

Effectiveness of Interferential Current for the Treatment of Chronic Low Back Pain

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ABSTRACT

Background: The problem of pain in the lumbar region is a big part of physiotherapy, which aims not only to relieve patients from pain but also to restore them to their previous levels of functionality. Various interventions are used for this physiotherapy treatment, one of them is electrotherapy. This review aims to investigate the effectiveness of interferential current (IFC) in pain management in patients with chronic low back pain (CLBP).

Methods: A search was conducted in electronic databases Google Scholar, PubMed, PEDro, Science Direct, and Cochrane Library in Greek and English language, combining keywords of the central axes of the issue such as "chronic low back pain" or "CLBP", "pain relief", "electrotherapy", "interferential current" or "IFC".

Results: Ten RCT studies, which examine the effectiveness of IFC were included in this review. A total of 807 patients were measured. Most studies (n=6) compared IFC with placebo and one of those combined placebo IFC with an exercise program. Three studies compared the different types of IFC and one study IFC with usual caressing.

Conclusion: The results of this review demonstrated that IFC showed a positive effect on reducing pain and improving the functioning of patients with CLBP. This approach presents to be a sufficient intervention method combined or not with other therapies.

Keywords: Chronic low back pain, electrotherapy, IFC, pain relief.

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I. INTRODUCTION

Low back pain (LBP) is a common, growing problem and an important symptom-related reason for seeing a physician [1]. It is defined as pain and discomfort, localized below the costal margin and above the inferior gluteal folds, with or without leg pain. Depending on the duration identification of symptoms, LBP cases are characterized in clinical cases of acute LBP persisting for less than 6 weeks, subacute LBP persisting between 6 and 12 weeks, and chronic LBP (CLBP) persisting for more than 12 weeks [2]. In addition, it is generally classified as "specific" or "non-specific". Non-specific LBP is defined as symptoms of unknown origin or without identifiable pathology, and specific is defined as that caused by a specific pathophysiological mechanism, such as disc prolapse or herniated nucleus pulposus, infection, inflammatory arthropathy, tumor, osteoporosis or fracture [3]. Therefore, due to the complexity of the structures of the human body and the diversity of causative factors, 90% of clinical cases fall into the category of cases of non-specific etiology [4].

According to research, LBP is a leading cause of disability and the most prevalent musculoskeletal condition globally [4]-[7] which affects many individuals at some point in their lives [8], [9]. The estimation is that between 5% and 10% of cases will develop CLBP, which is

responsible for high treatment costs, sick leave, and individual suffering, in addition to being one of the main reasons for people to seek health care services [9]. Some studies show that fifteen percent of patients receiving physiotherapy in primary care suffer from LBP [10]. It is estimated that 70% to 85% of the population will experience an episode of LBP at some point [11]. The prevalence of it is estimated to be between 30% and 80% among the general population and has been found to increase with age. A higher prevalence of LBP has been associated with lower socioeconomic status and lower education levels [12]. Therefore, LBP is the leading cause of activity limitation and absenteeism from work and results in a huge medical burden and economic cost [13].

Successful treatment of musculoskeletal pain is an important challenge in clinical practice. The electrotherapeutical technique that is used for pain handling is the treatment with Interferential Current (IFC) [14]. This approach was developed by Dr. Hans Nemec in the 1950s who tried to develop a way to provide electrical stimulation to the muscles without any skin irritation. Even though there is no standard definition, IFC could be considered "the transcutaneous application of alternating currents of average frequency, the width of which is shaped in low frequency for therapeutic purposes". More specifically, interfering treatment is based on the principle of interference according

to which one current shows a stable frequency of 4000 Hz, while the other could be alternating between 3900 Hz and 4100 Hz. The incision of these two currents in the tissues creates the interference phenomenon generating the “pulse frequency” which equals the difference between the frequencies of the two currents [15]. This current application thus, eliminated the patient’s discomfort, something that resulted in its becoming a widely utilized method for pain relief [16]. Some claimed advantage of IFC over low-frequency currents is its capacity to diminish the impedance offered by the skin [17], and its ability to generate an amplitude-modulated frequency (AMF) parameter, which is a low-frequency current generated deep within the treatment area [18]-[20].

