly being used to study facial palsy **(26).**

These technological advances were applied to develop Emotrics, a simple, high-throughput software platform that enables automatic facial landmark localization and computation of facial measurements. Emotrics is designed for use with frontal-view clinical photographs, automatically placing a set of 68 facial landmark dots on an uploaded image. Then automatically generates multiple facial measurements by scaling iris diameter to pixel width in each image using a mean human population iris diameter of 11.77 mm **(27).**

Emotrics can rapidly compute multiple relevant facial measurements simultaneously, with full analysis of one image taking less than 5 seconds on average **Fig.(2)**. Emotrics can also analyze the differences between 2 photographs, which allows automated calculated comparison between these 2 photographs **(28).**

Fig. 2: Calculated facial measurements using emotrics [28].

- **Low-level laser therapy (LLLT) or photobiomodulation (PBM):**

Investigation on low-level laser and its therapeutic effects started in 1967. It is referred to as "low level" because the energy densities are low when compared to other forms of laser therapy that are used for ablation, cutting, and thermally coagulating tissue, it is also known as "cold laser" therapy as the power densities used are lower than those needed to produce heating of tissue **(29).**

In the field of PBM, it is defined as ''therapeutic window'' the range of wavelengths useful and usable for this type of application; this window is located between 600 and 1150nm on the basis of the fact that absorption and diffusion of light in tissues depend on wavelengths and tissue chromophores: wavelengths below 600nm would be too much absorbed by hemoglobin, those above 1150nm from water in tissues **(30).**

Thus, LLLT& PBM which produces a non-thermal process involving endogenous chromophores eliciting photo-physical and photochemical events at various biological scales a better definition of existing interventions.

CONCLUSION:

Facial paralysis has considerable functional and psychological morbidity including anxiety, depression, social isolation, and lower self-esteem**.**

Three options exist for early facial nerve reconstruction:(1) primary tension-free repair (best option when feasible); (2) cable grafting between the proximal and distal nerve stumps, when the length of the defect prevents primary coaptation, and (3) nerve transfer, which is indicated when the proximal segment of the facial nerve is not accessible.

Physical therapy modalities such as therapeutic ultrasound and photobiomudalation therapy (PBMT) may provide the benefits of faster functional and nerve recovery. The photobiostimulatory effect of Low-level laser therapy (LLLT) prevents cell death, reduces inflammation, and promotes cell regeneration.

No Conflict of interest.

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