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Effects of different swing patterns of interferential currents on patients with low back pain: a single control trial

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Subjects and methods: Thirty-nine subjects with clinically and radiographically confirmed degenerative low back pain were recruited for the study. Subjects were randomly assigned into three intervention groups based on three patterns of IFC: 1 integral 1, 6 integral 6, 6 wedge 6. Each patient received 40 minutes of one out of three IFC interventions two times a week for a period of three weeks. The currents were administered via two electrodes using amplitude-modulated frequencies of 50 to 100 Hz.

Results: The results of two-way repeated measures analysis of variance showed a significance of time (p<0.001), but no statistical effect of experimental groups (p=0.89) or interaction (p=0.79). Conclusion: All three swing patterns decreased pain perception over a 3-week treatment. However, none of the three treatment parameters has superiority in pain modulation over each other.

Key words: Low back pain, Interferential current, Swing patterns.
Low back pain is one of the most frequent problems treated by physical therapists worldwide. Therapists often select alternating current of various frequencies or direct current applied continuously or as a train of pulses to treat their patients.1

There are various electric stimulation devices that can deliver electric currents to treat painful conditions within the physiotherapy profession. Interferential current (IFC) is one of the available modalities that are often used in modulating pain in patients with low back pain and other pains originated from musculoskeletal origin. Surveys have shown that IFC is used throughout the world and it is reported to be indicated in providing symptomatic relief of pain.2

The IFC is designed to generate amplitude-modulated interferential wave known as “beat” frequency.3 The principles of IFC is to maximize the current permeating the tissues, whilst reducing to minimum unwanted stimulation to cutaneous nerves is well documented.1,3

Evidence exists that IFC increases an experimentally induced cold pain threshold and decreases experimentally induced ischemic pain when compared with sham. Werners et al reported no significant differences in pain relief among low back patients when the effect of IFC was compared with motorized lumbar traction and massage.4 Similar results were also reported when IFC was used to manage Jaw pain and osteoarthritic knee pain. The IFC was found not to be better sham.5,6 Young et al7 failed to record any significant difference of IFC over placebo. However, Adedoyin et al reported that IFC is better than placebo in managing OA knee pain.8

Despite the widely use of IFC, therapists are still inconsistent in their use of IFC parameters. Wide range of choices exists in IFC machine and therapists can chose or alter pattern of delivery of amplitude-modulated (AMF) wave with continuous and burst patterns. The IFC can equally be set to deliver the AMF wave frequency (AMF) in a way that it will fluctuates between predetermined upper and lower boundaries in an interchangeable manner; this is often known as frequency sweep.9 Swing pattern may be achieved when the AMF moves between the lower and upper frequency boundaries on a fixed time period. Swing pattern is usually used on the premise that nervous system habituates to repetitive electric currents and that altered currents in different frequencies may counteract this effects.10 This assertion is yet to be justified in the literature.

Many of the reports that claimed effectiveness of swing patterns in pain modulation are either anecdotal or are not conducted under controlled experimental conditions.11 Lack of uniformity in the choice of IFC characteristics and treatment protocols are factors that produced inconsistencies in the literature. For example, Quirk et al,6 chose a wide range of frequencies between 0 to 100 Hz as sweep for 10 minutes and later change to 130 Hz for 5 minutes while managing OA of the knee; whereas, Shafshak et al,12 used a short range of 20 to 50 Hz sweep and 1/1 (1 integral 1) as swing pattern for pain modulation. A systematic investigation conducted recently on hypoalgesic effect of swing patterns of IFC on cold induced pain among healthy subjects elevated pain threshold when compared 1/1 IFC and sham IFC.10

Though cold induced pain experimental model is said to be reliable and safe method of recording pain outcome measures, it however, differs from clinical pain, because it results to no tissue damage.13-15 The pain in tissue damage is characterized by hyperplasic and allodynia.9 Clinical investigation to prove these findings is therefore lacking. The purpose of this study was to examine the effects of different swing patterns of IFC among patients with low back pain.

