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COMPARISON OF LOW-LEVEL LASER THERAPY VERSUS ELECTRICAL STIMULATION ON FACIAL DISABILITY AND SYNKINESIS IN SUBJECTS WITH ACUTE BELL'S PALSY: A RANDOMIZED CONTROL TRIAL

Physiotherapy

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ABSTRACT

Background And Objectives: Bell's palsy describes an acute peripheral paralysis of the facial nerve of the unknown cause. Bell's palsy is an idiopathic, rapid, ipsilateral onset of facial nerve paralysis due to the weakness of muscles responsible for facial expressions leading to facial asymmetry. The purpose of the study is to compare low-level laser therapy versus electrical stimulation on facial disability and synkinesis in subjects with acute bell's palsy by using Fascial disability index, Nerve conduction velocity, SD curve. **Methodology:** It was a single-blinded randomized control trial. Subjects were randomly allotted into two groups. Group-A=15(Experimental group) and Group-B=15(control groups). A written informed consent signed by subjects was taken, both groups received electrical stimulation, facial massage, and facial exercises commonly. Additionally, Group A received Low-level laser therapy (LLLT). The study was conducted for a total of 18 sessions over 3 weeks. FDI, NCV, and SD curves were evaluated before and after the study. **Result:** There was a significant improvement in both groups but on comparison of mean and p values, there was a better significance in GROUP A {experimental} who were given low-level laser therapy combined with electrical stimulations, facial exercises, and facial massage. The result for experimental group showed NCV (p=0.000), FDI physical component(p=0.000), social component (0.000), SD curve rheobase (0.000), chronaxie (0.010). And the Control group showed NCV(p=0.001), FDI physical(p=0.000), social (0.000), SD curve rheobase (0.000), chronaxie (0.001). **Discussion:** This study assessed the differences in facial disability and facial function in acute Bell's palsy when treated with LLLT and ES. On comparing the outcomes at baseline, and after the treatment program, we found a significant improvement in the facial disability and facial function of both the groups with comparatively better improvement in LLLT and ES than ES alone. **Conclusion:** The present study concluded that the potential therapeutic effects of LLLT given along with ES were found to be more effective compared to ES alone on facial disability and synkinesis in subjects with acute Bell's palsy.

KEYWORDS

INTRODUCTION

In 1798 Nicolaus A Friedrich first described the term Bell's palsy for the first time, Sir Charles Bell described Bell's palsy in 1821.[1]

The face is considered to be psychologically the most important part of the body and an important component of self-concept; it plays a major role while interacting and helps face-to-face communication.[2]

The human face is a vital part of the body that serves an important role in social interaction, emotion, sexual dimorphism, and overall health.[3] The face of the human body is an essential component in the person's psychic and social functioning as its expression mediates social interaction.[4]

The face demonstrates emotions and feelings through muscle movement for facial expression, which results in aesthetic symmetry.[5] The seventh cranial nerve (CN VII) is the face nerve. It originates in the brain stem and spreads to the vestibulocochlear nerve anteriorly and the abducen s nerve posteriorly. It passes via the stylomastoid foramen, the temporal bone's facial canal, and the posterior margin of the parotid gland, where it splits into terminal branches.

The facial nerve provides sensory innervation to the anterior two-thirds of the tongue, parasympathetic innervation to the glands of the oral cavity and lacrimal gland, and motor innervation to the face muscles that control facial expression.[6]

Bell's palsy is a peripheral facial nerve paralysis is the most common damage to the cranial nerves. The weakness of facial nerve damage results in muscle weakness on one side of the face. It may be idiopathic facial palsy, also called Bell's palsy is an acute disorder of the facial nerve, This may result in either complete or partial paralysis of movement on one side of the face and begin as mastoid pain symptoms. The main cause of Bell's palsy is the reactivation of latent herpes simplex virus type in the cranial nerve ganglia. The other most frequent causes of secondary peripheral facial weakness are systemic viral infection, tumors, immune disorders, drugs, degenerative diseases of the central nervous system, etc[7]

