Effect of Electroacupuncture Current Modulation in Chronic Mechanical Low Back Pain

Maher A. El Keblawy PTD*; Wafaa H. Borhan PTD*; Fatma Sedik Ph. D. * and Omar Tawfik PhD.**

*Department of Basic Science, Faculty of Physical Therapy, Cairo University. ** National Institute of Cancer.

ABSTRACT

Electroneedling is a particular kind of therapeutic method in which a small electrical charge, similar to the bioelectricity of the human body, is applied via needles already in points where the acupuncture sensation (deqi) has already allocated. Modulation of vibratory stimulation may be produced by changing the frequency, amplitude or the wave form of electric stimulation. The aim of the present study is to investigate the effect of modulation of wave form of vibratory stimulus in electroacupuncture in chronic mechanical low back pain. Sixty volunteers with chronic mechanical low back pain participated in the present study. They were classified randomly into four equal groups. The first group (control) received sham electroacupuncture without stimulation. The second group received twelve sessions of electroacupuncture in acupuncture points using spike form of stimulation. The third group was treated by biphasic form of current stimulation of electroacupuncture. The fourth group received biphasic spike form of vilbratory stimulus of electroacupuncture. Assessment was done before and one month after treatment including assessment of pain using verbal numerical scale forward flexion (FF) using pleurimeter V-inlinometer and lumbo-sacral angle (LSA) through plain lumbar radiograph. The results of the study showed significant improvement in the fourth group in reducing pain (89.1%) increasing range of forward flexion (102.7%) and changes lambosacral angle (LSA) (29.7%). In the third group, the percentage of improvement in reducing pain, increasing range of forward flexion (FF) and changing LSA were (65.5%, 60.7% and 23.7% respectively), less improvement was observed in the second group (30.7%, 19.3% and 12.3%). On the other hand sham electro acupuncture only (control group) showed very little improvement. The present study concluded that Biphasic spike (G4), Biphasic (G3) and spike (G2) form of current in electro acupuncture can be recommended respectively to alleviate chronic low back pain as safe and potent method of pain relief.

INTRODUCTION

The pathogenesis of chronic mechanical type of low-back pain is poorly understood[5] and as a consequence of this both the manner in which the condition is investigated, and its treatment are far from being satisfactory[7,23,24]. According to Kitchens and Bazin the greatest obstacle to the rational of chronic low-back pain treatment is the difficulty of deciding, in any particular case, the primary source of the pain[16,23]. The main possibilities are that the pain comes either from degenerative changes in the intervertebral discs and facet joints, or from a disorder of the muscle[5,7,22,23]. Each of

these will therefore be considered in turn. The general consensus of opinion among those with much experience of using acupuncture in the treatment of chronic low-back pain is that it provides worthwhile symptomatic relief in about 70% of cases[19].

Jayasuriya and Mao-Liang et al.,[10,18] concluded that the only advantage of electrical stimulation, over manual stimulation when using acupuncture for a prolonged period, is that more conventient and less tiring for the person applying it will be obtained[10]. The effect of applying this type of low-frequency high-intensity acupuncture for a few specially selected traditional Chinese acupuncture points is suppressing surgically or experimentally induced pain and to raise the pain tolerance[8,10,18,19].

Acupuncture sensation is called "deqi" in Chinese, in which the patient feels with a combination of numbness, heaviness, slight soreness, and distension. Radiation of one or more of these sensations may also occur along the channel[10,18]. For acupuncture analgesia to be successful it is essential that adequate "deqi" is elicited.

Mao-Liang stated that application of acupuncture in low back pain is performed in the points around vertebrae or distal points from the affected areas[18]. From these points, Urinary Bladder (UB) 25, Its location, 5 cun lateral to the lower border of the spinous process of the 4th Lumbar Vertebra, (1 cun = The breadth of the distal phalanx of the thumb, measured by specially designed insterment of double callipers called cunometer). UB54, it's location is at the level of the fourth sacral foreamen, 3.0 cun lateral to the mid line. Extra (EX) 21 which are series of 28 points situated 0.5 cun lateral to the lower ends of the dorsal spine of the first lumbar to fourth sacral yertebrae and gall bladder (GB) 30 which is located by drawing a straight line between the highest point of the greater trochanter and the sacral haiatus. The point is situated at the junction of the outer third with the medial two-third on the line. Trigger points (Ah-shi) points may also be used[13,17,18].