While IFC is widely used the research literature on this method is sparse. A review of the literature reveals incomplete and controversial documentation regarding the scientific support of IFC in the management of musculoskeletal pain [21]. The purpose of this review was to investigate the effect of electrotherapy and specifically the effectiveness of interferential currents in pain management in patients with chronic low back pain.

II. METHODS

A. Review Design

The results are presented per the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) reporting guideline (supporting checklist/diagram) [22].

B. Data Sources and Search Strategy:

A search on Google Scholar, PubMed, PEDro, Science Direct, and Cochrane Library was conducted, combing keywords of the main parts of the topic like chronic low back pain or CLBP, pain relief, electrotherapy, interferential current, or IFC. A total of 10 studies that examine the effectiveness of IFC were included in this review.

C. Inclusion Criteria

The review included studies designed to evaluate the effect of IFC on patients with chronic LBP in Greek and English language, with no limitation on the publication date. Systematic reviews, case reports and case series were excluded.

D. Study Selection

Eligibility screening of the studies was conducted in a blinded standardized way by two independent reviewers (Ev.T. and S.T.). Titles and abstracts were screened using and duplicate articles were excluded. After screening titles and abstracts, full paper copies were retrieved. The full-text screening was also performed blinded by the same reviewers (Ev.T. and S.T.). Disagreements between authors during any stage of the screening process were resolved by consulting a third reviewer (Em.T.).

III. RESULTS

Reference [23] aimed at studying the effect of interferential current on CLBP treatment with the use of

different intervention times. The study conducted was a randomized clinical test in which 45 people diagnosed with CLBP for a period bigger than 6 weeks, aged between 18 and 45 years, participated and were divided into 3 groups of 15 patients each. The 1st group received 15 minutes of IFC treatment, the 2nd group received 20 minutes of IFC treatment, and the 3rd group received 30 minutes of IFC treatment. All participants, regardless of their group, underwent 3 treatments in 2 weeks and one more session which took place one week later for the subjective and objective readings to be made. The tools that were used for the readings were the NRS-101 numeric rating scale of pain evaluation, PPT and the effect of LBP on the participants’ that were evaluated in terms of the Oswestry questionnaire’s everyday activities. None of the groups showed greater results than the other in terms of pain perception, however, the 1st and the 3rd group showed better personal improvement compared to the 2nd group that had a stable progression for the NRS-101 readings. Hence, the shorter IFC intervention time of 15 minutes could be used as a treatment for individuals with CLBP.

Reference [24] investigated the effects of IFC on pain, balance, and the ability to walk that appeared in elderly patients with CLBP. A total of 20 people participated and were randomly divided into 2 groups: the first group (2 male, 8 female) that received IFC treatment, and the second group (3 male, 7 female), that received an IFC placebo. The treatment for both groups, lasted for 20 minutes and in both groups, interference was evaluated before and after on the VAS scale, TUG, and balance on a standing position. The group that received IFC treatment showed significantly low scores on the scale for pain evaluation for elderly people with CLBP. The variation of the open and closed eyes position was significantly lower for the placebo group, while the IFC groups indicated remarkable improvement. The results showed that IFC is expected to effectively contribute to pain mitigation, as well as to significantly improve the ability to stand and walk.