In addition to facial muscle weakness, patients may present with altered facial sensation, post-auricular pain, hyperacusis, vestibular dysfunction, and pharyngeal symptoms. Some patients also exhibit disorders of lacrimation and salivation.[5]

When the patient is examined physically, the afflicted eyelid cannot be tightly closed or raised. The lips may also be dragged toward the unaffected side, and the nasolabial fold is usually missing. Individuals with a mouth that is too difficult to close may drool from the side that is impacted.[2]

NEED OF THE STUDY

Bell's palsy, characterized by facial nerve dysfunction, results in compromised physical function and voluntary movement loss, leading to facial asymmetry and the development of involuntary mass movements over time. Given the impact on physical appearance and non-verbal facial expressions, the psychological effects can be profound. Therefore, there is a critical need to address facial asymmetry and reduce mass movements in individuals affected by Bell's palsy.

A recent study found no significant difference between low-level laser therapy and electrical stimulation in improving facial symmetry and function among patients with acute Bell's palsy and limitations found in previous studies are:

· Pilot study cannot be generalized due to the small sample size.

· Objective assessment by electrophysiological tests like nerve conduction studies and electromyography were not done.

Thus, this study focused on the comparison of low-level laser therapy versus electrical stimulation of facial disability and synkinesis in subjects with acute Bell's palsy.

AIM OF THE STUDY

The aim of the study was to compare the effect of low-level laser therapy (LLLT) versus electrical stimulation (ES)on facial disability and synkinesis in subjects with acute Bell's palsy (BP).

OBJECTIVES OF THE STUDY

To evaluate the pre and post values of Nerev conduction velocity (NCV), Strength duration curve (SD curve) and facial disability index (FDI).

MATERIALS & METHODOLOGY

Treatment couch, Chair/stool, Laser, Electrical stimulation pen electrode, Talcum powder, Tape

METHODOLOGY:

Study Design: A randomized controlled study.

The subjects were randomly assigned to receive Group-A LLLT and Electrical Stimulation along with facial massage and facial exercise and Group-B ES along with facial massage and facial exercise lottery method was used for allocating the subjects of the groups.

Study Duration: 3 weeks

Sample Collection And Study Setting: Subjects with acute Bell's palsy from Neurology out patients and College of physiotherapy, Sri Venkateshwara Institute of Medical Sciences, Tirupathi were recruited in the study.

Sampling Method: Simple random sampling.

Sample Size: 30 samples.

Inclusion Criteria

- Subjects includes both genders
- Age group above 18 years
- Subjects with acute Bell's palsy were taken
- Unilateral Bell's palsy was included in this study

Exclusion Criteria

- Subjects with sensory loss over the face.
- Subjects who had undergone recent head and neck surgery.
- Subjects with recent trauma to the face.
- Subjects with implants around the head and neck area.
- Subjects with recurrent facial nerve palsy.
- Subjects with UMN palsy.
- Subjects with CNS disorders like MND GBS, and tumors.
- Subjects with ram say hunt syndrome.
- Subjects below 18 years of age are not included in this study

After explaining the detailed procedure of the study, written informed consent documents duly signed by the subjects were obtained. Pre-evaluation was done for the subjects in Groups A and B and they have undergone the intervention for 3 weeks Post values evaluation was done by using nerve conduction velocity, facial disability index, and strength-duration curve.

OUTCOME MEASURES

Facial Disability Index (FDI)

The facial Disability Index (FDI) was used to assess facial function. It is a patient-rated instrument with two subscales, where each measures the physical function and social well-being of the subject. The FDI comprises five items (with a scoring range of 0–5) to evaluate the physical function and an additional five items (with a scoring range of 0–6) to evaluate the social function. The overall score for each division is between 0 and 100, with 100 denoting the highest level of disability and 0 denoting no disability.

