International Journal of Yoga, Physiotherapy and Physical Education
Online ISSN: 2456-5067; Impact Factor: RJIF 5.24
www.sportsjournal.in
Volume 2; Issue 3; May 2017; Page No. 29-32

Effect of physical therapy on electromyography and nerve conduction velocity on early prognosis of Bell's palsy

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Abstract
Background: Bell's palsy is a facial paralysis of acute onset presumed to be due to non-suppurative inflammation of unknown etiology of facial nerve within its canal above its stylomastoid foramen. Bell's palsy accounts to be one of the most common cause for unilateral infranuclear facial weakness.
Purpose: The purpose of this study was to find out the effect of physical therapy on early prognosis of Bell's palsy.
Methods: An experimental study of 30 participants with the age group of 18-40 years was conducted. Electromyography and nerve conduction velocity was taken on 3rd, 7th and 14th day of physical therapy treatment for all the participants. All the participants received conventional treatment; Electrical stimulation, Facial massage, Facial PNF and specific facial exercises in front of mirror. Interrupted galvanic stimulation will be given on motor points of paralyzed muscles. Conventional treatment was given for 1 hour a day, 6 days a week for 2 weeks.
Results: Reading was calculated on 3 different days; co-efficient of variation of frontalis muscle on 3rd,7th and 14th day were 2.234, 1.916 and 1.682 respectively, for orbicularis occuli muscle on 3rd, 7th and 14th day were 1.439, 0.826 and 0.421respectively and for orbicularis oris muscle on 3rd,7th and 14th day were 0.996, 0.929 and 0.875 respectively. And Nerve conduction velocity for 3rd, 7th and 14th day were 8.533 ± 1.961, 6.466 ± 2.080 and 3.8 ± 1.730 respectively.
Conclusion: This study concluded that there is effect of physical therapy on electromyography and nerve conduction velocity on early prognosis of Bell's palsy.

Keywords: bell's palsy, EMG, NCV, physical therapy, prognosis

1. Introduction

An anonymous quote states that, "How can you face the problem, if the problem is your face?" Bell's palsy is a facial paralysis of acute onset presumed to be due to non-suppurative inflammation of unknown etiology of facial nerve within its canal above its stylomastoid foramen [1]. Bell's palsy accounts to be one of the most common causes for unilateral infranuclear facial weakness. It is the most common diagnosis given for acute facial palsy (>60%) and it causes peripheral facial neuropathy that tends to be unilateral and has a rapid onset. There is an equal male to female ratio and a 3.3 times greater incidence in pregnant females. The left and right sides of the face are equally involved, and less than 1% of cases are bilateral. The recurrence rate is about 10% and can be ipsilateral or bilateral. Patients with diabetes have 4 - 5 times more risk of developing this disease. A family history is positive in about 10% of patients with Bell's palsy [2]. This is the most frequent cranial mononeuropathy with an annual incidence of 10 to 40 cases per 100,000 population with geographical variations. It is the most common cranial infranuclear mononeuropathy which was first described by NA Friedreich in 1797. It is named after Sir Charles Bell (1774–1842) who described the syndrome along with the anatomy and function of the facial nerve [3]. Internationally, the highest incidence was found in a study in Seckori, Japan, in 1986, and the lowest incidence was found in Sweden in 1971. Most population studies generally show an annual incidence of 15-30 cases per 100,000 people [4]. It accounts for 60 to 75% of all cases of unilateral facial paralysis and the peak incidence occurs between the second and fourth decades (15 to 45 years) with males and females equally affected. The median age of onset is 40 years, but the disease may occur at any age [5]. Causes for the Bell's palsy are, microcirculatory failure of the vasonervorum, viral infection, ischemic neuropathy, autoimmune reactions, surgicalprocedure such as local anesthesia, tooth extraction, infections, osteotomies, preprosthethic procedures, excision of tumors or cysts, surgery of TMJ and surgical treatment of facial fractures and cleft lip/palate. The signs and symptoms include sudden onset of paralysis of muscles of facial expression, drooping of corner of mouth, decreased nasolabial fold, forehead is without furrowing, drooping of eyebrows, due to paralysis of orbicularis occuli the palpebral fissures is wider on affected side and closure of eye is impossible. When patient attempts to close his/her eye, eyeball moves upward and slightly inward. This is called as Bells phenomenon [6]. Various electro-diagnostic tools which are used for the diagnosis of Bells palsy, are Electromyography (EMG), Electroneurography (ENoG), Nerve conduction velocity (NCV) and Strength duration curve (SD-curve).Electromyography and Nerve conduction velocity are commonly use for the diagnosis of Bell's palsy [7]. Electromyography (EMG) is a quantitative test that measures action potentials produced with volitional muscle movement. Normal contraction is signaled by diphasic

