Laser therapy Versus Electrical Stimulation in Physical Treatment of Erb's Palsy

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ABSTRACT

Sixty Erb's palsy infants of both sexes were included in this study. Their age ranged from 27to 30 days. An initial evaluation was conducted on each infant to record the type of nerve lesion and the degree of muscle tone and volitional movements. The patients were randomly subdivided into three groups of equal number. The treatment program started after the initial evaluation and consisted of the following Laser therapy and exercise program for the first group (group A = 20 infants), Faradic stimulation and exercise program for the second group (group B = 20 infants), and only exercise program for the third group (group C = 20 infants) . The treatment sessions were conducted on three days per week bases over a period of five months. The sessions for group (A) consisted of Laser therapy for a period of 10 minutes and exercise program for 20 minutes. The sessions for group (B) consisted of faradic stimulation of the affected limb for 15 minutes followed by the same exercise program (as for group A) for 20 minutes. The sessions for group (C) consisted of the same exercise program for 20 minutes. The results showed a significant difference in all variables tested in favour of (group A) over (group B) and (group C).

INTRODUCTION

The word Laser is an acronym for Light Amplification by the Stimulated Emission of Radiation. It refers to the production of a beam of radiation which differs from ordinary light in certain typical characteistics.[25,15] Laser was successfully used for the first time in summer 1960 in the from of a ruby Laser . In 1963, it was used for the first time in medicine. Since then its application has spread to nearly all fields of medicine. Depending on the Laser medium there are now close to 200 different types. Laser had both physical and physiological effects.[8] Laser is considered nowadays as one of the most recent treatment modalities available to physiotherapists.[25] Laser therapy has the advantage of inducing no sensation of electrical current or pain. It is a non invasive method of treatment, easily accepted by the patients.[13] The use of low power Laser irradiation in the treatment of the injured peripheral nerves and spinal cords has been reported in a recent study[10]. Obstetrical brachial plexus injuries represent a unique group with similar etiology, age and prognosis.[6] It occurs at a frequency 0f 1-2 per

1000 live births.[2] The brachial plexus of an infants may be injured during a difficult delivery when a traction forces is applied to the head during delivery of the shoulder.[26,23] The severity of the lesion ranges from a physiological block to a complete avulsion of nerve roots. These children who are destined to a poor recovery can be identified in early infancy.[17] Thus, the treatment of peripheral nerves injuries has always constituted an important medical problem because, it is a very slow process and frequently incomplete, although clinical recovery eventually occurs[12]. Laser therapy might be used as a potentiating tool for spinal roots and peripheral nerves recovery, especially during the period of neural plasticity.[12] Also, because the Laser therapy effects persisted long after the irradiation, remarkable results had been reported in peripheral nerve regeneration and in accelerating the rehabilitation process[19].

SUBJECTS, INSTRUMENTATIONS AND METHODS

Subjects:

- Sixty infants with Erb's palsy (22 right and 38 left) were selected from the Out-patient Clinic of the Physical Therapy Department, El Sahel Teaching Hospital, Shoubra, Cairo.
- The patients included both sexes (30 males and 30 females).

All patients were selected according to the following criteria:

a- unilateral Erb's palsy.
b- age of infants should not exceed one month.
c- no other medical problems.

The patients were divided randomly into three groups (A,B and C) of equal number.

I. Instrumentations:

1. The Laser Equipment (Laser probe):- He- Ne→Ch 8965 Berikon,10 mW, 660.8 nm, 50 Hz, 220V. Germany.
2. Dynatron (438):- It is a low - frequency electrotherapy and electrodiagnosis apparatus. Pulse duration (0.01 - 100 msec.), Pulse interval (1-5000 msec.), Intensity (0-80 mA.), Italy.
3. EMG: (Amplaid EMG 12): two chanells: U.S.A.
4. Special scale:- Modified from the Scoring Sheet of Chandler (1980).

II. Methods

A- Evaluation:- EMG measurements were conducted on all patients to investigate the motor unit action potentials in the deltoid and biceps brachii muscles of the affected side at rest and on volition.

