

Effects of Electrical Stimulation in Early Bells Palsy on Facial Disability Index scores

ABSTRACT: Recovery following facial nerve palsy is variable. Physiotherapists try to restore function in patients with Bell's palsy. The choice of treatment modality depends on the stage of the condition. Although limited evidence exists for the use of electrical stimulation in the acute stage of Bell's palsy, some physiotherapists in South Africa have been applying this modality. This study examined 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. A two group pre-test post-test experimental design comprising of 16 patients with Bell's Palsy of less than 30 days duration was utilized. Patients with a clinical diagnosis of Bell's Palsy were systematically allocated to the control and experimental groups. Patients (n=16) were pre-tested and post-tested using the Facial Disability Index. Both groups were treated with heat, massage, exercises and given a home program. The experimental group also received electrical stimulation. The FDI of the control group improved between 17, 8% and 95, 4% with a mean of 52, 8%. The improvement in the experimental group ranged between 14, 8% and 126% with a mean of 49, 8%. Certain clinical residuals persisted in a mild form in both groups on discharge from the study. 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. A larger sample size, longer stimulation time or both should be investigated.

**Alakram P, MSc¹
Puckree T, PhD²**

¹ University of KwaZulu Natal

² Durban University of Technology

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INTRODUCTION

Bell's palsy is a neuromuscular disorder that is treated by physiotherapists. In addition to the range of modalities that are used to either promote recovery or prevent degeneration in the nerve and muscles, several tools assist in quantifying or documenting recovery. Some of the tools are clinician implemented and others require patient input. In busy clinical facilities patient administered tools may serve a useful purpose.

Although the prognosis for recovery following Bells Palsy has been reported to be good (Peitersen 2002) with two thirds progressing to full recovery within 3 months, in the remaining third of patients residual symptoms persist. Symptoms, which peak at about two weeks from onset, include inability to close the eye, tearing, drooling and facial pain.

Current evidence regardless of whether scientific or clinical anecdotal (Bell's Palsy Association of the United Kingdom) discourages the use of electrical stimulation in the early phase of Bell's palsy to prevent unintentional

damage to muscle fibers. Although electrical stimulation continues to be widely used, it may cause an increase of residual effects and delay regeneration of the facial nerve (Diels 2000). Farragher (1987) and Targan et al (2000) contradict these reports similar to Byers et al (1998) who reported that pulsed electromagnetic stimulation enhances early regeneration of the facial nerve.

Anecdotally, both newly qualified community physiotherapists as well as physiotherapists who qualified more than 20 years ago in South Africa, use electrical stimulation as a first line of treatment in Bell's palsy (Alakram- clinical experience). The effects of any treatment modality must be documented. It is not clear to what extent South African physiotherapists use measurement or assessment tools to document the outcomes of their treatments in Bells Palsy. Although there are several facial function reporting systems (House 1983) there is a lack of a globally accepted one. In 1984 the American Academy of Head and Neck Surgery adopted the House-Brackmann Facial Nerve Grading Scale

(House and Brackmann 1985). Although the House-Brackmann index showed high reliability against the "Sydney" and "Sunnybrook" facial grading systems in the assessment of voluntary movement and synkinesis, it was not sufficiently sensitive to changes in individual grades by different raters (Coulson et al 2005). The outcomes of electrical stimulation as quantified using the House Brackmann has been documented (Alakram and Puckree 2010). For a busy clinician a patient administered tool might be useful. The Facial Disability Index (FDI) is a tool that not only allows the patient to document changes in physical and social function but also quality of life. Since all therapy ultimately aims at

Corresponding Author:

Prof. T. Puckree
Faculty of Health Sciences
Durban University of Technology
Ritson Campus
70 Mansfield Road, Durban, 4000
South Africa
E-mail: puckreet@dut.ac.za

improving the quality of life of an individual, it seems appropriate to introduce the use of the FDI.

Therefore the primary purpose of this study was to quantify the effects of a program of electrical stimulation using the Facial Disability Index (patient self administered) in patients presenting with early Bells Palsy. This report will complement a paper accepted for publication in *Physiotherapy Theory and Practice* (Alakram and Puckree 2010) and one published in the *South African Journal of Physiotherapy* (Alakram and Puckree 2008).

METHODS

A two group, pre-test post-test experimental design was used. Patients referred to the physiotherapy department at the Port Elizabeth Hospital Complex which consists of 3 hospitals in the Eastern Cape, South Africa, made up the sample of convenience.