Each subscale's construct validity and reliability (social function = 0.83; physical function = 0.88) have been determined.[8]

Strength -Duration Curve

Strength – Duration Curve (SD) -The plotting of the strength duration curve indicates the strength of impulse of various durations required to produce contraction in a muscle. It is easy and consistent. It shows the percentage of denervation. It cannot indicate the site of the nerve lesion.

Rheobase

When stimulus is given using the maximum pulse width available on the stimulus, the intensity of the current required to produce a twitch is called rheobase.

Chronaxie

- The smallest pulse width necessary to cause a twitch at twice the rheobase intensity is referred to as the muscle chronaxie.[9]
- The strength-duration curve's 11 pulse durations had interrater coefficients of correlation ranging from r =.979 to r =.771 (mean r =.945). The Interrater reliability coefficients (mean r =.541) varied from r =.850 to r =.394. At p <.01, both mean coefficients were statistically significant.[10]

Nerve Conduction Velocity (NCV)

Measurements of the nerve conduction velocity seem to offer such as possibility though it is little used in the assessment of the facial nerve

Study Protocol

Subjects in Group A(the experimental group) were treated with low-level laser therapy along electrical stimulation, facial exercise, and facial massage, for one hour Low-Level Laser Therapy was given for10 minutes, ES was given for 30 minutes, facial exercises was given for 10 minutes, facial massage for 5 minutes and Group B (the control group)were treated with electrical stimulation, facial exercise, and facial massage for one-hour electrical stimulation was given for 40minutes,facial exercises was given for 10 minutes, facial massage for 5 minutes

ELECTRICAL STIMULATION FOR BOTH GROUPS

Patients in group A and group B were treated with electrical stimulation facial exercises, and facial massage.

Electrode Placement

The inactive electrode was placed over the nape of the neck. The active electrode was placed over the motor points.

Electrical stimulation was given for three sets of 30contactions over 11 motor points of the face

Frontalis, Corrugator supercilia, Orbicularis oculi, Levator labii superioris, Levator anguli oris, Risorius, Orbicularis Oris, Depressor anguli Oris, Depressor labii inferioris, Levatormenti

Galvanic Current

- Using a Galvanic current of a frequency of 30Hz
- The pulse duration was set at 100milliseconds with the inter-pulse interval of 0.3 milliseconds
- While the intensity was kept at a level where a minimal visible contraction was obtained

Faradic Current

- Faradic current was used at 50Hz frequency with a pulse duration of 0.7milliseconds
- Stimulation for the nerve trunk was given in 3 consecutive sets, with each set consisting of 30 contractions.[11]

Facial Exercises

During each session, subjects were asked to perform facial exercises in front of the mirror.

Table-1 Facial Exercises

Intervention Mirror Exercises	Frequency	Rational
Eye-closing and opening exercises	5 reps every hour	Improve lubrication of the eye to decrease eye dryness and strengthen the eyelid muscles.
smile, eyebrow raise, frown, pucker lips, scrunching face	10 reps 3 ties daily	Exercises to help Strengthen facial muscles.
Mouth Blowing and puffing exercises with straw and balloon	10 reps 3 times daily	Exercises to help Strengthen facial muscles

Sessions were held, 6times per week over 3 weeks. Patients were also instructed as to the correct practice of facial expression exercises. Balloon blowing and chewing gum on the paralyzed side were also recommended for all the patients.[12]

FACIAL MASSAGE

The massage technique was given initially in a supine lying position which includes

- Effleurage
- Kneading with fingers and thumb
- Stroking
- Tapping.

Each technique was given for 10 minutes with intervals of five minutes [13]

Group A –Low-Level Laser Therapy {LLLT}

Bell's palsy can be effectively treated with non-invasive and painless laser therapy. This therapy is suitable for all patients, including those with diabetes and hypertension who cannot take medication.