- Evaluation of electrical muscle activities was carried out three times throughout the study: before initiation of the treatment, at the end of the first three months and at the end of the suggested period of treatment (after five months).
- The tone of the muscle was assessed from supine position by moving the baby's arm in the different directions and was compared with the normal side. The recoil of both upper limbs was assessed. Tone was also tested in prone position while the baby was carried by his mother. Normally in the neonate, this is the position of maximum flexor tonus and the arms should strongly resist any attempt of extension.[21,22]. (Modified scale of Chandler 1980).
- The range of motion was assessed by carefully moving the whole arm through

abduction, elevation, flexion, extension and rotation; then, each joint was tested separately through its full range of motion.

- Muscle test was performed in the form of gross functional testing through using of tactile stimulation and scratching over the muscle belly either in a direct manner or in an opposite direction in order to force the baby to draw the affected limb away. (Modified scale of Chandler 1980).

B. Treatment:- The subjects were randomly divided into three groups.

* Group A: received Laser therapy and exercise program.
* Group B: received electric stimulation using the surged faradic current and exercise program.
* Group C: the control group which received exercise's program only.

Laser: -

- Each infant in the study group (Group A) received He - Ne (Laser probe) for a period of 10 minutes/ per session at the Erb's point.

Faradic Current:-

- Each infant in group (B) received surged faradic stimulation for all the affected muscles using bipolar technique.[1,4]
- One electrode was placed on the motor point of the muscle and the other electrode was placed on the same muscle or muscles group, a short distance away, close to the insertion (according to Kahan protocol). Faradic stimulation was applied for 15 minutes / session.

- A therapeutic exercise program was applied to all groups (A,B) & (C) for 20 minutes.

RESULTS

Comparisons were done between the mean values in the three groups using the ANOVA test to show statistical differences between all groups. This test was conducted for each one of the measured parameters, which included:

1- E M G measurements . 2- Muscle Tone 3- Volitional movements.

1- E M G measurements.

As shown from Table (1) and demonstrated in Fig. (1) before treatment of Group (A) the mean value of the deltoid muscle action potentials was 0.00 mV, which was increased after 3 months to be 1196.87± 101.94 mV. At the end of the treatment period (5 months), the total mean value of deltoid muscle action potentials recorded was 1727.50 ± 238.23 mV. The mean difference value between pre- post treatment period was 1727.50mV. Concerning group (B), the mean value of deltoid muscle action potentials was 0.00 mV before treatment and 709.38±306.37 mV after three months of treatment. At the end of treatment period (after 5 months), the mean value of deltoid muscle action potentials was 1143.75 ± 232.18 mV. Mean difference value between pre and post treatment period was 1143.75 mV. Concerning group (C) the results indicated no changes in the mean values of deltoid muscle action potentials after 3 months. However,at the end of treatment period, the mean value was 281.75 ± 140.84 mV forming a total mean difference of 281.7mV.

Table (1): Mean values and standard deviations of action potentials for deltoid muscle (mV) in all groups throughout treatment period.

Time	Group A		Group B		Group C	
	$\bar{X}$	S.D.	$\bar{X}$	SD	$\bar{X}$	SD
Pre ttt	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
After 3 months	1196.8	± 101.94	709.38	± 306.37	0.00	± 0.00
Post ttt	1727.50	± 238.23	1143.75	± 232.18	281.75	± 140.84
Mean diff. Post-pre	1727.50		1143.75		281.75	

$\bar{X}$: Mean S.D.: Standard deviation Mean diff.: Mean difference ttt: Treatment

