Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2018, 7(4): 108-113

Long Term Effects of Low-Frequency Magnetic Field Therapy in Treatment Patients with Low Back Pain

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ABSTRACT

Background: *Low back pain influences majority of the population, especially in working-age in modernity. It interferes with activity of daily living. A low frequency magnetic field therapy field has been advantageous in patients suffering from low back pain.* ***Methods:*** *The present study evaluated the effect of low frequency magnetic field therapy (1 Hz and 100 Hz) with intensity up to 100 Gauss per particular output on visual analogue scale for pain scores and baseline bubble inclinometer for forward and lateral (right and left) trunk flexion mobility in forty patients (22 males and 18 females) suffering from low back pain, their age ranged from 40-50 years old who received either low frequency magnetic field therapy as experimental treatment or sham exposure treatment.* ***Results:*** *Repeated analysis of study outcome measures pre-treatment, post-treatment, and follow up periods showed a significant difference in visual analogue scale (pain) and trunk mobility, ($p<0.05$). On the other side, there was no significant difference in sham group during evaluation periods in both outcome measures ($p>0.05$).* ***Conclusion:*** *The findings from our study give initial support for using low frequency magnetic field therapy as a long term effective treatment method for decreasing pain and increasing trunk mobility.*

Keywords: Low-frequency magnetic field therapy, Low back pain, Trunk mobility

INTRODUCTION

Low back pain (LBP) is a disqualifying and widespread disease all over the world, which leads to socio-economic problems [1]. About 60-80% of the world population suffered from LBP during their lifetime, the recurrent and existing for a long time occur within 65% of cases [2]. The common causes of back pain are muscle strains or ligament sprains, disc herniation, arthritis, spinal deformities, and fractures in osteoporotic patients [3]. The main risk factor for chronic LBP is the degeneration of the disc [4].

There are several pharmacological therapy choices available for treatment of pain due to LBP. The incidence of side effects, endurance, adverse events, and long-term toxicity has increased interest over their utilization in some patients with LBP [5]. On the other side, numbers of non-pharmacological treatments for LBP have been used; such as cognitive-behavioral therapy, exercise, spinal manipulation, and other physical therapy modalities for LBP [6]. Anesthesiologic and surgical procedures are frequently not efficient in the long period, and proof is lacking. In contrast, low-frequency magnetic field therapy (LFMFT) could supply a non-invasive, safe, and simplicity of application alternative to routine procedures that clearly treat the affected place, to decrease pain, and/or inflammation without any thermal effects with slight or no side-effects [7].

Low-frequency magnetic field (LFMFT) is very efficient in the management of pain (acute and chronic), edema, and inflammation, wound healings, soft tissue injury, skin ulcers, bone unification, and osteoporosis [8,9]. The analgesic effects of low frequency magnetic field therapy are still unclear, and some studies mentioned that LFMFT may stimulate endogenous and exogenous opiate pathways so that it helps in pain relief [10].

Various methods of evaluations have been applied as an objective assessment scale in low back pain as spinal mobility [11], aerobic capacity [12], and trunk muscle strength [13]. Spinal mobility has been approved as the most common objective assessment of spinal function [14].

Despite varying theories observed that pain is reduced, and back mobility is improved after application of LFMFT, lacking in evidence for any credible explanation. The purpose of this study was to evaluate the long-term effects of low-frequency magnetic field therapy in reduction of low back pain and improvement of mobility of back muscles.

PATIENTS AND METHODS

Study Design

This experiment was a prospective, randomized, placebo-controlled design with before treatment, after treatment and follow-up assessments. This study was performed from June 2017 to March 2018 at the physical therapy clinic (male and female sections) in the department of physical therapy and health, rehabilitation, College of Applied Medical Sciences, Prince Sattam Bin Abdulaziz University, KSA.

Subjects

Forty patients (22 males and 18 females) suffering from low back pain, their age ranged from 40-50 years old, participated in this study. Subjects meet the following criteria: all patients suffer from LBP with/without lower limb pain that persisting for the past 6 months as a minimum period. Body mass index (BMI) was less than 30 (kg/m^2). Subjects were excluded if they have cauda equina symptoms, tumors, metabolic disease, rheumatoid arthritis, osteoporosis, using steroid for a long time, signs of pressure on a nerve root, lumbar fracture, spinal surgery, pregnancy, cardiac pacemaker, and lumbar fixations. Subjects were referred to King Khalid Hospital and Prince Sattam Bin Abdulaziz University Hospital.