Patients diagnosed with Bell's palsy by a neurologist or an ear, nose and throat specialist were referred for physiotherapy. Patients were systematically (every second patient) allocated to the control and experimental groups respectively. Only patients with less than 30 days post onset of Bell's palsy were included to ensure intervention at an early stage. Patients who were pregnant, had pacemakers or any sensory impairment over the electrode placement area were not included, to ensure safety of patients during application of Transcutaneous Electrical Stimulation (TENS). Approval to conduct the study was obtained from the relevant Hospital Complex Ethics Committee, the University's Research Ethics Committee and the hospital manager. Following an educational session with each patient regarding the aims and objectives of the study using basic illustrations of the anatomy of the facial nerves and muscles the participant then read and signed the consent form in their preferred language.

The instruments and procedures used in the study included treatment modalities and assessment tools (Alakram and

Puckree 2010) are described in detail below. The researcher treated each patient in both the control and experimental groups with 5 minutes of heat, 10 minutes of massage and 10 repetitions of exercises three times a week. The experimental group was then treated with an additional 30 minutes of electrical stimulation of the facial muscles using a TENS unit. All patients were given an illustrated home exercise hand-out as described below. Each exercise on this sheet was thoroughly taught to the patient with instructions to do 10 repetitions of each exercise, three times daily. Patients kept a record of the number of exercises done daily as per record sheet. The average number of exercise sessions done daily was recorded on the data sheet to monitor patient compliance even though the rate was prescribed to them (Alakram and Puckree 2010).

Facial Disability Index

The Facial Disability Index is a patient self-reporting instrument for the assessment of disabilities in patients with facial nerve disorders. It holistically takes into account a patient's physical and social functional ability. The FDI physical functioning scale evaluates how Bell's palsy physically limits activities of daily living e.g. eating, drinking, speaking, brushing of teeth and the severity of eye tearing. The social functioning and well-being scale of the FDI assesses how the patient feels about this physical facial disability and deformity. The social functioning and well-being scale analyses the patient's mood, how the individual reacts to other people, how well they sleep at night and if they abstain from social activity as a result of Bell's palsy. This instrument has been translated into English, Afrikaans and isiXhosa for patient convenience. Van Swearingen et al (1996) established the reliability and validity of the FDI. The FDI subscales produce reliable measurements, with construct validity for patient-focused disability of individuals with facial nerve disorders (Beurskens et al 2003).

Hot Packs

Whitehall (Whitehall Manufacturing¹) myofacial thermal packs (58 cm long and not exceeding 70°C) were applied to both sides of the supine lying patient's face for 5 minutes (Shafshak 2006). Sensation was tested prior to application of the warm pack

Massage

After the facial muscles were pre-warmed, massage was applied for 10 minutes to both sides of the face and neck. The massage sequence included 30 seconds of simultaneous stroking over both sides of the face and neck, two minutes of circular massage using three middle fingers working from the centre to the outer face (Diels 2000). The researcher's gloved thumb worked on the inside of the cheek of the affected side of the face with 3 fingers to draw the tissues towards the mouth for 2 minutes. Deep pressure within the patients tolerance was used to clear any trigger points that were found. Effleurage applied for 2 minutes was followed by kneading, picking up and wringing to improve circulation, reduce involuntary contraction and mobilize the muscles for 2 minutes. The massage was concluded with 1 minute of hacking to evenly distribute the erythema and 30 seconds of stroking (Alakram and Puckree 2010).

Exercises

The exercise program as described by Segal et al (1995^{a, b}) in their facial retraining rehabilitation program was carried out in consultation with the physiotherapist. Exercises for muscles supplied by every branch of the facial nerve were included in the program. During every consultation with the researcher, the exercises as described below were repeated 10 times each to avoid fatigue (Diels 2000, Segal et al 1995, Henry et al 1999).

- bring your eyebrows together and downward as in frowning
- raise your eyebrows as in being surprised
- close your eyes gently and then tightly

1. Whitehall Manufacturing 2000 Operators Manual. USA: Whitehall Manufacturing Division 2000. 1415.

- flare nostrils by blowing out with your nose
- compress nostrils in a sniffing attempt
- smile closed mouth and then open mouthed
- attempt to whistle by puckering your lips and compressing cheek
- tighten you chin and neck to eventually pull your lower lip down to expose your lower teeth

Exercises were done to include both sides of the face using a mirror to promote symmetry and feedback. If there was overflow or abnormal movement coming in, the patient was asked to relax and try again with less effort.