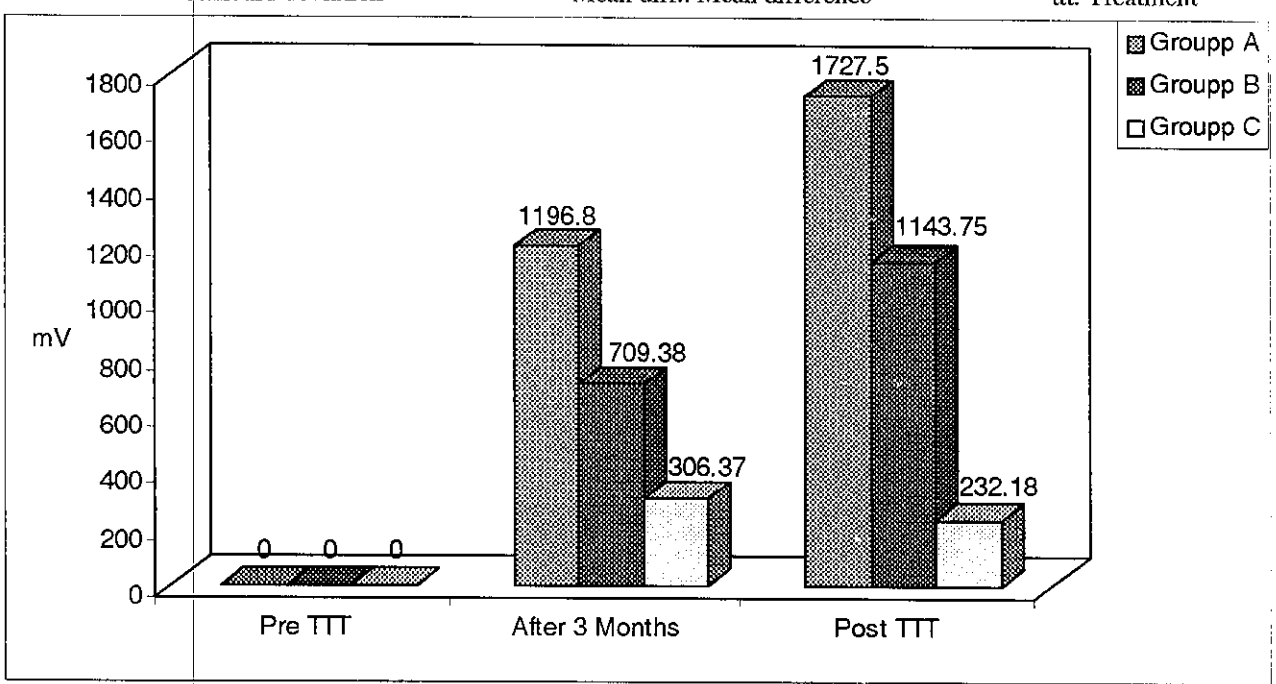

Fig. (1) Mean values and standard deviations of action potentials of deltoid muscle (mV.) in all groups throughout the treatment period.

As shown in Table (2) and Fig. (2), the mean value of the biceps muscle action potentials in group (A) was 0.00 mV before treatment. After 3 months, it was 1053.13 ± 146.61 mV and after 5 months of treatment (at the end of study) it was 1659.38 ± 215.05 mV. The mean difference between pre- post treatment period was 1659.38 mV. Concerning group (B),the mean value of the biceps muscle action potentials was 0.00 mV. After 3 months of treatment, it increased to be 146.61 ± 740.63 m V and at the end of treatment period (after 5 months), it was 1187.50 ± 206.79 mV. The total mean difference in biceps muscle action potentials at the end of 5 months was 1187.50 mV. The results of group (C) showed no significant changes in the mean value of biceps muscle action potentials after 3 months of treatment. After 5 months it was 318.5 ± 138.46 mV. The total mean difference was 318.5mV.

Table (2): Mean values and standard deviations of action potentials for biceps muscle (mV) in all groups throughout treatment period.

Time	Group A		Group B		Group C	
	X	S.D.	X	S.D.	X	S.D.
Pre ttt	0.00	± 0.00	0.00	± 0.00	0.00	± 0.00
After 3 months	1053.1	± 146.61	740.63	±332.14	0.00	± 0.00
Post ttt	1659.38	± 215.05	1187.50	± 206.79	318.50	±138.46
Mean diff. Post-pre	1659.38		1187.50		318.50	