or triphasic waveforms, fibrillation connotes degeneration, and polyphasic potentials indicate reinnervation. Electromyography is of limited value early in the evaluation of facial paralysis because fibrillation potentials indicating axonal degeneration do not appear until 10 to 14 days post onset. However, EMG becomes important for assessing reinnervation potential of the muscle two weeks after onset. By using surface electrodes placed transcutaneously into the muscles of facial expression, muscle action potentials generated by voluntary activity can be recorded. Electrical silence can indicate normal muscle in a resting state, severe muscle wasting and fibrosis or acute facial paralysis in the early stages. During normal voluntary contraction organized diphasic or triphasic potentials are seen. Fibrillation potentials indicate degeneration of the neural supply to the muscle in question. Polyphasic potentials indicate reinnervation. These are important because they usually appear 6 - 12 weeks before clinical return of function. It is generally obtained if ENoG displays more than 95% degeneration [8]. Electrophysiological tests may offer valuable information in defining the severity of nerve injury and possible subsequent dysfunction. For these reasons, these tests could be significant prognostic parameters [9]. Nerve conduction velocity (NCV) is another diagnostic tool used to determine the facial nerve dysfunction. Alford (1967) stated that nerve excitability studies are useful 72 hours after the onset of paralysis. Campbell *et al*. (1962), Laumans (1965), and Leclaire *et al*. (1975) correlated nerve excitability tests with the rate of recovery [10].

Bell's palsy can be treated under medical, surgical, and physiotherapy management. Medical treatment given for Bell's palsy is usage of steroids such as prednisone 1mg/kg/d up to 70-80mg. This is commonly tapered after 5-7 days, although treatment may be extended if no improvement is seen [11]. Surgical intervention such as Decompresion surgery of facial nerve is done most commonly. Indication for surgery was based on the theory of swelling and entrapment of the facial nerve in the bony fallopian canal [12]. The options available for physical therapy management for Bells palsy are.

1) Electrotherapy
2) Neuromuscular retraining
3) Manual massage
4) Kabat rehabilitation [13].

Recent advances like Mime therapy and Video-self modelling are also used [12, 14].

Materials and Methods

An Experimental study on 30 participants (19 males, 11 females) using convenient sampling was done. Participants diagnosed with Bells palsy with age group of 18-40 years were included according to inclusion and exclusion criteria. The inclusion criteria for this study were both male and female participants, clinically diagnosed with Bell's Palsy, unilateral Bell's Palsy with age group of 18-40years of age. And exclusion criteria were any neurological impairments, sensory loss over face and history of surgical intervention for Bell's Palsy. Conventional treatment (Electrical stimulation, Facial massage, Facial PNF and specific facial exercises in front of mirror) were given for 1 hour a day, 6 days a week for 2 weeks. Interrupted galvanic stimulation will be given on motor points of paralyzed muscles, 90 contractions was given to each muscle and intensity will be increased until minimal visible contraction of the muscle will be obtained. Facial massage which includes effleurage and kneading was given in upward direction for 5-10 min. It will be followed by facial PNF in which the therapist will facilitate the voluntary contraction of the involved muscle by applying a quick stretch, then resistance to that muscle and motivate the action by verbal commands and manual contact, for example the actions like raising the eye brows, nasal flaring, closing and opening of mouth, protrusion of lips etc. Then patients will be asked to do facial exercises in front of mirror for the visual feedback.

On the 3rd, 7th and 14th day of the treatment electromyography and nerve conduction velocity was noted. For the recording of electromyograhic changes muscles used will be frontalis, orbicularis occuli and orbicularis oris. For nerve conduction velocity electrodes was placed on upper and lower division of facial nerve. For the recording of electromyograhic changes muscles used will be frontalis, orbicularis occuli and orbicularis oris.

Results

Statistical analysis was carried out utilizing the trial version of Graph Pad Instat software and $p<0.05$ is considered as level of significance. Student's Paired' test and Co-efficient of variation was applied to analyze the data.

Table no-1 and Figure no-1 shows graphical representation of electromyographical changes of frontalis muscle on 3rd, 7th and 14th day. Co-efficient of variation of frontalis muscle on 3rd,7th and 14th day are 2.234, 1.916 and 1.682 respectively which suggest that less the value more significant is the recovery.