A standard exercise handout in English, Afrikaans and isiXhosa was given to every participant on the initial consultation with the physiotherapist. Only four exercises were included in the handout to ensure effectiveness and patient compliance. These four exercises were also included as part of the weekly clinic visit to reinforce the home program. Diels (2000) outlined short exercise sessions (8-10 repetitions of 4 exercises) with 2 to 3 daily sessions suggesting that quality of exercise was more important than quantity. The exercises included in the home program were taught to the patients on the initial treatment and reinforced at consequent treatments. Patient compliance to the home program was monitored using a data sheet.

Electrical Stimulation (Alakram and Puckree 2010)

The EV-803 Digital SD T.E.N.S. (Everyway Medical Instruments Co., Ltd.) was used for electrical stimulation of the facial muscles. The settings of the TENS unit were chosen to mimic the natural action of the facial muscles. Facial muscles are made up of predominantly slow postural fibres with a firing rate of about 6-12Hz (Kit-Lan, (1991). Farragher et al (1987) and Mann et al (2000) used a 10Hz and 10Hz to 40Hz pulse respectively in their stimulation regime to the facial muscles. Both studies reported return of facial symmetry and facial muscle activity in the chronic Bell's palsy sufferer. Therefore in this study the researcher used a pulsed setting and frequency of 10Hz, a pulse width/

duration of 10 microseconds to recruit mostly motor fibres similar to Farragher et al (1987) and Targan et al (2000). The intensity used was determined on the first consultation of the patient. This was achieved by stimulating the unaffected side to see what intensity was needed to obtain a minimally visible contraction of the muscles targeted. The stimulation produced visible muscle twitching on the paralysed side.

Muscles stimulated were targeted to enhance functional activities e.g. eye closure (frontalis or obicularis oculi), oral control (orbicularis oris) and learning to minimize asymmetrical facial expression (zygomaticus major). Other studies (Farragher 1987), Targan et al (2000) and Mann et al (2000) have chosen similar muscles in their stimulation of patients with chronic facial palsy. Once baseline intensity was established from the unaffected side, the same intensity was applied to the affected side of the face in consequent treatments. Each motor point was stimulated separately for 10 minutes to avoid synkinesis and the total electrical stimulation time at each treatment session for a patient in the experimental group was 30 minutes (Beck et al 1993).

In this study the following precautions were taken to avoid skin irritation: (a) Hypo-allergenic Lifecare electroconductive gel was used (b) the TENS unit was not used for more than 30 minutes at a time to prevent the electrode from drying out, as well as muscle fatigue (c) each patient had their own set of electrodes which were thoroughly cleaned with a sterile Webcol swab between treatments to maintain hygiene, and sensation was tested.

To ensure that the study was conducted in the acute phase, the researcher continued treatment for a maximum of 3 months post onset of Bell's palsy or until the patient reached a minimum of 80% on the House-Brackmann Facial Nerve Grading Scale.

Data sheet

Each patient had his/her own data sheet where the same physiotherapist recorded pre and post-test ratings of the FDI scale. The data sheet also made provi-

sion for all possible extraneous variables that was thoroughly analysed to ensure validity of the data.

DATA ANALYSIS

Data analysis was conducted under supervision of a statistician using SPSS version 11.0 for Windows. All data were normalized using the initial pre-test values as standard. This helped to reduce variability. The baseline values of the FDI and the number of weeks to recover differed among subjects. Therefore standardization to calculate the rate of recovery for a subject was calculated as follows: For the FDI: If a subject went from 58% to 100% recovery in 8 weeks. Therefore the percentage rate of recovery = $(100-58)/8 = 5,25$ per week. A subject who made the same recovery in 4 weeks will have a recovery rate = $(100-58)/4 = 10,5$.

To analyse the differences between the experimental and control groups with regard to a) Days from onset of Bell's palsy until subject commenced medication, b) Days from onset of Bell's palsy until subject commenced physiotherapy, c) Recovery rates for the FDI Scale, all pooled data were subjected to the Mann-Whitney tests. The Mann-Whitney U test is a non-parametric test that makes no assumption of the distribution of data and is used to compare two independent groups of sampled data. This test uses the ranks of data rather than their raw values to calculate the statistic. The probability was set at $p \leq 0,05$. The main purpose of this study was to quantify the effects of electrical stimulation through analysis of the differences between the experimental and control groups, therefore all pooled data were subjected to Mann-Whitney tests. In addition the Levene's Test was used to test for equality of variances for the FDI data.

RESULTS:

As shown in Table 1, 16 participants completed the study. Twelve subjects were excluded either because they refused to participate or did not comply with the once weekly treatments regimen. Both groups were very similar in terms of the different extraneous variables analysed (Table 4).

