



# “EFFECT OF NEUROMUSCULAR ELECTRICAL STIMULATION ON FACIAL ANGLE AMONG BELL’S PALSY PATIENTS”

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## ABSTRACT

**Background:** Bell’s palsy is a neuromuscular disorder. Bell’s palsy is treated by physical therapy modalities such as facial exercise, biofeedback, laser treatment, neuromuscular electrical stimulation, electrotherapy, massage and thermotherapy are used to hasten recovery, improve facial function and minimize sequelae. House-brackmann index showed high reliability against Sunnybrook facial grading scale. Kinovea is free bi-dimensional motion analysis software to the best knowledge, use of kinovea for analysis of facial angles (frontal angle, smile angle).

**Aim:** The aim of study is to find the effect of NMES with conventional facial exercise on facial angle among Bell’s palsy patients.

**Method :** 30 bell’s palsy patients will be taken for the study. In pre test assessment house-brackmann scale, facial angle measure by kinovea software will be taken. After that NEMS with facial exercises will be given. Total treatment protocol will be of 30 min per day for two weeks. Then in post test assessment again house-brackmann scale, facial angle measure will be taken by kinovea software.

**Results :** P-value of frontal angle, smile angle is less than 5% level of significance. Clinically, there is an effect of NMES on facial angle among bell’s palsy patients noticed by using HB scale. There is significant effect of neuromuscular electrical stimulation on the facial symmetry and facial angle among bell’s palsy patient .

**Conclusion :** This study concluded that NMES with conventional facial exercises is a effective on facial angles in bell’s palsy patients which is include the frontal and smile angle.

**Key words:** Bell’s palsy, Facial angles, NMES, Facial exercises, House-brackmann scale, Kinovea .

## INTRODUCTION

Bell’s palsy is a neuromuscular disorder. which is an idiopathic weakness or sudden onset paralysis of the face of peripheral nerve origin .<sup>1</sup> Facial paralysis, commonly known as Bell palsy (BP), is an acute facial nerve disorder that causes facial hemiparesis or paralysis. The first symptom is usually discomfort in the mastoid region.<sup>2</sup> The yearly the number of cases with BP per 100,000 individuals ranges from 11.5 to 40.2. <sup>3</sup>

Bell's palsy accounting for 60 to 75 percent of all unilateral facial paralysis instances. Both men and women are affected in the same way. The disease typically strikes people in their 40s, but it can strike anyone at any age. The incidence is lowest in children under the age of ten, increases from ten to 29, remains stable from thirty to seventy, and is highest in persons over seventy. Both the left and right sides of the face are equally affected.<sup>4</sup>Inability to close the eye, tears, drooling, and facial pain are all symptoms that peak around 2 weeks after beginning.<sup>5</sup>

Facial paralysis is a type of facial impairment that can cause severe psychological and social problems in sufferers. Their facial expression is either lessened or altered, which affects normal face-to-face communication, and nonverbal facial indications can be misread. Embarrassment can be caused by functional issues such as eating and drinking. The functional importance of facial paralysis extends to the eye region; a functionally dry eye combined with an inability to blink can cause corneal damage. It has been highlighted that the inability to smile and express oneself is one of the symptoms facial paralysis sufferers' most distressing emotion patient.<sup>6</sup> Due to such severe social, psychological, and functional impairments caused by bell's palsy measurement of facial angle become so important.that is the reason this study includes facial angle measurements.

Physical therapy for Bell's palsy has included thermal techniques, laser treatment, Taping, electrotherapy, massage, face exercises, and biofeedback. Exercise treatment has proven to be effective. Other interventions have been employed more than others.<sup>7</sup>

In the case of Bell's palsy, physical therapy mostly consists of methods that increase muscle and nerve function through exercise or electrotherapy. Thermal techniques and massage help to promote recovery by reducing oedema and increasing blood flow to injured tissues, increasing the quantity of oxygen available to damaged, hypoxic tissues.(Lockhart 2010b)

Different muscle areas supplied by each branch of the facial nerve were included in the exercises.Exercises were done with a mirror to promot symmetry , control and reduce synkinesis and feedback on both sides of the face. <sup>5</sup>

To avoid potential interference with neuronal regeneration, current therapeutic trends prohibit the use of electrical stimulation in the early stages of Bell's palsy . Although electrical stimulation is still extensively used, Diels (2000) argues that it may induce an increase in residual effects and delay facial nerve regeneration, despite the lack of proof (Diels, 2000), (Cohan and Kater, 1986).<sup>8</sup>

After a denervation injury, early electric stimulation (ES) was shown to maintain normal motor unit properties and increase functional recovery.<sup>2</sup>Eye closure [obicularis oculi], oral movements [orbicularis oris], and learning to minimise asymmetrical facial expression [zygomaticus major] were among the muscles that were stimulated by electrical stimulation.<sup>5</sup>