According to Johnson et al., and Bowsher modulation of vibratory stimulus may interfere with the results of treatment[3,4,11]. It may be carried out by changing the, intensity, frequency and wave form[3,4,13,14]. Therefore changing the wave form of electroacupuncture may enhance the analgisic effect of acupuncture in chronic lumbar low back pain.

The most commonly produced waveform is a biphasic asymmetrical, balanced square wave. The area under the positive wave is equal to the area under the negative wave. No net polar effects are produced, preventing the build-up of long-term positive-negative ion concentrations beneath each electrode, or within the tissues[1,4,12,19]. Consequently, there are no adverse skin reactions due to polar concentrations.

Kahn and Bowsher studied Biphasic form of current, they concluded that these wave forms can be square, rectangular, sinewave, or traingular/spiked. In most instance, efforts are made to equalize the positive/negative phases to maintain either a net direct current component of zero or no electrochemical effect due to excessive polarity[4,15].

They also stated that rectangular sometimes referred to as a square wave, the rectangular form of current is usually descriptive of a direct current with a rapid instantaneous rise, prolonged duration, and sharp drop-off. When the duration equals the intensity (graphically), the term square wave is used[4,15].

The spike-wave current features a tentilike appearance in which the rate of rise is

rapid, but not instantaneous, falling back to zero rapidly immediately upon reaching maximum[4,11,12,15].

According to Altree and Baldry, the dense wave; can reduce the stressed functioning of the nervous system via, firstly, its inhibitive action on sensory nerves and, secondly, its inhibitive action on motor nerves[1,2]. They also concluded that dense-sparse wave; is a wave-form with the alternate appearance of dense waves and sparse waves, each of which lasts for about 1.5 seconds, thus avoiding the disadvantages of a single wave which can easily be adapted to by the patient[1,2]. Tulgor et al., Johnson et al., and Altree mentioned that it has a strong dynamic action it promotes the body's metabolism and the circulation of the energy and blood, improves the nourishment of the tissues and eliminates inflammatory oedema[1,11,13,22].

The aim of the present study is to investigate the effect of wave form modulation in chronic mechanical low back pain.

MATERIAL AND METHODS

Subjects

Sixty patients with chronic mechanical low back pain participated in the present study (35 female & 25 male). Their ages ranged from forty to fifty five years. They were recruited from 6th October Hospital and Cairo Metropolitan areas. All participants were selected to exclude any congenital abnormalities, structural discrepancy and any medical problems that may interfere with the results. Also the participants had no previous lumbar operation.

Participants were randomly classified into four groups of equal number:

G1: (Control group) participants received twelve sessions of sham electroacupuncture for 20 minutes.

G2: Participants received twelve sessions of electroacupuncture with spiky form of vibratory stimulus for 20 minutes.

G3: Participants received twelve sessions of electroacupuncture with biphasic-square-wave form of vibratory stimulus for 20 minutes.

G4: Participants received twelve sessions of electroacupuncture using biphasic spike wave form of vibratory stimulus for 20 minutes.

Material

- Verbal numerical scale (VNS).
- Plain lumbar spine radiograph.
- Acupuncture filiform type of needle (two cn in length).

Equipment

- Pleurimeter V. inclinometer.
- Cunometer.
- Electrical pulse acupuncture stimulator, with several wave forms.

Evaluation Procedure

Assessment was done before and one month after treatment. Verbal Numerical Scale (VNS) was used for assessment of pain. The patient was allowed to choose a number between 1-10, which represent his pain intensity.

Range of motion of lumbar spine: Forward flexion (FF). Patient was placed in stride standing position. The pleurimeter V-inclinometer was supported at the level of lumbar 4, lumbar 5 and adjusted on zero, while both sides of it's arms were kept in contact with spine through adjustable elastic band. The participant was instructed to lean forward to the limit of pain reading was taken from the pleurimeter V-inclinometer.