Reference [25] study examined the effects of IFC frequency on pain in patients with non-specific CLBP. The researcher and his colleagues conducted a randomized controlled trial with 150 patients, 18-80 years old with non-specific CLBP, who were divided into 3 groups. The 1st group (50 patients) received 1 kHz frequency IFC treatment, the 2nd group (50 patients) received 4 kHz IFC treatment, and the 3rd group (50 patients) received placebo IFC treatment. The IFC treatments took place 3 times a week, in 30-minute sessions for overall 4 weeks of intervention. The volume of the pain scores, disability, total awareness, pressure pain threshold, functional performance, current dysphoria, painkiller consumption, and central pain mechanisms was immediately measured, after 12 treatment sessions and 4 months later. Statistically, there was not only significant local enhancement of pain threshold (low back region) but also sectional (anterior shinbone) with the use of 1 kHz frequency IFC in comparison to the placebo treatment. Moreover, the 1 kHz frequency group showed better results than the placebo group and the 4 kHz frequency group after 12 sessions. Even though the improvement was noticed in all the results of the 3 groups, no difference was observed in the placebo group on account

of PPT. The reduction of painkillers compared to the placebo group was significant. Finally, the conclusion that 1 kHz frequency reduces hyperalgesia not only locally but also deeply in the tissue, as well as improves local and partial central sensitization to patients with non-specific CLBP after 12 sessions of interference were drawn. The 1 kHz and 4 kHz frequencies lead to lower painkiller consumption in comparison to the placebo group. Therefore, the researchers concluded that 1 kHz frequency IFC use could be a supplement to the pain treatment for patients with CLBP.

Reference [26] evaluated the short-term effectiveness of the IFC treatment for the handling of pain and disability in people with non-specific CLBP. Regarding the study sample, it consisted of 64 people (20 male, 44 female) from 20 to 65 years old with CLBP for more than 3 months, who were divided into 2 groups. The 1st group (n=20) which was the control team received IFC treatment and the 2nd group, the experimental group received a “usual caressing”, namely a combination of massage and mobilization of the sensitive molecules. All participants had a treatment that lasted no more than 10 sessions, 25 minutes each for 2 weeks. It should be noted that in the IFC group 4 electrodes were used, the frequency was 4000 Hz, the shaped pulse rate was 65 Hz, and the volume of the current varied depending on the individual's stamina, as the aim was a needle-like feeling to be created without the presence of muscular contraction. The primary result scale for this study was the evaluation of pain on the VAS scale, while the secondary was the evaluation of disability based on the Oswestry rate. The evaluations occurred immediately after the beginning of the treatment and after the end of the intervention protocol, where significant differences between the two groups were noticed, concerning pain realization and disability level. The two-week IFC treatment showed significant short-term results in comparison to a “usual caressing” protocol concerning pain-relieving and the functionality of people with chronic low back pain.

Reference [27] compared the pain-relieving results of the 2 kHz or 4 kHz IFC to multiple rates of pulse frequency 2 Hz or 100 Hz to patients with CLBP. After written consent, 175 patients (70 male, 105 female) participated, aged between 18 and 60 years, with CLBP for more than 3 months, were randomly divided into 5 groups. The 1st IFC group received 2 kHz/ 100 Hz, the 2nd IFC group received 2 kHz/ 2 Hz, the 3rd IFC group received 4 kHz/ 100 Hz, the 4th IFC group received 4 kHz/ 2 Hz and the 5th group received IFC placebo. All 5 groups underwent a 30-minute treatment with the current in each canal to go through the pain area. The researchers evaluated the pain volume based on the Numeric Rating Scale (NRS), the McGill Pain Questionnaire (MPQ) and the algometer. The results indicated the significant differences in the NRS scores of the 2 kHz/ 2 Hz IFC group, of the 4 kHz/ 2 Hz IFC group and of the 4 kHz/ 100 Hz IFC group, compared to the placebo group, as well as a significant difference was observed in the MPQ scores of the 4 kHz/ 2 Hz IFC group and of the IFC group that received 4 kHz/ 100 Hz compared to the 5th placebo group. The algometer indicated a significant difference of 2 points at the lumbar area compared to the

placebo medicine only in the 4 kHz/ 100 Hz IFC group. Thus, it is obvious that 4 kHz frequency IFC showed more effective results even though there were no significant differences among the other IFC groups. The researchers concluded that one 4 kHz frequency IFC treatment and 100 Hz pulse rate frequency immediately provide pain relieving results in people with CLBP.