Material and methods

Subjects
Thirty-nine (13 men and 26 women) patients with history of low back pain participated voluntarily in this study. All the subjects were attending an outpatient clinic in the Physiotherapy Department of the Obafemi Awolowo University Hospital Complex, Ile-Ife during the data collection. The Institution’s Ethical Committee approved the study protocol.

Patients who had clinically and radiographically confirmed chronic low back pain and who were on electrotherapy naïve were
selected for the study. Patients with pregnancy, previous spinal surgery, spinal deformities, hypertension, peripheral neuropathies, cardiac pacemaker, and abnormal skin sensation were excluded from the study.

Patients, who expressed willingness to participate in the study, were briefed verbally and in written form on the procedure of the experiment, where necessary vernacular was used. They were told that they will be assigned into one of the three different settings of the IFC and that each setting is capable of relieving their pain. Explanation on the physiologic effect of IFC was provided as follows:9 The stimulator works by activating your body’s pain relieving systems. It does this by delivering currents that travel through your skin to activate the underlying nerves. This produces a response in your body similar to that when you rub a painful part.

**Procedure**

All patients were allocated to one of the three experimental groups (Group 1, 2 and 3) by alternate allocation. The first 3 patients were assigned (1∫1, 6∫6, and 6-6 (6 wedge 6) groups) respectively. The fourth patient therefore automatically assigned to 1∫1 group. Patients were blind to groups’ allocation.

Age, weight, and height of the subjects were recorded on the first visit of the treatment. Patients were made to be familiar with Verbal Semantic Differential Scale (SDS) for rating pain intensity.16 They were told to be honest and point to the level of how strong and severe their pain was on the 10-point scale. The SDS pain rating assessment was conducted at every appointment.

Each patient was positioned in prone lying on the treatment bed. Area to be treated was exposed. Painful areas were confirmed by digital pressure on the vertebra spines. Ely and Laseque’s tests were also performed to locate the spinal roots correspondence to painful area of the low back. Hurley et al recommended the use of IFC over the spinal nerve root for maximum effectiveness.17 Two electrodes well padded with lint were applied to the spinal nerve root correspondence to the painful area of the low back. The electrodes were secured in place by Velcro straps.

All the patients received two treatment sessions daily for 2 times a week for a period of three weeks. Each treatment session lasted 20 minutes IFC. The output of the treatment was delivered through (Endomed 582 ID Enraf – Nonius).

**IFC characteristics**

Each subject received 1 of 3 treatments of either 1∫1, 6∫6, or 6-6. The parameters were selected based on the work of Johnson and Tabasam.9 The AMF was fixed at 100 Hz for the burst group. The sweep between 50 and 100 Hz for 6∫6 and 6-6 groups were set. The range of frequencies was based on the recommendation of Palmer and Martin.18 Carrier frequencies were fixed at 4000 Hz in the channel while channel 2 is set to fluctuate between 4050 and 4100 Hz.

**Statistical Analysis:**

One-way ANOVA was used to compare the pretreatment mean SDS, while separate 2 – way ANOVA was used to compare the mean difference in the three groups across the six treatment sessions. Statistical significance level was set at 0.05. Analysis of data was performed using the SPSS statistical package (Version 11.0).

**Results**

Physical characteristics of the subjects are presented in the Table 1. There was no significant difference in the demographic data among the 3 groups using ANOVA for age (F=1.177, df=2, p=0.320), for weight (F=0.412, df=2, p=0.665), for height (F=0.204, df=2, p=0.816) and for Body Mass Index (BMI) (F=0.349, df=2, p=0.708).

There was no difference in the pretreatment VAS means among the groups when one-way ANOVA was performed (p>0.05).

**Pain intensity**

A 2 – way repeated measures ANOVA 3 X 6 (group X time) performed in the entire data revealed a significant decrease in pain over time (F=155.389, df=5, p<0.001).