Measurement of LSA. From the lateral view of the plain lumbar spine radiograph,

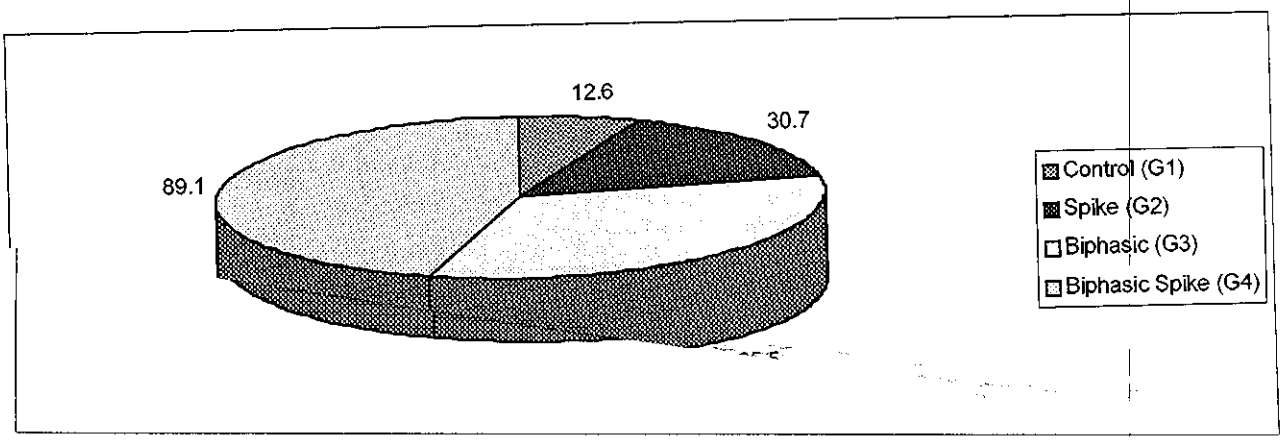

Fig. (2): Percentage of pain intensity reduction in four patients groups.

Forward Flexion

The table (2) and figs. (3 and 4) showed the mean and SD of forward flexion of the 4 investigated groups. Pre and post treatment was presented. As regard to the t-paired for the difference in the 4 groups. They were 2.9189, 2.8894, 10.2760 and 15.9436 in G1, G2, G3 and G4 respectively. Thus in group 1, percentage of change was 9.3 which is clinically insignificant. The percentage of change in the other three groups were 19.3, 60.7 and 102.7 respectively.

Table (2): Range of forward flexion in the four investigated group.

NO.	G1 (control)		G2 (spike)		G3 (biphasic)		G4 (biphasic spike)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	40	45	30	35	20	50	15	70
2	30	40	35	40	25	50	30	65
3	40	45	40	50	20	50	30	70
4	40	40	45	50	30	40	40	70
5	32	40	20	30	40	45	30	60
6	22	25	20	30	35	50	25	70
7	35	33	48	55	40	60	30	65
8	7	38	25	32	27	42	38	58
9	45	48	15	30	20	40	40	70
10	30	35	35	48	40	55	42	70
11	24	20	42	47	30	45	40	70
12	25	22	30	34	50	70	40	70
13	42	50	20	25	30	50	40	70
14	40	45	40	20	40	70	30	70
15	25	30	35	42	30	50	32	70
Mean	33.8	37.5	32.0	37.9	31.8	51.1	33.8	67.9
S.D+	7.5	9.4	10.2	10.4	8.9	9.3	7.5	4.0
T paired	2.9189		2.8894		10.2760		15.9436	
P	<0.01		<0.01		<0.001		<0.001	
% change	9.5		19.3		60.7		102.7	

SD= Standard deviation.
P= Probability.