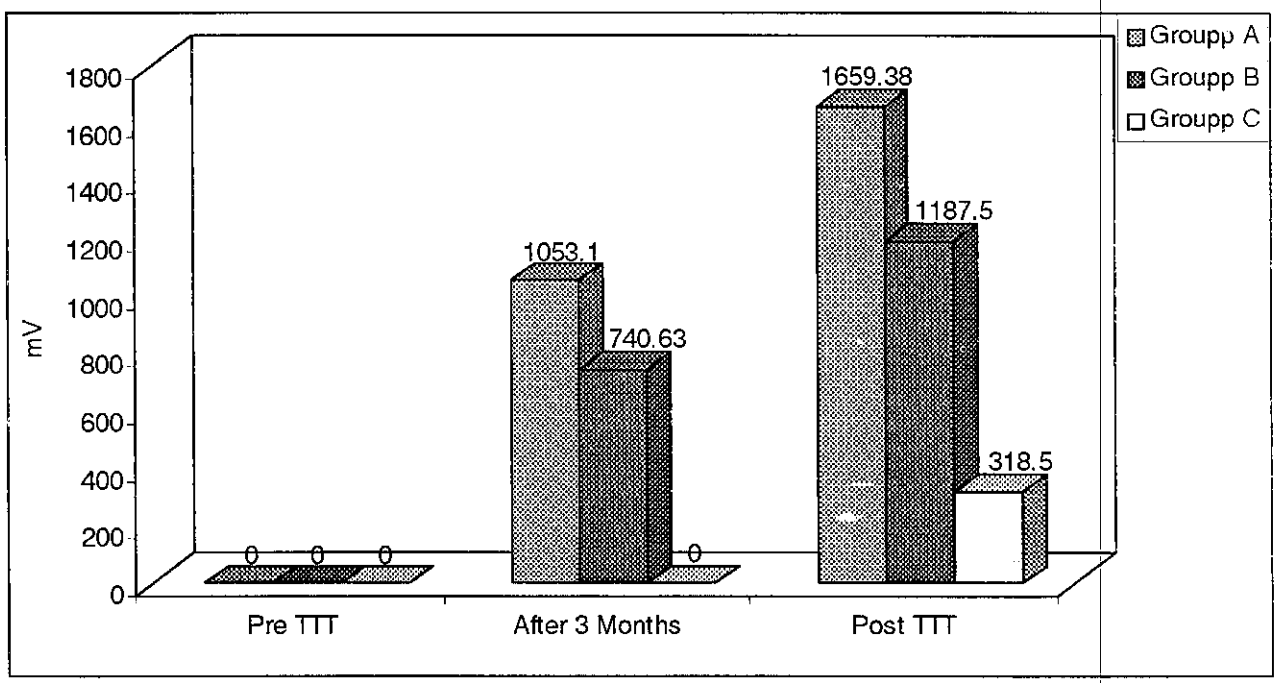

Fig. (2) Mean values and standard deviations of action potentials of biceps muscle (mV.) in all groups throughout the treatment period.

2- Muscle Tone.

Table (3) and Fig.(3) show that, the mean value of muscle tone (in degrees) in group (A), before treatment was 1.90 ± 0.31 degrees which increased after 3 months of treatment to be 3.15 ± 0.49 degrees, this was followed by additional improvement after 5 months of treatment to be 3.85 ± 0.37 degrees. The total mean difference between pre and post treatment values was 1.95 degrees. The mean value of muscle tone in group (B) before treatment was 1.7 ± 0.66 degrees which increased to be 2.25 ± 0.64 degrees after 3 months of treatment. Then it became 2.4 ± 0.5 degrees after 5 months of treatment (at the end of treatment period). The total mean difference during the whole period of treatment was 0.70 degree. The mean value of muscle tone in group (C) before treatment was 1.8 ± 0.59 degrees which decreased to be 1.75 ± 0.44 degrees after 3 months of treatment and changed to be 1.90 ± 0.41 degrees after 5 months of treatment. The mean difference value between pre- post treatment period was 0.1 degree.

Table (3) Mean values and standard deviations of muscle tone (degrees) in all groups throughout treatment period.

Time	Group A		Group B		Group C	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Pre ttt	1.900	± 0.31	1.700	± 0.66	1.800	± 0.59
After 3 months	3.15	± 0.49	2.25	±0.64	1.75	± 0.44
Post ttt	3.850	± 0.37	2.400	± 0.50	1.900	± 0.41
Mean diff. post-pre	1.95		0.70		0.10	