Informed consent was taken from all subjects after informing them verbally and through printed sheets about the study prior to participation and they were free to withdraw at any time from the study. Assessments of the forward and lateral trunk flexion (right and left) mobility were done using a baseline bubble inclinometer and back pain by visual analogue scale (VAS). After assessment, subjects were randomly assigned by a computer program into 2 groups of the same number of subjects (20 subjects in each group), the experimental group (Group A), and sham group (Group B) which was the placebo-controlled group. The treatment given to subjects of Group A was magnetic therapy in the form of low-frequency magnetic field therapy for thirty minutes three times per week up to four weeks. Each subject was well supported, comfortable position on the bed of the machine inside the tunnel of the LFMFT over the lower back of the spine. However, the other group, Group B, each subject was in the same position as in the experimental group, but the LFMFT device was switched off without emitting any magnetic field for the same time as in the other group.

Procedures

Outcome measures

There were 2 outcome measures, visual analogue scale (VAS) for measuring pain scores and a baseline bubble inclinometer for measuring forward and lateral trunk flexion (right and left) mobility. Assessments were done before the beginning of the treatment, after the end of the last session of treatment, and follow-up time (3 months after the end of the treatment).

Visual Analogue Pain Scale (VAS)

The VAS is a valid and reliable measure of chronic pain intensity. Operationally, VAS is usually a flat line, 100 mm in length, anchored by phrase descriptors at each end, (0=no pain, 100=worst pain). Subjects of both groups marked on the line the point that they felt pain of their current state. The VAS score was measured in millimeters from the left side end of the line to the point that the subject marks [15].

Baseline bubble inclinometer

A standard plinth, new Baseline® bubble inclinometer (model 12-1056, Fabrication Enterprises; White Plains, New York, USA), was used in measurement of forward trunk flexion and lateral trunk flexion (right and left). Subjects of both groups were asked to stand bare skin without tension and their upper limbs beside them while their skin was marked nearly at the 12^{th} thoracic spinous process (T12) by determining the 12^{th} rib and next to the spinous process. After placing the Baseline bubble inclinometer on T12 spinous process; from the sagittal plane for measuring forward trunk flexion and from the frontal plane for measuring later trunk flexion for both sides, inclinometer was adjusted in zero position before starting each measurement and in re-measuring; the site of T12 spinous process must be the same [16].

Measuring forward trunk flexion

Subjects were asked to fully flex the trunk without bending their knees and measuring was recorded to the nearest degree.

Measuring lateral trunk flexion

Subjects slide hand down to the thigh and fully side-bend the trunk without bending their knees and measuring was recorded to the nearest degree for both sides.

Treatment procedures

Group A: It was the experimental group which comprised of 20 LBP patients were treated by CHINESPORT™ MAGNETO 4 - Plus Line (Italy), which generates a low-frequency magnetic field (adjustable between 1 and 100 Hz) with intensity up to 100 Gauss per particular output. Subjects were placed on the bed of the magnetic generator in the most comfortable and well-supported position (supine, prone, or side-lying position), and then the tunnel of the magnetic generator was applied at the lower back or at the site of pain. At each session, the initial intensity utilized at a minimum level and would be progressively raised until the subject's tolerance for thirty minutes three times per week up to four weeks (12 sessions). At the end of each session, the treated area was observed for any side effects such as erythema, discomfort, or irritation.

Group B: It was the sham group, 20 LBP patients were placed on the bed of the magnetic generator as an identical procedure of the experimental group, except the magnetic tunnel would be not attached from the magnetic source and stabilized below the machine to prevent it to be seen by the subject, thin subject was hearing the same rhythmic sound which would be presented throughout the procedure for the same time and same sessions as in the experimental group.

Statistical Analysis

The differences between groups were evaluated with Mann-Whitney U (VAS) and independent t-tests (forward trunk flexion and lateral trunk flexion). Repeated measures ANOVA (RM) was used to evaluate the effects of intervention on forward trunk flexion and right and left lateral trunk flexion at pre-treatment, post-treatment and follow-up time and post hoc Bonferroni test was used for pairwise comparison. Also, Friedman's test was used to evaluate the effects of intervention on VAS at pre-treatment, post-treatment and follow-up time and Mann-Whitney U was used for pairwise comparison. The raw data were coded and inscribed to a statistical package of social science (SPSS, version 20). The significance level was set at $p<0.05$.

RESULTS

Baseline patient characteristics for both groups are given in Table 1. There were no significant differences between the groups in any of the parameters measured.