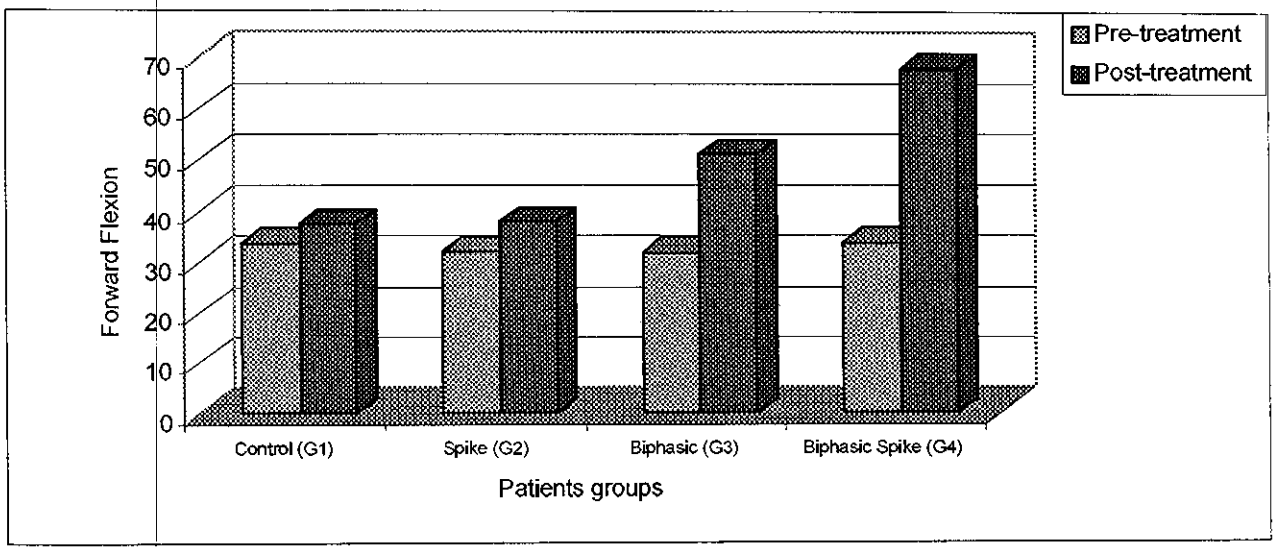

Fig. (3): Forward flexion assessment in the 4 investigated groups.

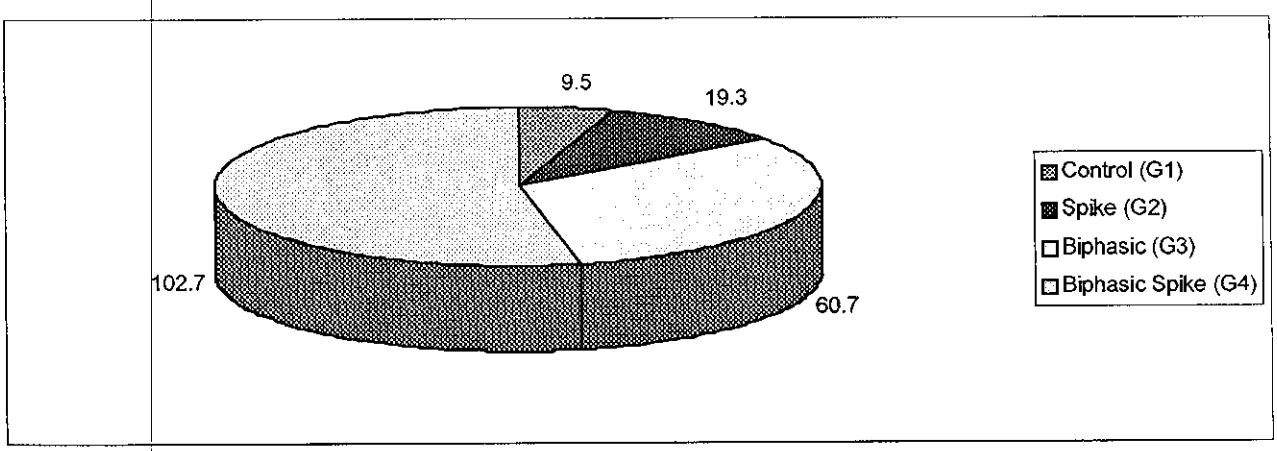

Fig. (4): Percentage of forward flexion increase in the 4 investigated groups after treatment.