Changes over time of pain intensity score are presented in Figure 1. There were no significant effect between groups (F=11.220, df=2, p=0.063) or statistically significant interaction effects (F=0.905, df=10, p=0.529).
Table 1. Physical characteristics of the subjects.

<table>
<thead>
<tr>
<th></th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>55.31±11.7</td>
<td>49.15±11.8</td>
<td>53.08±6.7</td>
<td>1.177</td>
<td>0.320</td>
</tr>
<tr>
<td><strong>Body weight (kg)</strong></td>
<td>72.23±15.17</td>
<td>68.46±11.87</td>
<td>68.0±11.8</td>
<td>0.412</td>
<td>0.665</td>
</tr>
<tr>
<td><strong>Height (m)</strong></td>
<td>1.65±0.04</td>
<td>1.64±0.06</td>
<td>1.65±0.05</td>
<td>0.204</td>
<td>0.816</td>
</tr>
<tr>
<td><strong>BMI (kg/m²)</strong></td>
<td>26.53±5.7</td>
<td>25.62±5.39</td>
<td>24.94±3.2</td>
<td>0.349</td>
<td>0.708</td>
</tr>
</tbody>
</table>

BMI: Body Mass Index.

Figure 1. Mean change in pain intensity scores from pretreatment baseline across treatment sessions.

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Discussion

The purpose of this study was to evaluate the effect of swing patterns of IFC in modulating low back pain. There are claims that swing patterns of IFC modify its analgesic effect in the literature.\textsuperscript{16,20} The result of this study found no significant differences in the swing patterns for pain modulation (VAS score) in low back patients after 20 minutes of IFC treatment over the period of three weeks. To the best of our knowledge, there have been no clinical investigations into the analgesic effects of swing patterns of IFC.

The recent randomized controlled trial has also challenged the claims that different swing patterns of IFC modulate pain.\textsuperscript{9} They recruited forty healthy volunteers and assigned them randomly to receive 1 of 4 IFC treatment intervention of either 1, 6, 6, or burst. Treatment was administered for 20 minutes under a strong but comfortable intensity with amplitude-modulated frequencies of 1 to 100 Hz. They concluded that no differences in the hypoalgesic effects of different swing patterns existed. Though their study was based on experimental cold-induced pain, it supports our own result in clinical pain among low back patients. Martin and Palmer reported earlier that the inclusion of a frequency sweep had no effect on the amount of adaptation experienced by subjects.\textsuperscript{21}

This study does not challenge the effectiveness of IFC in modulation pain. Though, the subjects in this study experienced reduction of pain over time, but the absence of control group is a limiting factor to proof the effectiveness of IFC in pain modulation. Our aim was to compare effects of different swing patterns of IFC in modulating pain. Previous studies have reported that IFC was better than sham in pain modulation.\textsuperscript{7,22}

Literature revealed that therapists often choose swing patterns that are comfortable to patients and in this case wide AMF ranges are often prefer to increase the chances of hitting effective parameters during the sweep circle.\textsuperscript{7} Selection of wide range of treatment band may be less effective than smaller ones, as the wide range will cover the appropriate treatment frequencies but the relative total treatment time will be reduced and some parts of the range might be counterproductive for the primary aims of the treatment.\textsuperscript{23} Our results and that of Johnson failed to support this assertion. Johnson and Tabasam chose a wide range of AMF of 1 to 100 Hz,\textsuperscript{9} while we chose a smaller range of 50 to 100 Hz. Similar study with wider and different range of AMFs of between 20 and 220Hz found no differences in the magnitude of change in pain threshold.\textsuperscript{24}

This present study is limited because of a few numbers of subjects recruited and for the fact that the patients were not followed up after the end of the treatment to monitor the patients’ pain perception. Nevertheless, this study has challenged the claim that swing pattern of IFC has positive role in pain modulation. As the clinical trials on the usefulness of the swing patterns for pain modulation shall continue be reported in the literature, the efficacy of IFC in pain modulation is still substantiated in this study. We recommend further study with larger sample size.

References

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