Table 1 Baseline characteristics in patients with low back pain in both groups

Variables	Group A	Group B	Significance
Age (years)	44.8 ± 3.20	43.5 ± 3	0.192
Gender (M/F)	10/10	12/8	0.602
BMI (kg/m^2)	28.45 ± 1.28	27.50 ± 1.76	0.059

The findings of pain assessment in the two groups using VAS are shown in Table 2. Subjects who underwent low-frequency magnetic field showed significant pain reduction post-treatment and after 3 months from the end of treatment (follow-up period) ($p<0.05$ compared with pre-treatment). On the other hand, there was non-significant pain reduction in the sham group during the whole observation times ($p>0.05$).

Table 2 Pain assessments using VAS in both groups

VAS	Pre-treatment	Post -treatment	Follow-up	Significance
Group A	75.5 (66.25 - 87)	12.5 (10 - 22.25)	10 (6.25 - 22.50)	<0.001*
Group B	79.5 (56 - 100)	78.5 (63.5 - 89.75)	81.5 (63.75 – 88.75)	0.914
Significance	0.705	<0.001*	<0.001*	
Data expressed as median (25th-75th percentile); *: significant at $p<0.05$				

The findings of forward trunk flexion and lateral trunk (right and left) flexion in the two groups using Baseline® bubble inclinometer are shown in Table 3. Subjects in the experimental group, who received low-frequency magnetic field, showed significant increase in forward trunk flexion and lateral trunk flexion for both sides post-treatment and after 3 months from the end of treatment (follow-up period) ($p<0.05$ compared with pre-treatment). There were statistically significant differences in right lateral trunk flexion in the sham group during the whole observation period ($p<0.05$). On the other hand, there was non-significant change in forward trunk flexion and left lateral trunk flexion for both sides in the sham group during the whole observation times ($p>0.05$).

Table 3 Forward trunk flexion and right & left lateral trunk flexion in both groups

Group	Pre-treatment	Post -treatment	Follow-up	Sig.
Forward trunk flexion				
Group A	20.55 ± 6.25	54.95 ± 20.17	53.55 ± 19.39	<0.001*
	(17.62 - 23.47)	(45.51 - 64.39)	(44.47 - 62.62)	
Group B	21.80 ± 5.72	22.40 ± 6.46	23.50 ± 6.96	0.163
	(19.09 - 24.51)	(19.37 - 25.42)	(20.24 - 26.75)	
Sig.	0.516	<0.001*	<0.001*	-
Rt. lateral trunk flexion				
Group A	12.45 ± 2.61	20.75 ± 5.30	21.25 ± 5.49	<0.001*
	(11.23 - 13.67)	(18.26 - 23.23)	(18.67 - 23.82)	
Group B	11.85 ± 2.28	12.40 ± 2.50	12.35 ± 2.45	0.027*
	(10.78 - 12.91)	(11.22 - 13.57)	(11.20 - 13.49)	
Sig.	0.443	<0.001*	<0.001*	-
Lt. lateral trunk flexion				
Group A	12.60 ± 2.48	21.15 ± 5.56	21.35 ± 5.60	<0.001*
	(11.43 - 13.76)	(18.54 - 23.75)	(18.73 - 23.96)	
Group B	11.90 ± 2.40	12.35 ± 2.45	12.40 ± 2.58	0.055
	(10.77 - 13.02)	(11.20 - 13.49)	(11.24 - 13.55)	
Sig.	0.37	<0.001*	<0.001*	-
Data expressed as mean ± standard deviation (95% confidence interval)); Sig.: significance; *Significant at p<0.05; Rt.: Right; Lt.: Left				

The differences within subjects in both groups are shown in Table 4. Within the subjects of Group A, there was statistically significant difference in pain reduction using VAS and forward trunk flexion and lateral trunk flexion (right and left) using Baseline® bubble inclinometer pre-treatment and post-treatment and also between pre-treatment and follow-up but there was a non-significant between post-treatment and follow-up. Although data analysis in group B indicated within subjects' difference regarding right lateral trunk flexion, the pairwise analysis reported non-significant differences of the right lateral trunk flexion when the pre-treatment outcomes compared to either the post-treatment or the follow-up outcomes. Also, the post-treatment and follow-up outcomes were similar.