L.S.A.

Table 3 and fig. (5 and 6) showed the mean and SD of LSA of the 4 investigated groups, pre-and post-treatment. As regard to the T-paired for the difference in the 4 groups, they were 2.353, 5.790, 17.486 and 14.534 in G1, G2, G3 and G4 respectively. In group 1 L.S.A. change was 4.3%. Although it is statistically significant, yet the change was clinically insignificant. The LSA was statistically and clinically improved in the other three groups. They were 12.3, 23.7 and 29.7 in G2, G3 and G4 respectively.

Table (3): Lumbosacral angle assessment in the four investigated groups before and after treatment.

NO.	G1 (control)		G2 (spike)		G3 (biphasic)		G4 (biphasic spike)	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	35	32	40	38	46	35	45	30
2	37	35	45	40	46	35	40	32
3	43	42	38	34	45	35	40	30
4	50	50	52	48	39	32	40	30
5	42	32	50	38	45	30	48	31
6	45	45	48	45	45	36	47	32
7	50	48	47	32	45	32	39	30
8	32	32	40	35	44	37	40	30
9	44	44	55	45	40	30	45	30
10	50	45	55	50	43	32	40	30
11	40	40	37	35	40	30	42	30
12	40	40	42	38	45	32	50	30
13	36	36	42	38	42	32	43	30
14	52	50	46	40	42	32	46	30
15	37	34	48	45	46	35	50	35
Mean	42.2	40.4	45.7	40.1	43.5	33.2	43.7	30.7
S.D+	6.3	6.4	5.8	5.5	2.4	2.6	3.9	1.4
t paired	2.3533		5.7909		17.4864		14.5344	
P	<0.02		<0.001		<0.001		<0.001	
% change	4.3		12.3		23.7		29.7	

SD= Standard deviation.
P= Probability.

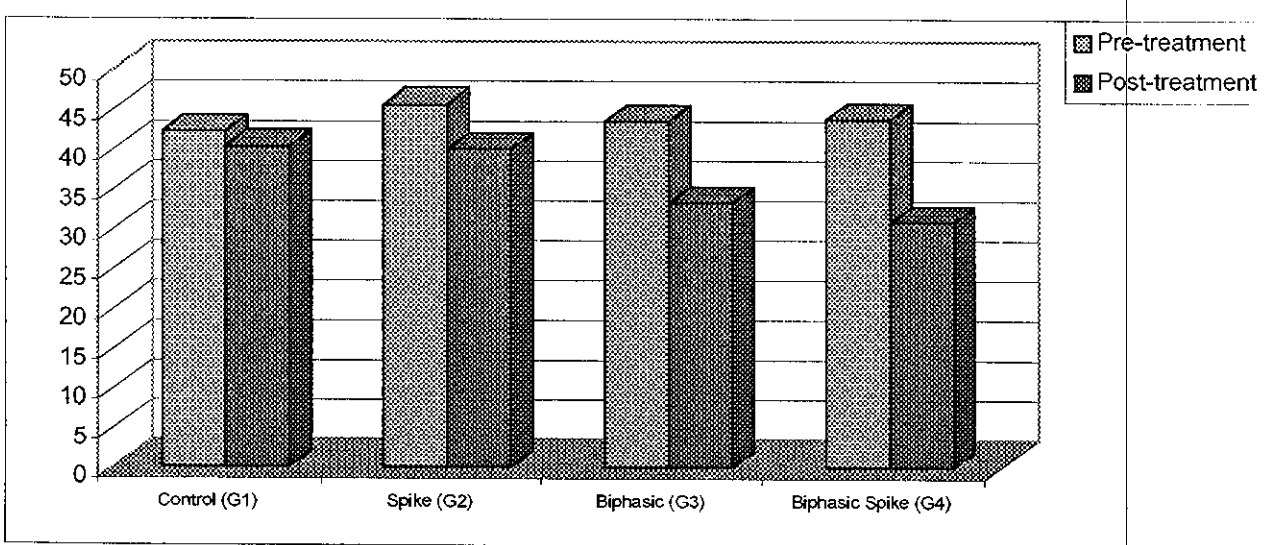

Fig. (5): Lumbosacral angle assessment in the four investigated groups pre- and post treatment.