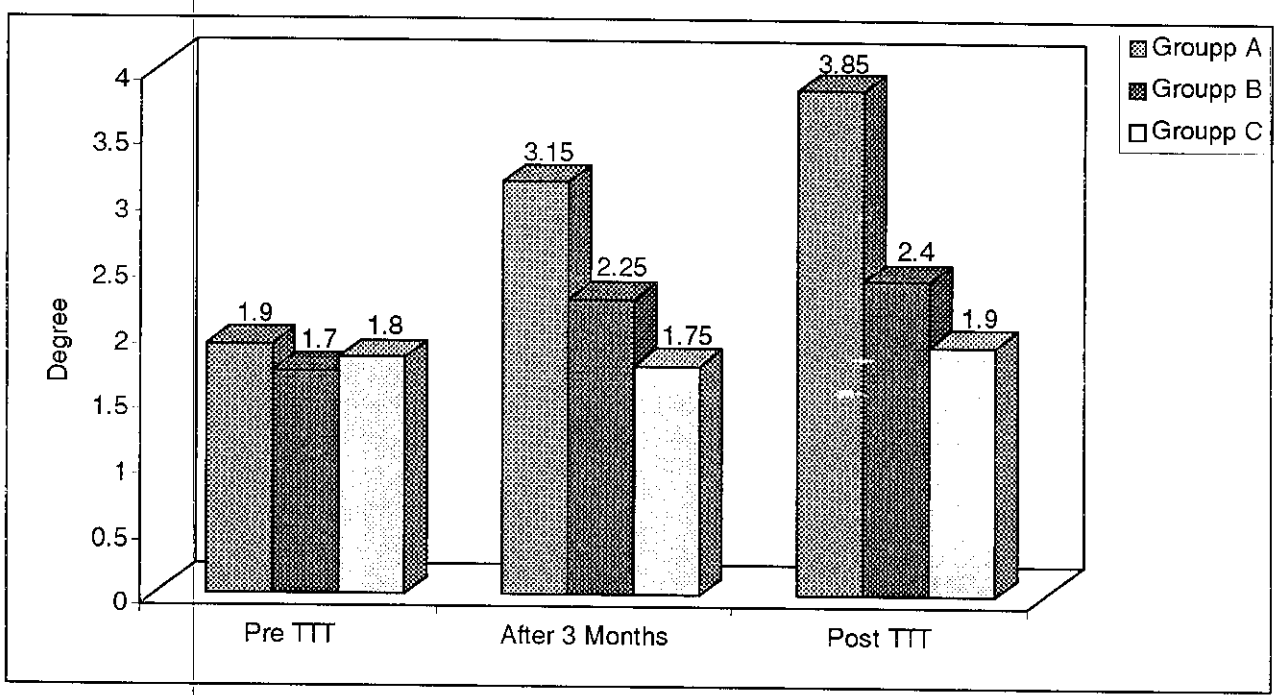

Fig. (3) Mean values and standard deviations of muscle tone (degrees) in all groups throughout the treatment period.

3- Volitional movements.

As show from Table (4) and Fig. (4), the mean value of volitional movements of group (A) was 0.00 degree which increased after 3 months to be 2.35 ±0.59 degrees. At the end of treatment period (after 5 months), it was 3.65 ± 0.44 degrees. The total mean difference in volitional movements was 3.65 degrees. Concerning group (B), its mean value was 0.00 degree which changed to be 1.4 ± 0.5 degrees after 3 months treatment. At the end treatment period (after 5 months), the mean value was 2.4 ± 0.5 degrees. The total mean difference between pre-post treatment period was 2.4 degrees. The results of group (C), showed that the mean value of volitional movements was 0.00 degree which had no change after 3 months of treatment.. Conversely, this mean value increased to be 1.25 ± 0.44 degrees after 5 months of treatment. The total mean difference is 1.25 degrees.

Table (4): Mean values and standard deviations of volitional movements (degrees) of all groups throughout the treatment period.

