Electric Stimulation Versus E.M.G. Biofeedback on Grip Force of Chronic Hemipleagia

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ABSTRACT

Twenty four male stroke patients participated in this study. All patients were randomly divided into to two equal groups. The first group was treated by electric stimulation together with proprioceptive neuromuscular facilitation (P.N.F.). The second group was treated by EMG biofeedback plus the same P.N.F. patterns as the first group. All patients were treated for six weeks, five days/week, and were evaluated twice, prior to the treatment session and at the end of the treatment program in terms of measuring the grip force of the affected hand in pounds by the vigorimeter machine. The results showed significant improvement in the grip force for all patients of both groups at 0.05 level of significance. Although the improvement of the first group was better than that of the second group, but there was no statistically significant difference between the two groups. The results proved evidence that the hand grip force will be better improved when more than one physical therapy technique is used in the treatment.

INTRODUCTION

No doubt that Hand grip force affection or impairment following cerbro-vascular accident (CVA) is one of the main problems for the patients with chronic CVA. It restrict many of the functions of the hand of those patients. Hammond[7] reported that the most important factor in restricting the functional activity of the hand is co-contraction of the antagonist (extensors) and impaired recruitment of the agonist (flexors). This cocontraction is the resultant of spasticity. In this aspect many trials have been done to improve the function of the hemiplegic hand by using different techniques, as EMG biofeedback by Basmajian[4,5], and positional feedback with electric stimulation by Bowman[6]. Also, Alfieri[1] reported that low-intensity electric stimulation of wrist extensors had been shown to reduce flexor spasticity. On the other hand Kriz[13] mentioned that feed back-based training of grip force may be a useful enrichment of motor therapy, and Inglis[9] mentioned that EMG biofeedback may be a useful adjuvant in combination with other physical therapy modalities. Lord and Hall[14] reported that the neuromuscular retraining techniques did not result in great improvement in functional status in stroke patients, than the traditional functional retraining. Also Basmajian[3] mentioned that it is unclear whether neuromuscular facilitation technique alone is efficacious, and that there is a consensus that current rehabilitation techniques are less

function in chronic CVA if the treatment contains only a single technique[3].

It was mentioned that biofeedback or electric stimulation are the common techniques involved in enhancing upper limb function in chronic hemiplegia, where feedback cues from electrically stimulated muscles may be even more effective than conventional EMG biofeedback training with audiovisual cues[12]. This is due to activation of more appropriate afferent pathway from joint and muscle receptors. Also, it was concluded that chronic stroke patient can achieve and maintain improvements in the upper extremity function when the physical treatment contains electric stimulation techniques with voluntary effort[12].

MATERIAL AND METHODS

Subjects:

Twenty four male volunteers participated in this study. They were randomly divided into two equal groups. The age of the first group ranged between [45 and 66] years with a mean value of 56±5.97, while the age of the second group ranged between [43 and 70] years with a mean value of 57.80±7.90. All patients were right handed and have mild spasticity according to (Ashworth s Scale)[2].

Instrumentation:

- Electric stimulation machine, (El tron-D 413) which have two electrodes (positive & negative).
- E.M.G. biofeedback machine (Myomed 432) which have four electrodes (each two electrodes were working together as a one unit).
- Wooden plinth (200 cm length - 60 cm height and 120 cm width).
- Wooden stool 60 cm height.
- The vigorimeter machine (The machine had the ability to measure the grip force in pounds, it has a rubber boll to be pressed by the affected hand) of the patient.

Treatment Methods:

Each patient was evaluated twice, prior to the treatment session and at the end of the treatment program, in terms of measuring the affected hand grip force in pounds by using the vigorimeter machine. The subjects were seated in front of a table, the evaluated arm was flexed at the elbow joint in a comfortable position and rested on the table. The affected hand grasped the rubber ball of the vigorimeter, while the patient was completely relaxed. Each patient was then asked to press maximally the rubber ball three continuous times with one minute rest in between press. The mean of the three readings was then recorded. At the end of the treatment program re-evaluation was done by the same way for all patients.

The treatment was given by the same physiotherapist five days weekly for six weeks with an average of 40 minutes per session. Each treatment session consisted of:

For the first group:

Twenty minutes faradic stimulation to the extensors of both wrist and fingers. After that the patient received the following two patterns of proprioceptive neuromuscular facilitation (P.N.F.) for another twenty minutes:

Flexion adduction external rotation with flexed elbow and extension abduction internal rotation with extended elbow, with more emphasis on hand.

For the second group:

E.M.G. biofeedback for twenty minutes applied to the affected hand. After that the patient received for another twenty minutes the same patterns of P.N.F. by the same way as the first group.

same patterns of P.N.F. by the same way as the first group.