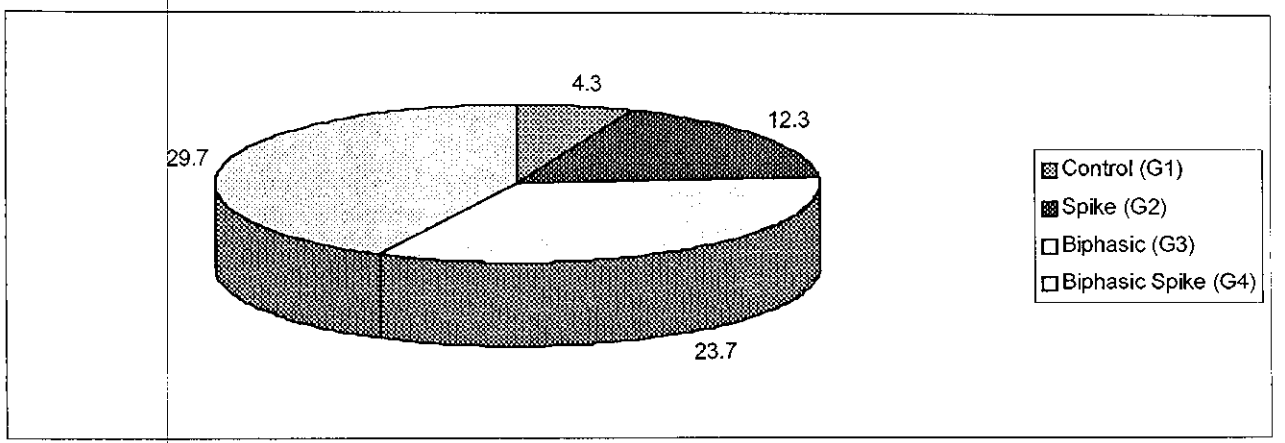

Fig. (6): Lumbosacral angle percentage of change in the four patients group after treatment.

DISCUSSION

According to Johnson et al., there has been little or no clear evidence of physiological benefit of any specific wave form other than some ability to provide patient comfort[11]. In some instances, however, the pathology demands a rapidly rising form (e.g., the spike wave), whereas others require a longer duration (rectangular or square wave form)[1,2,4]. Kahn and Bowsher postulated that the spike waves are generally more irritating to the skin and often require frequent movement of electrodes or shorter treatment times to avoid skin irritations[4,15].

Devor and Bowsher suggested that for hypersensitive patients, the square or rectangular (biphasic) wave is recommended[3,6]. These longer duration wave forms are also applied when some nerve damage has been associated with the pain pathology[3,6,11]. As these wave forms approach the shape of the sinewave the skin irritation is less[4,22].

Bowsher concluded that spike waves are recommended for intense or hyperirritating stimulation, which should be administered for acute pain or resistant tissues[4]. Jayasuriya and Mao Liang concluded that it was found that intense stimulation with spike waves does not produce as long-lasting a relief as that provided by the longer duration square or rectangular types[10,18]. Perhaps clinicians should use the sharp, spike wave for immediate, temporary relief with acute pain and the longer duration square, rectangular or sinewave forms for chronic pain patients to provide delayed but longer lasting analgesia[4,10,15,18,20].

According to Jayasuriya the spike form might supress pain intersegementally through (Gate control theory of pain)[10,19]. Chemical or hormonal mechanism might also explain the long lasting effect of Biphasic form of current in chronic pain[3,4].