Table no-2 and Figure no-2 shows graphical representation of electromyographical changes of Orbicularis occuli muscle on 3rd, 7th and 14th day. Co-efficient of variation of orbicularis occuli muscle on 3rd, 7th and 14th day are 1.439, 0.826 and 0.421 respectively which suggest that less the value more significant is the recovery.

Table no-3 and Graph no-3 shows graphical representation of electromyographical changes of Orbicularis Oris muscle on 3rd, 7th and 14th day. Co-efficient of variation of orbicularis oris muscle on 3rd,7th and 14th day are 0.996, 0.929 and 0.875 respectively which suggest that less the value more significant is the recovery.

Table no-4 and Graph no-4 shows graphical representation of Nerve conduction velocity on 3rd, 7th and 14th day were 8.533 ± 1.961, 6.466 ± 2.080 and 3.8 ± 1.730 respectively and $p = 0.001$ which shows that result is extremely significant.

Discussion

This study evaluated the effect of physical therapy on Bell's palsy using the electromyography and nerve conduction velocity. The patients were evaluated on 3rd, 7th and 14th day of the physical therapy treatment. The result of the present study shows that there is extremely significant recovery in patients with Bell's palsy through physical therapy. According to electromyographic results there is extremely significant recovery in upper, middle and lower quadrants of the face. And according to nerve conduction velocity there was extremely significant recovery when amplitude differences between the contralateral sides were compared.

In the present study, results obtained from the electromyography suggests that there is extremely significant recovery in upper, middle and lower quadrants of the face after giving the conventional physiotherapy treatment. A study conducted by Fernanda Sassi *et al.*; concluded that the use of

modern scientific techniques of data analysis, such as the use of sEMG, combined with self-report measurements most certainly offers great promise to clinicians and their patients [11]. A similar study was conducted by Gordana Djordjević and Gordana Djordjević, used electrophysiological tests for defining the severity of the nerve injury and a possible subsequent dysfunction and they concluded that Clinical parameters in the early stage of Bell's palsy have a great diagnostic value, but they are not enough for the prognosis of the course of the illness. Electrophysiological tests are more significant in Bell's palsy since they may provide important quantitative information about an axonal damage degree [8].

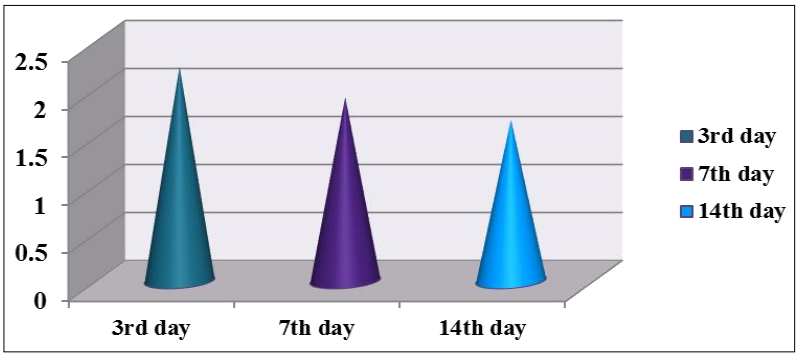
In the present study according to nerve conduction velocity there was extremely significant recovery when amplitude differences between the contralateral sides were compared. Nerve conduction studies, provides an objective quantitative assessment of facial nerve function, are potentially the most accurate method of assessing facial nerve degeneration. The amplitude of the CMAP represents the synchronous discharge of a group of facial muscle motor units resulting from supramaximal stimulation of the facial nerve. The reduction in amplitude of the CMAP on the affected side, when compared with the normal side is thought to reflect the number of fibres that have undergone Wallerian degeneration [15]. G. Djordjević, S. Djurić concluded in their study, almost all patients (41 out of 43) whose MEP amplitude values were between 11% to 100% compared to the healthy side had a complete recovery, but in different period of time. The correlative analysis of MEP amplitude and the length of the clinical recovery reveal a minor correlation during the first days of the illness, since the amplitude deviation was insignificant as well. The results observed on the fourteenth day of the illness show a strong positive correlation between the parameters we were monitoring [8].

Conclusion

The present study concluded that, the use of physical therapy on electromyography and nerve conduction velocity have great diagnostic value on early prognosis of Bell's palsy. The use of Electrophysiological tests in estimating the recovery can be useful for the clinicians for the prognosis of Bell's Palsy.