Preparation of the subject:

The patient was positioned in the sitting position on a stool in front of a table while the affected arm was supported comfortably on this table. Following cleaning of the skin with alcohol and drying with sterile gauze pads. In order to insure consistent electrode placement in all sessions genitor violet was used repeatedly to mark placement site.

The technique of using faradic stimulation:

Two adhesive skin surface electrodes were placed over the specific area in the targeted muscles (extensors of both wrist and fingers of the affected hand). The intensity of the electric stimulation was ranged between 0.7 to 3 mA.

The technique of using E.M.G. biofeedback:

Four adhesive skin surface electrodes were placed over the specific area in the targeted muscles (two electrodes over wrist and fingers extensor & two electrodes over wrist and fingers flexor).

The technique of using proprioceptive neuromuscular facilitation (P.N.F.) patterns:

The patient was positioned comfortably either in supinlying on the plinth or in sitting position on the stool. The affected arm was free from any clothes. The physiotherapist applied the two patterns alternatively with regular short rest period in between. The two patterns were:

Flexion adduction - External rotation with flexed elbow. and
Extension - abduction - internal rotation with extended elbow.
with emphasis on the hand.

RESULTS

General characteristics of subjects:

Characteristics of subjects in both groups is presented in table (1), inspection of this table revealed that both groups were almost matched regarding the age and duration of illness.

Measurements of hand grip force:

The mean value of measurement of hand grip force before and after six weeks of treatment is presented in table (2) and illustrated in fig. (1) for the first group, and table (3) and fig. (2) for the second group. Inspection of table (2) and fig. (1) revealed that the mean value of hand grip force increased from 24.30 to 34 pounds with a percentage of 48%, the increment was statistically significant at 0.05 where the P. value was 0.023.

In the second group, inspection of table (3) and fig. (2) revealed that the mean value of handgrip force increased from 24.60 to 32.70 pounds with a percentage of 41.30%. The improvement was statistically significant at 0.05, where the P. value was 0.01.

In both groups marked increase in hand grip force was found in all patients, with no significant difference between both groups where the P. value was 0.42.

Table (1): General characteristic of both groups.

First Group			Second Group		
No. of patients	Age (years)	Duration of illness in months	No. of patients	Age (years)	Duration of illness in months
1	52	7	1	46	6
2	59	14	2	60	12
3	66	16	3	59	6
4	60	15	4	54	7
5	59	13	5	67	14
6	52	12	6	70	16
7	58	6	7	61	14
8	45	16	8	65	16
9	62	15	9	60	13
10	56	17	10	60	15
11	55	11	11	55	6
12	48	14	12	43	12
Mean	56	13.13	mean	57.80	11.40
S.D.	5.97	3.50	S.D.	7.90	4.03

Table (2): Statistical characteristics of first group.

Characteristic	Mean	Standard Deviation
Age	56	05.97
Duration of illness in months	13	03.50
Initial score of hand grip	24.30	12.50
Final score of hand grip	34	17.50
Difference	09.75*	03.70
Percentage	48	21.90

* Significant at 0.05 P-value 0.0229

Table (3): Statistical characteristics of second group.

Characteristic	Mean	Standard Deviation
Age	57.80	07.90
Duration of illness in months	11.40	04.03
Initial score of hand grip	24.60	10.50
Final score of hand grip	32.70	12.11
Difference	08.10*	02.10
Percentage	41.30	13.22

* Significant at 0.05 P-value 0.01

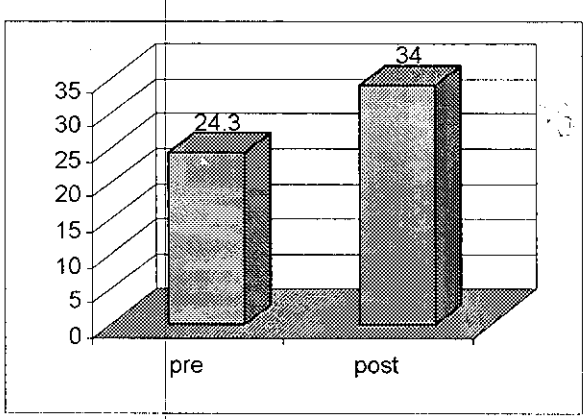

Fig. (1): The mean value of both initial and final score of hand grip of first group.