Electrical muscle stimulation (EMS), of an intact lower motor neuron (LMN) to stimulate paralysed or paretic muscle is known as NMES. It is also utilised to treat a variety of ailments. NMES may have a specialised effect that improves function but does not offer function directly. The nerve or the motor point of the nerve proximal to the neuromuscular junction are stimulated by clinical NMES devices.<sup>9</sup>

NMES (neuromuscular electrical stimulation) is a treatment that uses a tiny electrical current to activate neurons that innervate muscles damaged by paralysis.<sup>2</sup> Choi has shown that NMES is beneficial in muscle strengthening, preventing muscular atrophy, neuromuscular rehabilitation, and improving the strength of facial muscles in patients with facial paralysis.<sup>10</sup>

Kim stated that NMES is difficult to produce enough face muscles. Since they insert into the skin, they apply loads, whereas limb muscles insert into the bones. It's thought that facial expressions play a role. If a particular amount of stress or pressure is applied to NMES, it will be more effective, While the face muscles are voluntary contracting.<sup>11</sup>

Despite the fact that there are various facial function reporting systems (House 1983), there isn't one that is universally approved. <sup>5</sup> Facial grading schemes such as the House-Brackmann or Sunnybrook scale, as well as the facial disability index score, are examples of subjective clinical assessments.<sup>12</sup> The

House Brackmann Facial Nerve Grading Scale (HBGS) was adopted by the American Academy of Head & Neck Surgery in 1984.<sup>13</sup>

Even though House-Brackmann index had good reliability in assessing voluntary movement and synkinesis when compared to the "Sydney" and "Sunnybrook" face grading systems, it was not sensitive enough to variations in individual grades by various raters (Coulson et al 2005)<sup>8</sup>

The HBGS was shown to be based on the function of the eyes, lips, and forehead movement in determining estimated function. House-Brackmann is a showing fictional character. The degree of nerve damage in facial nerve palsy is further graded by Score, which ranges from 0% (Grade VI) to 100% (Grade I).<sup>13</sup>

Objective quantitative face examinations have frequently concentrated on one or a few facial muscles, neglecting the rest of facial movement, utilising bidimensional and three-dimensional measurements.<sup>14-16</sup>

Bidimensional approaches assess the distance between facial locations at rest and during movement using photography or videography. Automation technologies and complex algorithms have been applied in three-dimensional assessments, often at the expense of time, expensive equipment, and a shaky application to everyday practise.<sup>12</sup>

Kinovea (0.8.15 2006 to 2011; Joan Charmant &Contrib, Bordeaux, France), a free, Bidimensional and open source programme for movement analysis. The software may measure distances and timings manually or via semi-automated tracking to follow locations and evaluate live values or trajectories, starting with simple video recordings or pictures of motions.<sup>2</sup>

The user may control temporal settings and measure angles and distances frame by frame with Kinovea. Because the software does calibrations in non-perpendicular planes to the camera-object line being studied, these measurements can be taken from various angles. Because Kinovea is not a 3D application, users can choose which plane to execute the dimensional analysis in 2D on.<sup>17</sup>

This study design to observe the effect of NMES with Conventional facial exercises on facial angle (frontal angle, smile angle).

## **AIM AND OBJECTIVES**

**AIM :** The aim of the study is to find the effect of neuromuscular electrical stimulation with conventional facial exercises on facial angles (frontal angle, smile angle) among bell's palsy patients.

**OBJECTIVES :** To observe the effect of neuromuscular electrical stimulation and conventional facial exercises on facial angle ( frontal angle ,smile angle) by using kinovea software.

To find the effect of neuromuscular electrical stimulation and conventional facial exercises on facial symmetry by using House-Brackmann scale.

## **MATERIAL AND METHODOLOGY**

Ethical clearance was obtained from the Institutional Ethical Committee. Subjects was selected according to the inclusion criteria. Which was includes Both Male and Female, 15 yr to 45 yr age group, Acute episode of Bell's palsy suffered from last seven days, Dignosed bell's palsy by physician. Subject were neoplasia, dermatological and autoimmune diseases in progress, Motor neuron disease, Dental implants and metal implants, Altered sensation on face, Trauma excluded. Prior to the study subjects was explained the procedure in vernacular language. A written informed consen was taken from the subjects prior to the intervention. Before the intervention subjects pre values was taken by the house brackmann scale .Smile angle and frontal angle was measured by using kinovea software.

Then the neuromuscular electrical stimulation and facial exercises was given for 2 weeks 1 session/day. After the intervention subjects post values was taken by the house-brackmann scale .Smile angle and frontal angle was measured by using kinovea software. The effect of neuromuscular electrical stimulation and conventional facial exercises on facial symmetry was noted.