Time	Group A		Group B		Group C	
	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
Pre ttt	0.00	± 0.00	± 0.00	± 0.00	± 0.00	± 0.00
After 3 months	2.35	± 0.59	1.40	± 0.50	0.00	± 0.00
Post ttt	3.65	± 0.44	2.40	± 0.50	1.25	± 0.44
Mean diff. Post-pre	3.65		2.40		1.25	

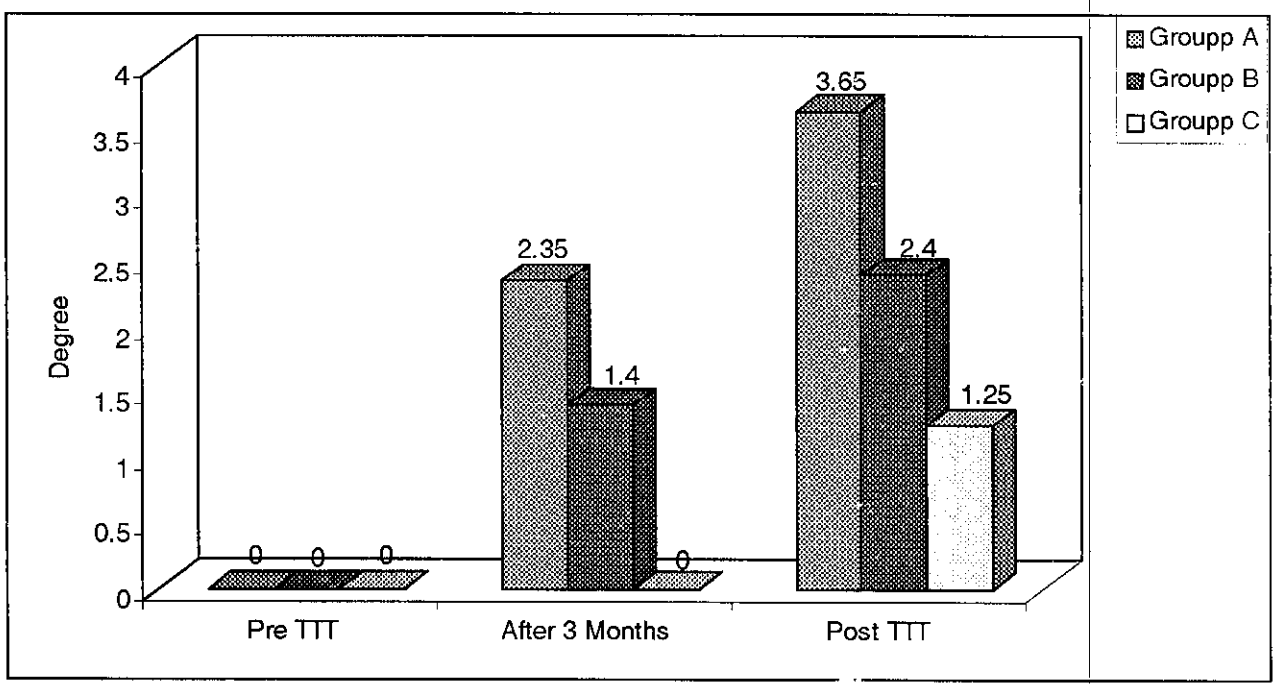

Fig. (4): Mean values and standard deviations of volitional movements (degrees) in all groups throughout the treatment period.

DISCUSSION

The results of the present study revealed significant change in the E.M.G. measurements of the deltoid and bicips muscles at the end of treatment period (5months) for group (A) as compared to group (B) and group (C) ($P < 0.01$) which indicated significant improvement in the group treated by Laser . On the other hand, the statistical results of both muscle tone and volitional movemensts of group (A) treated by laser showed significant difference ($P<0.01$) compared to group (B) which was treated by Faradic stimulation and group (C) which was treated by exercise program only. Proper management of peripheral nerve injuries depends on accurate localization of the lesion, a precise estimate of the extent of the lesion and careful choice of the treatment program. Researchers suggested that the morphophysiological state of nerve cells can