Reference [28] study investigated the efficiency of IFC treatment in the terms of pain improvement, disability, and balance in patients with non-specific CLBP. A total of 40 patients, both male and female, between 19 and 40 years of age were chosen based on the presence of CLBP for 3 months or more. These patients were randomly divided into 2 groups, where the 1st group (n=20) received IFC treatment, while the 2nd group (n=20) received IFC placebo treatment. Both groups attended 30-minute-long sessions, 5 times a week for 2 weeks of intervention, while the IFC group received 30-minute, 4000 Hz frequency treatment and 80 Hz pulse rate frequency. The tools that were used for the patients' readings before and after the 2-week intervention was the Visual Analog Scale (VAS), where readings while stillness and functional movement were done, as well as the Oswestry Disability Index (ODI) for the evaluation of LBP and standing oscillation. Comparing the groups, the IFC treatment group showed significantly bigger improvement in terms of pain, while leaning forwards when standing still and in terms of balance when standing still when the individual stood with closed eyes. The results of the study showed that the IFC treatment can improve pain, disability and body posture, highlighting the benefits that stem from the body arousal because of the IFC.

Reference [29] study examined the effect of IFC on pain, movement range and quality of life of patients with non-specific CLBP. Regarding the study sample, 61 patients (30 male, 31 female) participated, aged between 25 and 60 years, and were randomly divided into two groups. The 1st group (n=30) received IFC treatment with a frequency of 4000 Hz, pulse rate frequency of 80 Hz for 30 minutes and 20-minute exercise. The exercise program included exercises such as backbend, pelvis bow and energetic exercises for the strengthening of the abdomen and waist muscles, 15-20 repetitions for each muscle group and in 20 minutes total time. The 2nd group (n=31) received placebo IFC treatment, for 30 minutes, as well as the same 20-minute exercise program as the 1st group. The patients were evaluated before and after the intervention in terms of pain levels, on the VAS scale, in terms of the movement range of the low back area, in terms of health with the Short Form 36 (SF-36) questionnaire and quality of life with the Quality of life (QOL) questionnaire, where significant differences were noticed in all the results of the IFC group in comparison to the placebo group. The placebo group presented no significant improvements regarding the quality of life and the movement range of the low back. The researchers concluded that 4 weeks of IFC intervention and therapeutic exercise are the most effective combination when it comes to pain relief, the improvement of the range of the low back and the improvement of the quality of life of patients with CLBP.

TABLE I: STUDIES INCLUDE IN THE REVIEW

Author (s)	Method	Sample	Intervention	Conclusion
[23]	Randomized controlled trial	45	1 st group: IFC, 15 minutes 2 nd group: IFC, 20 minutes 3 rd group: IFC, 30 minutes	None of the groups was more effective than the other in terms of the participants' pain perception. However, the shortest amount of intervention time (15 minutes) could be used for treating CLBP.
[24]	Randomized Controlled Trial	20	1 st group: IFC 2 nd group: placebo IFC	The intervention currents (IFC) contribute to pain reduction and improve the ability to stand and walk. Their application could be an effective method for elderly people with CLBP.
[25]	Randomized placebo-controlled trial	150	1 st group: IFC, 1kHz 2 nd group: IFC, 4kHz 3 rd group: placebo IFC	1 kHz frequency reduces hyperbolic pain in the deep local tissue and improves the local and partial central sensitization of the patients with CLBP.
[26]	Randomized controlled trial	64	1 st group: IFC 2 nd group: "usual caressing"	2 weeks of IFC intervention indicated significant short-term results compared to a "usual caressing protocol" regarding the conceivable pain and the functionality of people with CLBP.
[27]	Randomized controlled trial	175	1 st group: IFC, 2 kHz/ 100 Hz 2 nd group: IFC, 2 kHz/ 2 Hz 3 rd group: IFC, 4 kHz/ 100 Hz 4 th group: IFC, 4 kHz / 2 Hz 5 th group: placebo IFC	4 kHz/ 100 Hz IFC provides immediate relieving results to people with CLBP.
[28]	Randomized controlled study	40	1 st group: IFC 2 nd group: IFC placebo	The findings of this study showed that IFC treatment can improve pain, disability and body posture highlighting the benefits that stem from body arousal because of the IFC.
[31]	Randomized controlled single-blinded study	100	1 st group: IFC (pumping electrodes) 2 nd group: IFC (silicone electrodes) 3 rd group: exercise + warm patches	IFC treatment that was done with pumping electrodes resulted in a significantly bigger and clinically more important reduction of the VAS, ODI and SF-36 scores than the use of IFC with silicone electrodes on patients with CLBP.
[32]	Randomized controlled trial	142	1 st group: IFC 2 nd group: IFC placebo	The use of interference current before doing Pilates can lower pain more quickly than the placebo IFC when used on patients with CLBP.
[29]	Randomized controlled trial	61	1 st group: IFC + exercise 2 nd group: IFC placebo + exercise	This trial revealed that 4 weeks of IFC intervention combined with exercising had significant results on pain lowering, ROM and QOL improvement of the patients with CLBP.
[30]	Clinical trial	10	1 st group: monitoring group 2 nd group: IFC 3 rd group: observation group	IFC was not so effective for the handling of CLBP, however, it showed that it reduced pain before and after the treatment and it could be used as one intervention method combined with other therapeutic techniques.