Table 1: Demographics information of participants in the study (n=16)

Different groups	Blacks	Whites	Asians	Side of Bell's palsy (%)		Gender (%)	
				Left	Right	Male	Female
Experimental (N=8)	4	2	2	50	50	62.5	37.5
Control (N=8)	7	1	0	37.5	62.5	37.5	62.5
Total Sample (N=16)	11	3	2	43.7	56.2%	50	50

Table 2: Individual recovery rates (%) using the FDI

Group	Individual Recovery Rate per week								Average Rate of recovery
	1	2	3	4	5	6	7	8	
Control N=8	5,0	7,07	4,81	5,86	7,95	6,63	4,44	4,52	5.79
Experimental N=8	5,25	6,56	4,88	7,66	3,69	5,94	10,25	4,83	6.13

Table 3: Mann-Whitney tests for FDI recovery rates (Ranks)

	N	Mean rank	Sum of Ranks
Control	8	8.13	65.00
Experimental	8	8.88	71.00

The majority of the participants were Black. The sampling resulted in more female participants in the control group and more males in the experimental group. More participants had a right-sided Bells Palsy.

The number of days from the onset of Bell's palsy until they commenced either their medication or physiotherapy was not significantly different between the experimental and control groups. All patients consulted the doctor either on the same day of onset of Bell's palsy or at a maximum of 2 days later and there was no statistical difference between the groups with regard to the time that elapsed from onset of Bell's palsy to starting the medication. The time from onset of Bell's palsy until the patient had their first session of physiotherapy was an average of 14± 3days in the experimental group and an average of 12± 3 days in the control group. Although the average is slightly higher in the experimental group, data analysis showed no statistically significant difference between the 2 groups on baseline.

Prescription of medication was standardized within ethical limits namely prednisone (2mg per kg daily and weaned off within 2 weeks), those with eye problems were given eye drops and those with pain were given Panados. The occupational profile of the subjects could not be standardized. Regardless of the fact that 100% of the subjects spoke English either as a first or second language an interpreter was available for those subjects who spoke English as a second language.

The average number of daily exercise sessions completed by the control (2.4 sessions) and experimental (2, 3 sessions) was very similar. Subjects decreased the number of daily exercise sessions if recovery appeared to have stagnated i.e. their grading on the FDI or the House-Brackmann Facial Nerve Grading Scale (Alakram and Puckree 2010) remained the same for a few weeks.

Two subjects from the experimental group (subjects 2 and 5) had a history of Bells palsy suffered 3 and 2 years ago respectively. Both subjects recovered

fully within 2-3 months from onset. One subject in the control group developed Bell's palsy 22 days post caesarean section, 25% of the entire sample was hypertensive and 19.7% was diabetic. The comparison of individual recovery rates for the FDI (Table 2) indicates that the mean rate of recovery in the experimental group was higher than that of the control group. This is clinically significant as shown by the Mann-Whitney (Table 3) tests sum of ranks despite not reaching statistical significance.

Table 4 shows the statistical data for age of participants, weeks to recover from onset of bells Palsy, first and final reading on the FDI in percentage, rate of recovery per week and compliance to exercise in average number of times per week. It is clear that the mean age is similar for the control and experimental groups but the wide standard deviation suggests a wide age range in both groups as shown in the table. Overall recovery is clinically significant.

Average rate of recovery per week on physical functioning was 7, 93% for the

Table 4: Summary of data for the group

Group	Age (Years)	Weeks to recover from onset of bells palsy	FDI first %	FDI last	FDI rate of recovery per week %	Compliance to Exercise (Times per week)
<u>Control</u>						
Mean	41,37	9,12	48,93	98,6	5,79 (52,8%)	2,42
Sd	16,49	3,14	11,89	1,28	1,31	0,38
Minimum	21	4	37	97	4,44 (17,8%)	1,86
Maximum	68	12	72	100	7,95 (95,4%)	2,83
<u>Experimental</u>						
Mean	38,63	8,13	52,51	97,91	6,13 (49,8%)	2,34
Sd	17,75	2,9	10,21	2,79	2,05	,36
Minimum	11	4	35	93	3,69 (14,8%)	1,71
Maximum	67	12	62	100	10,25 (126%)	2,80
<u>Total</u>						
Mean	40,00	8,63	50,72	98,26	5,96 (51,4)	2,38
Sd	16,61	2,96	10,86	2,13	1,67	0,36
Minimum	11	4	35	93	3,69 (14,8%)	1,71
Maximum	68	12	72	100	10,25 (126%)	2,83

(Sd =standard deviation)

control group and 7, 85% for the experimental group. As far as social functioning was concerned, recovery was 6, 05% in the control group and 6, 25% in the experimental group. There was no significant difference found when comparing the individual recovery rates between the experimental and control group on these 2 scales.