be influenced by radiation from a continues wave Helium-neon (He-Ne) Laser (wave length of 632.8 nm) of low power.[28] These results are in agreement with the present study in which there was acceleration in the growth of somatic nerves with exposure to He-Ne Laser radiation. Also as a result of a study on Laser-induced somatosensory evoked potentials, believed that the peripheral nervous system possesses a previously unsuspected degree of photosensitivity, which may provide rationale for therapeutic applications of low-power laser.[27] Several theories have been proposed to explain the He-Ne radiation effect on tissue healing. One theory is that the radiation causes a local temperature rise resulting in increased vascularization.[26] Another theory is that radiation causes an increase in ATP formation and in the number of cell mitochondria.[28] On the contrary , in another study on the effect of Laser irradiation on peripheral nerves. Krikorian et al,[14] claimed no difference between control and Laser-treated rats in the healing rate of bruised tissue. They reported the possibility that the method used for evaluating the experimental effect may not have been accurate.[14] Researchers reported the beneficial effects of irradiation on peripheral nerve regeneration, namely; the maintenance of the functional activity of the neuromuscular system, preventing scar formation and decreasing degenerative changes after nerve injury, thus accelerating the regeneration of the injuried peripheral nerve.[18] Electrical stimulation of innervated muscle continues to be a popular form of treatment, though stimulation of innervated muscle is less popular.[5] Certain research studies claim that denervated muscle is stimulated to maintain it in as healthy as the state possible while awaiting reinnervation.[16] Studies on the role of exercise program in such cases of Erb's palsy was to maintain normal muscle length and to stimulate active movement of the affected arm . For infants suffering motor disability, cmust be taken to encourage normal development.[21,22] Based on the results of the present study combination of Laser irradiation with routine exercises gave a marked improvements in the infants studied, both at the level of nerve regeneration from EMG measurements and in the motor function improvement as observed and measured according to a modified Scale of Chanlder (1980).

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الملخص العربي

مقارنة بين العلاج بالليزر والعلاج بالتنبيه الكهربائي في العلاج الطبيعي لحالات شلل أرب عند الأطفال

في هذه التجربة تم اختيار ٦٠ طفلا وطفلة من الأطفال المصابين بحالات شلل أرب الناتج عن حالات ولادة صعبه أو متعسرة لأسباب مختلفة بقسم العلاج الطبيعي بمستشفى الساحل التعليمي - شبرا - القاهرة (هيئة المستشفيات التعليمية) اختيار عشوائيا وتتراوح أعمارهم بين ٢٧ يوما - ٣٠ يوما . وقد تم أجراء الفحص الطبي الأولى والتشخيص بواسطة أطباء المستشفى المتخصصين فى الأطفال لتحديد نوع ودرجة أصابه العصب وقبل بداية الفترة العلاجية ومدتها خمسة أشهر تم فحص القدرة الحركية والعضلية بواسطة الباحثة ، كما تم قياس درجة الاستجابة الكهربائية للعضلات المصابة لكل طفل وطفلة على حدة وتم تسجيل البيانات فى الجدول المخصص لكل منهم : - فحص القدرة الحركية والعضلية ثم أجراءه بواسطة اختبار شاندلر ١٩٨٠. قياس وتسجيل درجة الاستجابة الكهربائية للعضلات المصابة تم قياسه بواسطة جهاز اختبار العضلات ، وعند أجراء التجربة تم تقسيم الأطفال المصابين بحالات شلل أرب إلى ثلاثة مجموعات كل منهم تتكون من عشرين طفل وطفلة. تم علاج أطفال المجموعة الأولى بأشعة الليزر لمدة ١٠ دقائق يتبعها تمرينات علاجية لمدة ٢٠ دقيقة بينما تم علاج أطفال المجموعة الثانية بالتنبيه الكهربائي مستخدمين التيار المتردد منخفض الجهد للعضلات المصابة لمدة ٢٠ دقيقة يتبعها نفس التمرينات العلاجية لمدة ٢٠ دقيقة . وتم علاج أطفال المجموعة الثالثة بالتمرينات العلاجية فقط (نفس التمرينات السابقة فى المجموعتين) لمدة ٢٠ دقيقة وقد تم تطبيق القياسات قبل بداية التجربة وبعد ثلاثة أشهر من بدايتها وفى نهاية مدة التجربة (خمسة أشهر). وقد كان هناك اختلافا واضحا فى نتائج القياسات بين تلك التى أجريت قبل بداية التجربة وفى منتصفها وبعد نهايتها إذ تحسنت القدرة الحركية والعضلية لجميع الأطفال المشتركين فى التجربة كما تحسنت درجة الاستجابة الكهربائية للعضلات المختلفة فى الذراع المصاب بشلل أرب . وبمقارنة مستوى التحسن فى المجموعات الثلاث، كانت هناك فروقا ذات دلالة إحصائية لصالح المجموعة التجريبية .