Pre interventional values was taken By observing the subjects eye, lips, and forehead movement HBGS. In sitting position, Photograph was taken by a therapist by using smart phone. After that the photograph was uploaded in kinovea software and values of frontal angle and smile angle were taken.

NMES was applied using interrupted galvanic current and surged faradic current. Subject lies in supine position, therapist in sitting. There are two electrodes which is named Indifferent and active electrodes. By the therapist indifferent electrode is placed at C7 vertebra and active electrode which is pen electrode placed at nerve trunk or motor point.

First interrupted galvanic current was given to the motor points of zygomatic major and frontalis muscle, 3 sets for each muscle. (1 set = 15 contraction ) interval was taken for 2 min to avoid muscle fatigue. Secondly, surged faradiac current was given to the upper, middle, and lower trunk, 1 set for each trunk (1 set = 15 contraction).



In order to achieve symmetrical movements and to avoid muscle fatigue facial exercise was given. these exercises done in front of a mirror and tell them use your fingers to assist. Perform the exercises slowly and gently.

- 'Affected' side of the face : stroke the cheek up towards your ear and from your eyebrow to the hairline.
- 'Unaffected' side of face : relax the face and massage gently from your ear down the corner of your mouth.
- Position fingertips slightly above eyebrows and assist eyebrows to raise 3 times, on third attempt hold the position.
- With fingers positioned as above gently assist movement as you attempt to frown.
- Place fingers above and below the eye socket- stretch to a fully open position and then pull fingers together to close the eye.
- Place 2 fingers on the forth teeth, run them along to the back of the mouth, pull and stretch cheeks and run fingers to the bottom of the gums .
- Seal lips, using fingers to assist if required and blow cheeks out as symmetrically as possible.
- With your fingers on each side of the mouth to assist- move the corners of your mouth outwards as if saying ee.
- With your fingers on your cheeks –curl the corners of your mouth upwards.

The same procedure used for pre-interventional test was followed for testing the post-interventional test for the muscles i.e., zygomatic major and frontalis. Both the pre and post test data was compared and the effect was evaluated.



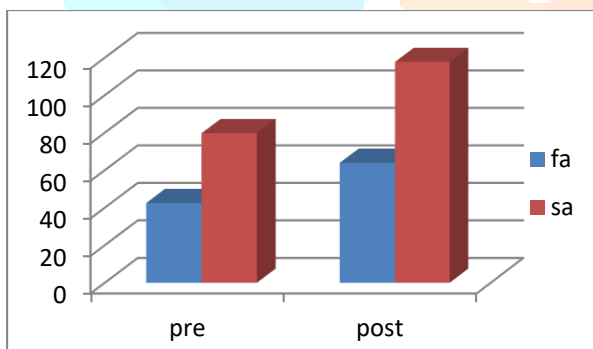
## RESULT

Data analysis was performed using Statistical Package for the Social Sciences [SPSS] Software. The level of significance for pre and post test facial angle, smile angle and housebrackmann scale within the group was calculated using paired t test.

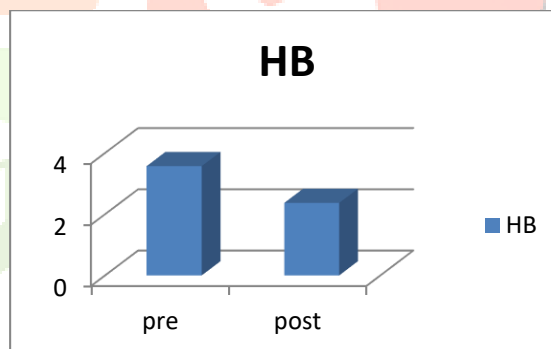
OUTCOME	PRE TEST VALUE Mean	POST TEST VALUE Mean	P-CORREALATION
HB	3.566667	2.366667	0.665375
FRONTAL ANGLE	42.53333	63.96667	0.423749
SMILE ANGLE	79.7333	117.7333	0.821565

Tab.1: Pre and Post within group analysis by using Paired sample t test

From the above within groups analysis using paired sample t test, it is observed that frontal angle, smile angle and HB scale mean value indicated changes post treatment . The mean value of HB scale before intervention is 3.56 and after intervartion 2.36 which is shown improvment in facial function and symmetry. Clinically, there is a effect of NMES on facial angle among bells palsy patients noticed by using HB scale.



Graph.1 pre and post mean value of frontal angle



Graph.2 pre and post mean value of housebrack- Mann (HB) scale (fa) and smile angle(sa)

42.53 is a pre intervention mean value and 63.96 is a post intervention mean value of frontal angle, 79.73 is a pre intervention mean value and 117.73 post intervention mean value of smile angle, post test mean values both the frontal and smile angle are increased than pre test value which shows that there is an improvement in frontal angle and smile angle. (Tab.1)

From the above within groups analysis using paired sample t test, it is observed that *p-value* of frontal angle after intervention is 0.019, *p-value* of smile angle after intervention is 0.0003 and *p-value* of HB scale after intervention is 0.000 which is highly significant.