Reference [30] study evaluated the effects of the interferential current on people with chronic low back pain. The study sample consisted of 10 volunteer patients, 8 female and 2 males, aged averagely 52,9 years, with CLBP for 3 weeks. These patients were divided into 3 groups, the 1st group which was the monitoring group, the 2nd group which was the treatment group and the 3rd group which was the observation group. The treatment group received 4 kHz/100 Hz IFC for 20 minutes, 5 days in a row. The outcome parameters, such as pain, were evaluated on the VAS scale, and the blood pressure with the algometer, while ODI and the McGill questionnaire were also used. The results did not show differences in the everyday pain evaluation. The researchers concluded that IFC was not so effective on patients with CLBP regarding the functional improvement and the pain results, however, it seemed that it lowers pain before and after the treatment and it could be used as an intervention method combined with other therapeutic techniques.

Reference [31] aim of their study was the evaluation of IFC regarding pain, disability and the quality of life of patients with CLBP, as well as the comparison of the advantages of IFC were pumping and silicone electrodes were used. A total of 100 patients participated in the study, aged between 18 and 65 years, who were randomly divided into 3 groups. The 1st group (n=34) received IFC treatment

with pumping electrodes for 20 minutes, the 2nd group (n=34) received IFC treatment with silicone electrodes for 20 minutes and the 3rd group (n=32) did not receive IFC treatment, they only exercised and received warm patches for 20 minutes. All groups were evaluated before, after one week and 12 weeks after the VAS scale treatment for the pain evaluation, with the ODI indicator for the disability evaluation and with the SF-36 questionnaire for the evaluation of each person's quality of life. Groups 1 and 2 resulted in a statistically significant reduction of pain and disability and an improvement in life quality compared to the pre-treatment. While in the 3rd group there was no significant improvement in the VAS, ODI and SF-36 readings. Group 1 showed better relieving and functional effects compared to the second and third groups. Therefore, the researchers concluded that the 1st group with the use of pumping electrodes showed a clinically bigger reduction of the VAS, ODI, SF-36 readings than the IFC-used silicone electrodes.

Reference [32] tried to evaluate whether IFC before doing pilates exercise improves pain faster than the placebo IFC. The sample consisted of 142 athletes, aged between 18 and 80 years, that had CLBP for more than 3 months and pain volume bigger or equal to 3 points on the Arithmetic Scale for Pain Evaluation (0-10 points) of both genders. These patients were divided into two groups and underwent

therapy with active IFC or placebo IFC respectively, before doing pilates exercise. For the application of IFC, an alternating current of the medium frequency with the bipolar application was used, with two channels on the pain area. More specifically, 4 kHz frequency, a pulse rate frequency of 100 Hz and, a scanning frequency of 50 Hz was used. Both groups received 6 weeks of therapy, 3 sessions per week, and a total amount of 18 sessions. The pain volume was counted daily on the Arithmetic Scale for Pain Evaluation, before and after every therapy and the statistical analysis was done using the Kaplan-Meier method. After the end of the therapy, the intervention group with IFC showed a pain reduction of 30% more or less 1 session earlier, a pain reduction of 50% 2 sessions earlier, and 100% pain reduction 3 sessions earlier than the placebo IFC group. Therefore, IFC before and after exercise can reduce pain faster than the placebo IFC for patients with CLBP.