Table 4 Pairwise comparisons within subjects in both groups

Groups	VAS		Trunk forward flexion		Rt. lateral trunk flexion		Lt. lateral trunk flexion	
	A	B	A	B	A	B	A	B
Pre-treatment/post-treatment	<0.001*	-	<0.001*	-	<0.001*	0.054	<0.001*	-
Post-treatment /follow-up	0.397	-	0.926	-	0.169	0.087	0.642	-
Pre-treatment /follow-up	<0.001*	-	<0.001*	-	<0.001*	0.999	<0.001*	-
*Significant at p<0.05; Rt.: Right; Lt: Left								

DISCUSSION

Low back pain is widespread in the general population, affecting genders and all age individuals; the main cause of fatigue, decreasing activity of daily living, pain, discomfort, and limiting back mobility. Most patients recover rapidly; however, recurrence is part of LBP history [17]. The aim of this study was to evaluate the long-term effects of LFMFT in reduction of LBP and improvement the mobility of back muscles. Using a prospective, randomized, placebo-controlled study design reinforces the validity of these results. The results of this study showed that a high improvement, in pain relief and increase back mobility in forward and lateral trunk flexion for both sides in patients with LBP, were discovered in the LFMFT group compared with the sham group after finishing the treatment and this improvement was continued 3 months later which mean that LFMFT was an effective, relatively safe tool without any side effects, and had a long term effects in both the subjective sensation of pain relief and objective increasing in back mobility.

Many recent studies have recommended that LFMFT may give a variable advantage in terms of reducing pain and/or physical activity (back mobility) in various pathophysiological situations of LBP [18-22].

Low frequency magnetic field therapy mechanisms in pain relief is not obvious, its sedative effect, through the stimulation of inhibitory fibers and however, raise in central β-endorphin secretion, hyperpolarization at the motor end plate and consistently relax the muscles and the enhancement of chondrogenesis [23]. Lednev in 1991 suggested that nociceptive C-fibers have a diminished action potential and that a magnetic current may influence neuronal depolarization by altering the resting membrane potential. The mechanisms responsible for LBP may be vasodilation to the tissues and secretion of cytokines [24]. Any one of these suggested mechanisms may have a role in the results of the current study since LBP has multiple aspects and begins from different origins, such as muscles, bones, or nerves.

Mellin in 1986 proposed that among different trunk motilities, forward and lateral right and left trunk flexion, had a high correlation with LBP severity and functional disabilities [25]. In the present study, subjects with MBI more than 30 and had belly abdomen were excluded from the study because belly abdomen may interfere with the trunk mobility and limit forward and lateral trunk flexion.

Because of the different causes of LBP, subjects were supposed to be divided into subgroups according to the main cause of LBP. Future studies should be adequately strong to carry out a subgroup of the different causes of LBP (such as degenerative disc disease, facet joint dysfunction, and lumbar spondylosis) to discriminate if LFMFT is particularly or distinctively effective in any specific cause of LBP.

Because of the improvement of the experimental group in pain relief and increasing trunk mobility, the sham group received LFMFT after the end of study to get the benefits from study protocol.

CONCLUSION

In this study, there were no critical contrary conditions interfered with the LFMFT machine, treatment procedures, or outcome measures. The results of the current study suggested that low frequency magnetic field therapy was an effective, relatively safe tool, and had a long-term effect on the approach for management of pain and increasing back mobility in patients with low back pain.

Acknowledgement

The authors are grateful to the Deanship of Scientific Research, Prince Sattam Bin Abdulaziz University, Saudi Arabia for financial support to carry out this work. Project No (2017/03/7760).

REFERENCES

[1] Hoy, Damian, et al. "Measuring the global burden of low back pain." *Best Practice & Research Clinical Rheumatology,* Vol. 24, No. 2, 2010, pp. 155-65.

[2] Airakinson, O., J. Hildebrandt, and A.F. Mannion. "European guidelines for the management of chronic non-specific low back pain."

[3] Amirdelfan, Kasra, Porter McRoberts, and Timothy R. Deer. "The differential diagnosis of low back pain: a primer on the evolving paradigm." *Neuromodulation: Technology at the Neural Interface,* Vol. 17, S2, 2014, pp. 11-17.

[4] Karppinen, Jaro, et al. "Management of degenerative disk disease and chronic low back pain." *Orthopedic Clinics,* Vol. 42, No. 4, 2011, pp. 513-28.

[5] Peniston, John H. "A review of pharmacotherapy for chronic low back pain with considerations for sports medicine." *The Physician and Sports Medicine,* Vol. 40, No. 4, 2012, pp. 21-32.

[6] Chou, Roger, and Laurie Hoyt Huffman. “Non-pharmacologic therapies for acute and chronic low back pain: a review of the evidence for an American Pain Society/American College of Physicians clinical practice guideline.” *Annals of Internal Medicine,* Vol. 147, No. 7, 2007, pp. 492-504.