Low-Level Laser Therapy (LLLT) is used to reduce tissue healing time, edema, swelling, discomfort, and inflammation. It is believed that Low-Level Laser Therapy works by inhibiting the release of histamine and bradykinin - two inflammatory chemicals that trigger the body's inflammatary response. It is believed that laser stimulation primarily works to reduce inflammation by decreasing prostaglandin activity. Prostaglandins cause blood vessels to widen at the site of inflammation, which allows inflammatory cells to enter surrounding tissue and promote healing. Low-Low-level laser therapy (LLLT) is a useful treatment for peripheral nerve inflammation, repair, regeneration, axonal growth, and myelination. Specific dosages of Low-Level Laser Therapy have been suggested for nerve inflammation disorders such as trigeminal neuralgia, carpal tunnel syndrome, and Bell's palsy. Its depends on the wavelength, pulse duration, pulse/energy, energy density, and delivery method, laser therapy has varying effects on different tissues, as previously discussed. Studies of laser dose response suggest that different wavelengths have specific penetration abilities and subsequently different effects on tissue.[14]

Laser Parameters

• LLLT was provided using tech lasers-1000 by Techno med Electronics. These points are irradiated with a laser probein direct contact with the superficial roots of the facial nerve.

Table- 2 Parameters Of Laser

manufacture	Dotor smile
Model identifier	wiser
Type of emitter	Diode GaAl-As
Hand piece	AB-2799 Flat – top
Wavelength	808nm
Pulse mode	Continuous – wave
Power	1w
Power density	1w/cm
Energy	60J
Fluence	60J/cm
Exposure duration	60s
Beam sport size at target	1cm
Irradiation mode	contact
Point irradiated per session	7
Energy irradiated per session	420J/7points

STATISTICALANALYSIS & RESULTS

The statistical analysis was performed using the "SPSS 20.0 version software. The data was first entered into a Microsoft Excel spreadsheet, tabulated, and then subjected to statistical analysis.

All 30 participants completed the study protocol within three weeks of treatment sessions. The demographic data was analysed using the chi-square test. Paired t-tests were used for within-Experimental group analysis, whereas unpaired t-tests were used for between-Experimental group analysis

To determine the effectiveness of the treatment, a t-test was used for both the experimental group and between-experimental group analysis, with outcome measures of Nerve conduction velocity, Facial disability index, and Strength-duration curve.

Data Collection

Pre-evaluation was done for the subjects in Groups A and B and they have undergone the intervention for 3 weeks Post values evaluation was done by using nerve conduction velocity, facial disability index, and strength-duration curve.

Table 3: Comparison Of Pre And Post Values Group-A And Group-B Subjects

Synod	Outcome Measures		Group-A Pre-test Mean ± SD	Group-A Post-test Mean ± SD	t - Value P - Value	Group-B Pre-test Mean ± SD	Group-B Post-test Mean ± SD	t - Value P - Value
1.	NCV		1.96± 0.61	3.61± 0.37	T= 9.312 P= 0.000	1.88± 0.506	2.6± 0.413	T= 3.503 P= 0.001
2.	FDI	Physical	44.8± 13.4	83.3± 8.81	T= 16.32 P=0.000	46± 15.376	82± 9.445	T = 15.691 P= 0.000
		Social	72.5± 15.27	93.3± 8.06	T = 6.956 P= 0.000	69± 14.390	89±7. 768	T= 5.803 P= 0.000
3.	SD CURVE	Rheobase	3.33± 1.67	7.66± 2.16	T= 15.17 P= 0.000	2.84± 1.509	7± 2.070	T= 1.49 P= 0.000
		Chronaxie	20.4± 26.3	0.53± 0.40	T= 2.95 P= 0.002	15.6± 15.173	8.03± 0.401 9	T= 3.911 P= 0.002

Data expressed as mean±SD

Table 2 shows Both groups received the intervention of group A (experimental group) low-level laser therapy (LLLT)with electrical stimulation (ES), facial massage, and facial exercises, and group B (control group) received electrical stimulation (ES) facial massage and facial exercises mean changes in Nerve conduction velocity, Facial disability index, Strength duration curve.