IV. DISCUSSION

Ten RCT studies, which examine the effectiveness of IFC were included in this review. A total of 807 patients were included in this review. Most studies (n=6) compared IFC with a placebo and one of those combined a placebo IFC with an exercise program. Three studies compared the different types of IFC and one IFC with “usual caressing”.

Research by [24] and [28] divide their participants into two groups, the group with active IFC and the group with placebo IFC. Their research concluded that IFC contributes to pain reduction and improves the ability to stand and walk and body posture. Another study by [32], also, divide patients into the IFC group and a placebo IFC group and the results showed that the use of IFC before Pilates can lower pain more quickly than the placebo IFC.

Two other studies, one by [25] and [27] compared different types of IFC. The first study by [25] showed that 1 kHz frequency reduced hyperbolic pain in the deep local tissue and also improves the local and partial central sensitization of the patient with chronic low back pain. On the other hand, the study by [27] aimed that 4kHz/100Hz frequency provides immediate relieving results to people with CLBP. Only one clinical trial by [30] showed that IFC was not so effective. However, it concluded that IFC reduced pain before and after the treatment and that it could be used as one intervention method combined with other therapeutic techniques.

Moreover, research by [26] evaluated the short-term effectiveness of the IFC treatment in the handling of pain and disability in people with non-specific CLBP. The results showed that two-week IFC treatment showed significant short-term results in comparison to a “usual caressing” protocol concerning pain-relieving and functionality of people with CLBP.

Research by [29] examined the effectiveness of IFC with exercise and placebo IFC with exercise. The exercise program included exercises such as backbend, pelvis bow and energetic exercises for the strengthening of the abdomen and waist muscles. The researchers concluded that the placebo group presented no significant improvements. However, 4 weeks of IFC intervention and therapeutic exercise are the most effective combination when it comes

to pain relief, the improvement of the range of the low back and the improvement of the quality of life of patients with CLBP. Also, the study by [31] mention that IFC treatment with pumping electrodes resulted in a significantly bigger and clinically more important reduction of the VAS, ODI and SF-scores than the use of IFC with silicone electrodes on patients with CLBP.

Another randomized controlled trial by [23] aimed that the effect of IFC on CLBP treatment with the use of different intervention times. The 1st group received 15 minutes of IFC treatment, the 2nd group received 20 minutes of IFC treatment and the 3rd group received 30 minutes of IFC treatment. None of the groups showed greater results than the other terms of pain perception. However, the shorter IFC intervention time of 15 minutes could be better used for treating CLBP.

V. CONCLUSION

The results of this review demonstrate that the application of the IFC and mainly the 4 kHz current frequency and the 100 Hz pulse rate frequency can contribute to the reduction of pain and can improve the individual's functionality, body posture, as well as the ability to walk and balance. In more detail, 1 kHz and 4 kHz frequencies were found to contribute to the reduction of painkillers consumption, with the 4 kHz current frequency and the 100 Hz pulse rate frequency indicating short-term results both regarding the perceptible pain and the functionality of the patients with CLBP. Only one study mentioned that IFC was not effective for the handling of pain that patients with CLBP experience, however, its application can be supported when it is combined with more treatment methods and techniques. The limitation of this review is that there was sparse literature concerning IFC as an isolated treatment, thus no clear conclusions can be drawn. Further research is needed to fully examine the effects of this treatment in a large number of patients with CLBP and to examine the effects and the implications their long-term use can entail.

CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

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