[7] Harden, R. N., et al. “Prospective, randomized, single□blind, sham treatment□controlled study of the safety and efficacy of an electromagnetic field device for the treatment of chronic low back pain: A Pilot Study.” *Pain Practice,* Vol. 7, No. 3, 2007, pp. 248-55.

[8] Hazlewood C, Markov M, Kostarakis P. Magnetic fields for the relief of myofascial and/or low back pain through trigger points. In: Proceedings of the fourth international workshop biological effects of electromagnetic fields. 2006, pp. 475-83.

[9] Markov, Marko S. “Pulsed electromagnetic field therapy history, state of the art and future.” *The Environmentalist,* Vol. 27, No. 4, 2007, pp. 465-75.

[10] Moffett, John, Linley M. Fray, and Nicole J. Kubat. “Activation of endogenous opioid gene expression in human keratinocytes and fibroblasts by pulsed radiofrequency energy fields.” *Journal of Pain Research,* Vol. 5, 2012, p. 347.

[11] Cady, Lee D., et al. “Strength and fitness and subsequent back injuries in firefighters.” *Journal of Occupational Medicine: official publication of the Industrial Medical Association,* Vol. 21, No. 4, 1979, pp. 269-72.

[12] Hurri, H., et al. “Aerobic capacity among chronic low-back-pain patients.” *Journal of Spinal Disorders,* Vol. 4, No. 1, 1991, pp. 34-38.

[13] McQuade, Kevin J., Judith A. Turner, and David M. Buchner. “Physical fitness and chronic low back pain. An analysis of the relationships among fitness, functional limitations and depression.” *Clinical Orthopaedics and Related Research,* Vol. 233, 1988, pp. 198-204.

[14] Kang, Seong Woong, et al. “Correlation of spinal mobility with the severity of chronic lower back pain.” *Yonsei Medical Journal,* Vol. 36, No. 1, 1995, pp. 37-44.

[15] Rodriguez, Carmen S. “Pain measurement in the elderly: A review.” *Pain Management Nursing,* Vol. 2, No. 2, 2001, pp. 38-46.

[16] Laboratory Manual: Evidence-based examination and selected investigations for patients with lumbo-pelvic spine and hip disorders. http://www.evidenceinmotion.com/.2009; October 26.

[17] Shen, Francis H., Dino Samartzis, and Gunnar BJ Andersson. “Non-surgical management of acute and chronic low back pain.” *JAAOS-Journal of the American Academy of Orthopaedic Surgeons,* Vol. 14, No. 8, 2006, pp. 477-87.

[18] Li, Shasha, et al. “Electromagnetic fields for treating osteoarthritis.” *The Cochrane Library,* 2013.

[19] Negm, A., A. Lorbergs, and N.J. Macintyre. “Efficacy of low frequency pulsed sub-sensory threshold electrical stimulation vs placebo on pain and physical function in people with knee osteoarthritis: A systematic review with meta-analysis.” *Osteoarthritis and Cartilage,* Vol. 21, No. 9, 2013, pp. 1281-89.

[20] Pilla, Arthur A. “Non-thermal electromagnetic fields: From first messenger to therapeutic applications.” *Electromagnetic Biology and Medicine,* Vol. 32, No. 2, 2013, pp. 123-36.

[21] Ryang We, Seo, et al. “Effects of pulsed electromagnetic field on knee osteoarthritis: A systematic review.” *Rheumatology,* Vol. 52, No. 5, 2012, pp. 815-24.

[22] Bagnato, Gian Luca, et al. “Pulsed electromagnetic fields in knee osteoarthritis: A double blind, placebo-controlled, randomized clinical trial.” *Rheumatology,* Vol. 55, No. 4, 2015, pp. 755-62.

[23] Trock, David H. “Electromagnetic fields and magnets: investigational treatment for musculoskeletal disorders.” *Rheumatic Disease Clinics,* Vol. 26, No. 1, 2000, pp. 51-62.

[24] Lednev, V.V. “Possible mechanism for the influence of weak magnetic fields on biological systems.” *Bioelectromagnetics,* Vol. 12, No. 2, 1991, pp. 71-75.

[25] Mellin, Guy. “Chronic low back pain in men 54-63 years of age. Correlations of physical measurements with the degree of trouble and progress after treatment.” *Spine,* Vol. 11, No. 5, 1986, pp. 421-26.