In the entire sample, 11 out 16 subjects had pre-test values that were higher on the social functioning and well-being scale as compared to the physical functioning scale of the Facial Disability Index. Also 11 subjects reached their highest score on the social functioning and well-being scale faster than the physical functioning scale. Therefore it can be concluded that in the FDI, patients recovered faster on the social functioning and well-being scale as compared to the physical functioning scale.

No statistically significant difference in the prevalence and severity of clinical residuals between the experimental and control groups was observed. Hence electrical stimulation during early Bells

Table 5: Prevalence of common clinical residuals in the sample on discharge from the study.

Clinical residual	Proportion of participants %		
	Control (n=8)	Experimental (n=8)	Total (n=16)
Synkinesis	62,5	50	56,25
Tearing	50	50	50
Crocodile tearing	25	37,5	31,25
Zygomatic droop	75	62,5	68,75
Post paralytic hemi-facial spasm	50	50	50

Palsy has no impact on the prevalence and severity of clinical residuals in patients with acute Bell's palsy. As shown in Table 5, some common clinical residuals persisted in a mild form in a proportion of participants in both groups.

DISCUSSION

Despite trying to recruit subjects over a period of more than 1 year, the available population for this study remained low. Previous studies, Targan et al (2000) had 17 subjects, only 12 of who were Bell's palsy sufferers; Farragher (1987)

had 40 subjects. Another factor that may have affected the availability of potential participants was the inclusion factors. Only patients in the early phase of Bells Palsy (less than 30 days post onset) were included. Attrition was supported by a lack of compliance to the treatment regimen which was one of the conditions for participation in the study. Some patients could not commit to the program because it affected their ability to work, while others could not afford the travel costs or leave their dependants alone to come for weekly treatments.

The experimental and control group were similar at baseline with regard to the patient's age, number of weeks he/she took to recover, average number of exercise sessions done as per home program and the number of days from onset of Bell's palsy until the patient commenced with medication and physiotherapy as shown in Table 2. The mean age of the sample in this study was 40 years and this fell close to the range of the mean age of Bell's palsy sufferers as obtained from the literature i.e. 42-43 years, (Farragher et al, 1987, Coulson et al, 2005)

Based on his experience, Diels (2000) encouraged rest and discouraged the use of vigorous treatment and electrical stimulation during the first 2 weeks of onset, as it would cause severe clinical residuals. In our study electrical stimulation, exercise, heat and massage commenced on an average of 2 weeks post onset, allowing the patient to rest and reach his/her peak of spontaneous recovery in the initial 2 weeks.

The patient compliance to exercise was similar in both groups (2.42 and 2.34 times per week in the control and experimental groups respectively, Table 4). The studies conducted by Targan et al (2000), Farragher et al (1987) and Gittens et al (1999) were heavily reliant on patient compliance yet the authors made no mention of how the home programs were controlled to ensure patient compliance, thus the confidence in the data of these studies can be questioned.

The FDI like the House-Brackmann Facial Nerve Grading Scale (Alakram and Puckree 2010) showed no significant differences in recovery rates between the experimental and control groups. However the individual rates of recovery in the experimental group were higher than that of the control group and this suggests clinical significance. These findings are interesting especially because the FDI was patient self administered while the House Brackmann was investigator administered. A larger sample size may provide a clearer indication of significant differences in recovery rates following electrical stimulation in the early phase of Bells Palsy. On the other hand physiological explanations for the discouragement of

electrical stimulation during the early phase of Bells Palsy may be proven correct by the results of this study. The clinical improvement in recovery rates from 48, 93% to 98, 6% in the control group and from 52, 51% to 97, 91% in the experimental group makes it impossible to determine whether the improvement was due to spontaneous recovery or due to the physiotherapy intervention. However, the data seem to confirm that the electrical stimulation program was safe and did not interfere with recovery since no deterioration in patient function occurred.

The fact that some clinical residuals were still present but mild at discharge in both groups may also suggest either some spontaneous recovery or the effects of "suggestion" as a result of attending treatment sessions. The fact that clinical residuals did not deteriorate may refute the suggestion that electrical stimulation in the early phase of bells Palsy may not be beneficial.

CONCLUSION

On the small sample tested, electrical stimulations during the acute stage of Bells Palsy showed clinical improvement in FDI rate of recovery similar to that of the House-Brackmann scores (Alakram and Puckree, 2010). However the sub-motor electrical stimulation did not deter such progress. Therefore it can be concluded that the application of TENS in the acute stage of Bells palsy is at best, safe and doesn't interfere with recovery, but is indistinguishable from spontaneous recovery.

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