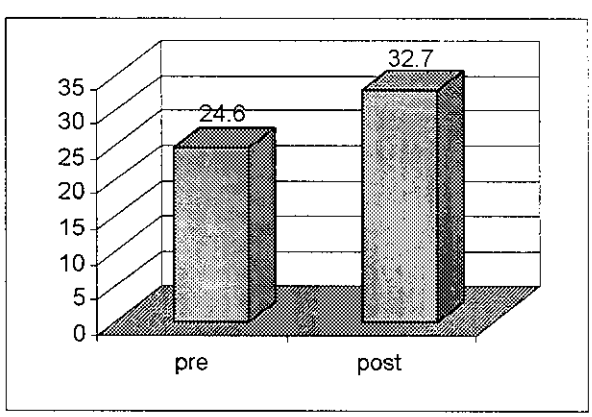

Fig. (2): The mean value of both initial and final score of hand grip of second group.

DISCUSSION

Faradic stimulation in conjunction with proprioceptive neuromuscular facilitation P.N.F. which were used in the treatment of the first group, and the E.M.G. biofeedback with the same patterns of P.N.F. which were used in the treatment of the second group, produced a significant increments in the hand grip force of all patients of both groups, who had chronic stroke. However no modality was superior over the other. These results appear to justify the opinions regarding the effectiveness of faradic electric stimulation, E.M.G. biofeedback and P.N.F. described in several studies. Alfieri[1] found that low intensity electrical stimulation of wrist and finger extensors can control spasticity of flexor muscles that persisted beyond the period of treatment.

Kraft[12] have theorized that low-intensity stimulation of upper limb extensor muscles combined with voluntary effort might improve muscle balance by reducing spasticity and enhancing the excitation of extensor muscles relative to flexors.

Basmajian[4] mentioned that E.M.G. biofeedback was effective method in treating stroke patients who were less than three months post stroke, or more than three months post stroke, provided that the stroke is less severe. In another study Basmajian et al.,[5] compared a program including E.M.G. biofeedback with Bobath technique, for patients post stroke one to twelve months. They found that there was a significant improvement in hand function which was maintained for all patients in both groups with more superiority to the E.M.G. biofeedback group with no significant difference between both groups.

Also Ince et al.,[8] found a greater improvement in hand function of stroke patients less than nine months post stroke with EMG biofeedback training than with traditional therapy, and they recommend its use for patients more than six months post stroke. Kraft et al.,[12] evaluated the effectiveness of P.N.F. on hand function of chronic stroke patients who were 12 to 17 months post CVA, and they found that the P.N.F. showed a limited improvement. Kriz et al.,[13] mentioned that the feed back based training of grip force may be a useful enrichment of motor therapy. On the other hand Kraft et al.,[12] reported that there was improvement of hand function following the use of different physical therapy modalities, but how much the improvement was due to the physical therapy modalities, and how much was due to the spontaneous neurologic improvement, was unclear. Jenkins and Merzenich[10] speculated that after cortical lesions a correspondingly greater capacity for reorganization would be expected in higher representations in the cortical hierarchy such as associational cortical areas. Jenkins et al.,[11] mentioned that re-mapping of cutaneous receptive fields is enhanced by repeated tasks that produce cutaneous stimulation of a limited sector of skin on the distal phalanges.

CONCLUSION

All these explanations support the concept of the importance of the role of brain plasticity in recovery from stroke.

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الملخص العربي

التنبيه الكهربائي في مقابل التغذية الحيوية العائدة وتأثيرهم على قوة قبضة اليد في الشلل النصفي الطولي المزمن

شارك في هذه الدراسة أربعة وعشرون مريضا متطوعا، تم تقسيمهم عشوائيا إلى مجموعتين متساويتين، ضمت كل منهم أثنتا عشرة مريضا. تم علاج المجموعة الأولى بالتنبيه الكهربائي بالإضافة إلى التسهيل العضلي العصبي الإستقبالي ، أما المجموعة الثانية فقد تم علاجها بالتغذية الحيوية العائدة بالإضافة إلى نفس تمرينات التسهيل العضلي العصبي الاستقبالى المستخدمة مع المجموعة الأولى. تم علاج جميع المرضى بالمجموعتين لمدة ستة أسابيع بمعدل خمسة أيام أسبوعيا، كما تم تقييم جميع المرضى مرتين الأولى قبل بدء العلاج والثانية في نهاية برنامج العلاج، وذلك باستخدام جهاز (الفيجروميتر).

أظهرت النتائج تقدما إيجابيا في قوة قبضة اليد لجميع المرضى في المجموعتين، بينما الفرق بين المجموعتين لم يكن إيجابيا. كذلك أثبتت النتائج أن تحسن قبضة اليد لمرضى الشلل النصفي الطولي المزمن ــ ممكن بشرط أن يستخدم أكثر من وسيلة علاج طبيعي واحدة مع كل مريض.