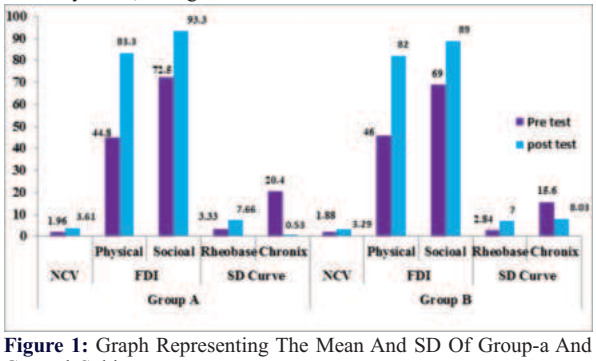

Figure 1: Graph Representing The Mean And SD Of Group-a And Group-b Subjects

The result was found Comparison of both groups group A is more significant p>0.000 than Group B except SD curve p>0.001.

DISCUSSION

The human face holds paramount importance both functionally and emotionally, significantly influencing self-concept and aesthetics Bell's Palsy (BP).

The purpose of this study was to compare the effects of low-level laser therapy (LLLT) with electrical stimulation (ES) on facial disability and synkinesis in individuals with acute Bell's Palsy. A total of 30 subjects participated and were randomly assigned to either a control group (ES treatment) or an experimental group (LLLT, ES, facial exercise, and massage). Both groups received the facial exercise and massage treatments for three weeks. After comparing the results, the experimental group showed significantly greater improvement in the Facial Disability Index (FDI) with a p-value of 0.000, as well as in the Nerve Conduction Velocity (NCV) and strength-duration Curve (SD) with p-values of 0.000 and 0.001, respectively.

The combination of Low-level laser therapy (LLLT) and Electrical Stimulation (ES) offers a multifaceted approach to addressing nerve damage and muscle dysfunction, particularly evident in conditions

such as Bell's palsy. Low-level laser therapy acts through photo biomodulation, accelerating nerve regeneration by stimulating cellular proliferation and enhancing microcirculation. It also promotes muscle mass improvement and facilitates the rapid myelination of regenerated nerve fibers. Additionally, Low-level laser therapy exerts anti-inflammatory effects, reducing cytokine levels and increasing anti-inflammatory factors, thus aiding in tissue healing.

Electrical stimulation initiates nerve sprout formation, enhances axonal regeneration, and preserves myelination by Schwann cells, crucial processes for nerve recovery. Moreover, Electrical Stimulation prevents muscle atrophy and maintains the contractile properties of facial muscles, preparing them for re-innervation and eventual voluntary movement restoration.

In 2021, a study was conducted by M. Javath, Arnold D. Fredrick D'Souza, and Sydney Roshan Rebello on 25 participants who were randomly assigned into two groups. One group received low-level laser therapy (LLLT), while the other group received electrical stimulation (ES). All participants underwent 12 treatment sessions over a period of 2 weeks. Facial symmetry was measured using the Sunnybrook Facial Grading System (SFGS), while facial function was assessed using the Facial Disability Index (FDI). The study concluded that both treatments were equally effective in improving facial symmetry and function in acute Bell's palsy patients. Therefore, there was no significant difference in effectiveness between low-level laser therapy and electrical stimulation.

In 2023, Poornachitra et al conducted a study on 104 cases of Bell's palsy. The data was retrospectively collected over two years. The study concluded that Nerve Conduction Studies (NCS) should be included as a mandatory assessment protocol for Bell's palsy cases. This is because it helps in quantifying nerve degeneration and serves as a prognostic tool during treatment.[15]

Therefore, result showed that significant improvement in Low-level laser therapy with Electrical Stimulation in Facial disability in synkinesis subjects with acute Bell's palsy.

CONCLUSION

The present study concluded that the potential therapeutic effects of Low-level laser therapy along with Electrical Stimulation were found to be more effective compared to Electrical Stimulation alone on facial disability and synkinesis in subjects with acute Bell's palsy.

LIMITATION AND RECOMANDATIONS

1. The 3 months follow-up period is limited, thus long term follow up is advised.
2. Large sample size is recommended.

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