Table 1: Tabular representation of electromyographical changes of frontalis muscle on 3rd,7th and 14th day.

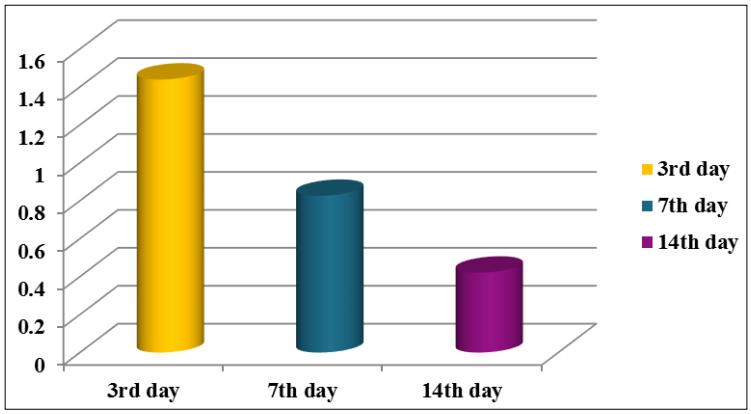
	3rd Day	7th Day	14th Day
Mean ±SD	260.033 ± 5.810	321.933 ± 6.170	360.233 ± 6.061
Co-efficient of Variation	2.234	1.916	1.682



Graph 1: Graphical representation of electromyographical changes of frontalis muscle on 3rd, 7th and 14th day.

Table 2: Tabular representation of electromyographical changes of orbicularis oris muscle on 3rd, 7th and 14th day.

	3rd Day	7th Day	14th Day
Mean ±SD	280.3 ± 2.793	339.76 ± 3.159	383.3 ± 3.354
Co-efficient of Variation	0.996	0.929	0.875



Graph 2: Graphical representation of electromyographical changes of orbicularis oris muscle on 3rd, 7th and 14th day.

Table 3: Tabular representation of Electromyographical changes of orbicularis occuli muscle on 3rd, 7th and 14th day.

	3rd Day	7th Day	14th Day
Mean ±SD	260.7 ± 3.752	323.566 ± 2.674	361.4 ± 1.522
Co-efficient of Variation	1.439	0.826	0.421

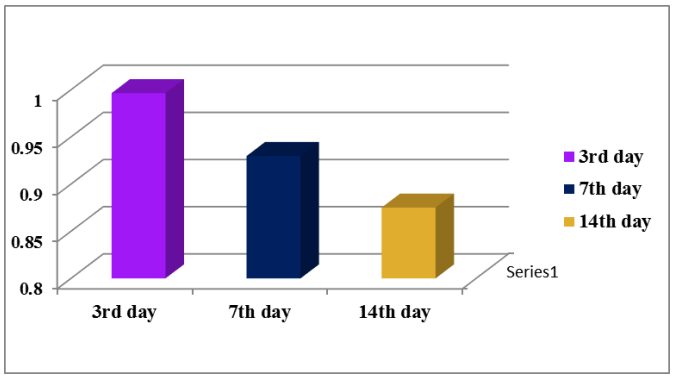


Fig 3: Graphical representation of Electromyographical changes of orbicularis occuli muscle on 3rd, 7th and 14th day.

Table 4: Tabular representation of Nerve conduction velocity (Amplitude Difference) on 3rd, 7th and 14th day.

	3rd day	7th day	14th day
Mean ± SD	8.533 ± 1.961	6.466 ± 2.080	3.8 ± 1.730

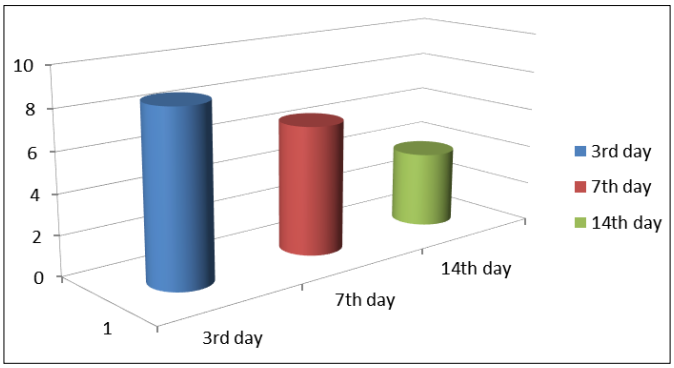


Fig 4: Graphical representation of Nerve conduction velocity (Amplitude Difference) on 3rd, 7th and 14th day.

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