Tulgar et al., proposed that Biphasic form of currents lead to stimulate supraspinal segement (pre acuduct gray, reticular formation and raphi system)[22]. This might produce the release of 5 hydroxy-tryptamine (serotonin)[2,4]. Endrophin released from pitutary gland acts as "hormon and at the same time as neurotransmitter, suppress pain through presynaptic inhibition[2,3]. Also this endorphin might affect the centers responsible of chronic pain perception with suppression of it[1,2,10].

The results of the present study showed the maximum improvement in the fourth group

in chronic mechanical low back pain. This might be due to double effect of both forms which has overcome the acute and chronic pain at the same time with long lasting effect of suppressing pain and muscle spasm[4,10,15,18,21]. Therefore the L.S.A. could be improved or normalised followed releasing of muscle spasm in the lumbosacral region[9,21]. Mills et al., suggested that decreasing muscle spasm would lead to increasing the active forward flexion range of motion[21].

In the third group, application of Biphasic form of wave lead to improvement of FF and suppression of pain with changing LSA. The improvement in this group was more than the second group (spike form). This might be due to the fact that spike form of current stimulation affected mainly the acute type of pain & Biphasic affect mainly chronic pain[4,10,15,18]. Least results were obtained in control group. (G1- Sham electro acupuncture). These results might be attributed to the effect of acupuncture in stimulating acupoints[9,10,18], therefore the stimulation is not enough to alleviate pain and overcome the problem of abnormal LSA or decreasing active range of motion.

CONCLUSION

According to the results of this work, Biphasic spike, Biphasic and spike form of current in electroacupuncture can be recommended respectively to alleviate chronic low back pain as safe and potent methods of pain relief.

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الملخص العربي

تأثير تعديل شكل موجة ذبذبة التنبيه في الإبر الصينية الكهربية على آلام أسفل الظهر الميكانيكية المزمنة

الاستخدام الأساسي للإبر الصينية هو التغلب على الألم الميكانيكي الذي له علاقة بالحركة. تعديل ذبذبة التنبيه يمكن إنتاجها بتغيير التردد وشدة التيار وشكل الموجة. الدراسة الحالية تم تطبيقها على ستين مريضا من المتطوعين الذين يعانون من آلام أسفل الظهر الميكانيكية المزمنة لدراسة تأثير تغير شكل موجة الإبر الصينية الكهربية. وقد قسمت المرضى إلى أربعة مجموعات بالتساوي المجموعة الأولى تم علاجها بالأبر الصينية الكهربية الكاذبة والثانية باستخدام الشكل الحاد من التنبيه الكهربي للإبر الصينية والثالثة تم علاجها باستخدام شكل التيار ثنائي الاتجاه. أما الرابعة فقد استقبلت التيار الحاد والمتغير الاتجاه معا. وقد استمرت جلسات العلاج اثنا عشرة جلسة لكل مجموعة، حيث تم قياس الألم وزاوية انحناء الفقرات القطنية الأمامية والزاوية القطنية العجزية قبل العلاج وبعد انتهاء الجلسات. وقد أسفرت النتائج عن تقدم المجموعة الرابعة عن بقية المجموعات حيث انخفض الألم بنسبة ٨٩,١% وزاد الانحناء الأمامي بنسبة ١٠٢,٧% وتغيرات الزاوية القطنية العجزية بنسبة ٢٩,٧% بينما في المجموعة الثالثة وهي التي تلت ذلك في التقدم. انخفض الألم ٦٥,٥% وزاد الانحناء ٦٠,٧% وتغيرات الزاوية القطنية العجزية ٢٣,٧% بينما في المجموعة الثانية. قلت النتائج فانخفض الألم ٣٠,٧% وزادت الحركة ١٩,٣% وتغيرت الزاوية القطنية العجزية ١٢,٣%. وتشير النتائج السابقة إلى أهمية استخدام التيار ثنائي الاتجاه في الآلام المزمنة والتيار الحاد في الحالات التي بها آلام حادة أما في حالة استخدام التياران معا فقد أثبتت نتيجة الدراسة أنه يخفض الألم الحاد والمزمن معا في حالات آلام الظهر الميكانيكية المزمنة.