Thus reference to the results of the test analysis at 5% significance level, there is a significant statistical reliable difference between the pre & post treatment values with *p-value* is less than the 5% significance level (i.e.  $0.001 < 0.05$ ) in the study and therefore it justifies the improvements in health outcome post intervention.

OUTCOME	PRE		POST	
	<i>t-stat</i>	<i>p-value</i>	<i>t-stat</i>	<i>p-value</i>
HB	5.55	6.0518	4.71	0.0000
FRONTAL ANGLE	0.20	0.8386	2.47	0.0196
SMILE ANGLE	7.62	2.6306	4.03	0.0003

Tab.2: Significant changes in pre and post analysis of HB, smile angle, frontal angle (fa) and smile angle (sa)

From the table 2 it is observed that within group analysis is significant for frontal, smile, HB scale the pre time frame at 5% level significance but it is significant for post and difference values at 5% level significance since *p-value* is less than 5% level (i.e.  $0.001 < 0.05$ ).

## **DISCUSSION**

The highlights of this study was to evaluate the effect of neuromuscular electrical stimulation with conventional facial exercises on facial angles (frontal angle, smile angle) among bell's palsy patients. In this study, we selected 30 samples for experiment to check the effect of NMES on facial angles in patients having bell's palsy.

In this study after giving 2 weeks intervention we observed that Clinically, there is a effect of NMES on facial angle among bells palsy patients noticed by using HB scale. statistically observed that within group analysis is significant for frontal, smile, HB scale the pre time frame at 5% level significance but it is significant for post and difference values at 5% level significance since *p-value* is less than 5% level (i.e.  $0.001 < 0.05$ ). In this study kinovea software is an outcome measure used for measuring facial angle to evaluate bells palsy.

NMES (neuromuscular electrical stimulation) is a treatment that uses a tiny electrical current to stimulate neurons that innervate paralysed muscles. Choi has shown that NMES is beneficial in muscle strengthening and muscle prevention in neuromuscular rehabilitation and face improvement face paralysis and muscle strength in stroke patients neurological problems .

Nicola Marotta (2020) reveals that combining diathermy with neuromuscular electrical stimulation is valid and reliable in the treatment of chronic Bell palsy, as evidenced by improvements in the symmetry of voluntary movements. And Kinovea was used for the parametric measures it is a free, bidimensional, easy software and by using kinovea found that the symmetry ratio of voluntary movements improved significantly ( $P < 0.05$ ) so this study include that kinovea is a bidimensional software to use for the measure facial angle and results that after the intervention there is a increase in angles.

Tuncay F, Borman P (2015), The aim of this study was determine the efficacy of electrical stimulation when added to conventional physical therapy with regard to clinical and neurophysiologic changes in patients with bell palsy. They concluded that, the addition of 3 weeks of daily electrical stimulation shortly after facial palsy onset (4 weeks) improved functional facial movements.

Nevien Mm Gharib (2011), this study was conducted to investigate the reliability of the three dimensional motion analysis system as a method for assessment of Bell's palsy quantitatively. Three dimensional motion analysis by Qualisys motion capture system was used to analyze facial movements.

Marjolaine Baude (2015), the aim of this study to design a bidimensional facial movement measuring tool and study its reliability. The result of this study Intrarater and interrater reliabilities were good to excellent for frontalis (PA and ICC  $> 70\%$ ; CV  $< 15\%$ ), moderate for orbicularis oculi, zygomaticus, and orbicularis oris, and poor for corrugator and buccinators.

Alakram P, MSc Puckree T, PhD (2011), this study examined that the effects of electrical stimulation on functional recovery from Bell's palsy using the Facial Disability Index, a tool that documents recovery from the patients' perspective. They concluded that the effects of electrical stimulation as used in this study during the acute phase of Bell's palsy, quantified as the FDI was clinically but not statistically significant.

Carien H. G. Beurskens et al(2003), the purpose of this study Evaluation of the effect of mime therapy, a novel therapy combining mime and physiotherapy, for patients with longstanding (at least 9 months) sequelae of unilateral peripheral facial paralysis. they concluded that, mime therapy is a good treatment choice for patients with sequelae of facial paralysis.

## **CONCLUSION**

This study may concluded that NMES with conventional facial exercises is a effective on facial angles in bells palsy patients which is include the frontal and smile angle. Clinically, there is a effect of NMES on facial angle among bells palsy patients noticed by using HB scale.

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