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Effects of Interferential Current Stimulation for Treatment of Subjects with Recurrent Jaw Pain

KATHY TAYLOR, ROBERTA A. NEWTON, WALTER J. PERSONIUS, and FRANCIS M. BUSH

This study evaluated the effectiveness of interferential current stimulation (ICS) to decrease recurrent jaw pain and to increase maximum vertical jaw opening. Forty subjects with either a history of recurrent jaw pain of three months’ duration or of constant, chronic jaw pain that recurred within the preceding two months participated in the study. Twenty subjects received three 20-minute treatments of ICS, and 20 other subjects received three 20-minute treatments with a placebo procedure. The intensity of jaw pain and the amount of maximum vertical jaw opening were the dependent measures. Scatter diagrams indicated no relationship between the intensity of jaw pain and amount of vertical jaw opening before or after treatment. Statistical tests (p < .05) showed no significant differences in the level of jaw pain or the amount of maximum vertical jaw opening between the ICS and Placebo Groups. We concluded that a short-term ICS treatment proved no more effective than a placebo treatment for decreasing jaw pain or for increasing vertical jaw opening.

Key Words: Electric stimulation, Physical therapy, Temporomandibular joint.

Facial pain, jaw pain, and temporomandibular joint (TMJ) and myofascial pain dysfunction (MPD) syndromes, involving problems with soft tissues and joints of the head and neck, are relatively common in the general population. Of these problems, TMJ and MPD syndromes are the most frequent disorders reported by dental clinicians. Patients with TMJ noises and pain, limited jaw movements, earaches, and tooth and gum aches demonstrate varying degrees of muscle soreness in the jaw, head, and neck. Some cases of facial pain become chronic and recurrent. Currently accepted treatment approaches for the management of facial pain are divisible into several categories. One category involves irreversible dental treatments that often modify the jaw and teeth. More conservative treatments include physical therapy that produces no permanent structural changes to the jaw or dentition.

Some dental practitioners refer patients for physical therapy to reduce pain and improve functional mobility of the jaw, head, and neck. Examples of treatments available include exercise and postural correction, joint and soft tissue mobilization, relaxation, biofeedback, ultrasound, moist heat, ice, and electrotherapeutic stimulation.

Interferential current stimulation (ICS) represents one kind of therapeutic electrical stimulation recently introduced into the United States from Europe. Interferential current therapy produces biphasic pulses within the tissue and does not produce skin irritation, as do some other electrical stimulation techniques. Two medium frequency biphasic pulsed currents, one generally fixed at 4,000 Hz and the other ranging from 4,000 to 4,100 Hz, are applied simultaneously to the body so that the two currents superimpose to produce a new frequency deep within the tissue. Generally, this new frequency ranges from 1 to 100 Hz. Interferential current stimulators use medium frequency currents to overcome high skin and subcutaneous tissue impedance.

Much of the literature on ICS is not written in English, and those that are written in English are descriptive observations, case reports, or anecdotes only. Moreover, they lack the application of statistics. Several authors have argued that ICS has been found empirically to be an effective, adjunctive clinical modality for the treatment of chronic and acute pain syndromes and dysfunction of the neuromusculoskeletal system. Thus, the primary purpose of this study was to examine the effectiveness of ICS in reducing recurrent or chronic jaw pain and improving vertical jaw opening. The research questions were: 1) Will recurrent jaw pain decrease after three ICS treatments applied to the region of the TMJ and muscles of mastectomy as compared with a placebo treatment? and 2) Will vertical jaw opening increase after three ICS treatments applied to the region of the TMJ and muscles of mastectomy as compared with a placebo treatment? The null hypotheses were 1) ICS would not significantly decrease jaw pain in an ICS treatment group as compared with a placebo group and 2) ICS would not significantly increase vertical jaw opening in an ICS treatment group as compared with a placebo group. Another purpose of this study was to determine if ICS would decrease pain and improve vertical jaw opening. The research questions were: 1) Will recurrent jaw pain decrease after three ICS treatments applied to the region of the TMJ and muscles of mastectomy as compared with a placebo treatment? and 2) Will vertical jaw opening increase after three ICS treatments applied to the region of the TMJ and muscles of mastectomy as compared with a placebo treatment? The null hypotheses were 1) ICS would not significantly decrease jaw pain in an ICS treatment group as compared with a placebo group and 2) ICS would not significantly increase vertical jaw opening in an ICS treatment group as compared with a placebo group.

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study was to determine whether a relationship existed between the intensity of jaw pain and the amount of vertical jaw opening.

METHOD

Criteria

Criteria for admission to our study were as follows: 1) Subjects must have had ipsilateral or bilateral jaw pain that was recurrent for a duration of three months or 2) subjects have had constant, chronic jaw pain that recurred within the preceding two months. The subjects who met these criteria reported that pain occurred at rest or with jaw opening. These subjects had none of the following conditions: 1) infectious conditions of the face or jaw, 2) malignant tumors of the face or jaw, 3) dermatological diseases involving the face, or 4) conditions that precluded the use of ICS (eg, artificial pacemaker or cardiac arrhythmia). Forty-five percent of the subjects had a diagnosis of TMJ or MPD syndrome or had undergone TMJ surgery. No definitive diagnosis was made on the remaining 55%.

Subjects

Forty subjects (38 women, 2 men) volunteered to participate in this study. The subjects in the ICS Group (19 women, 1 man) ranged in age from 21 to 61 years (mean age, 30.8 ± 10.6 years). The subjects in the Placebo Group (19 women, 1 man) ranged in age from 18 to 58 years (mean age, 31.7 ± 12.4 years). We asked the subjects to refrain from taking medication or receiving treatment specific for their jaw pain, such as moist heat, ultrasound, ice, or exercises, during the duration of the study. All subjects were given a written explanation of the treatment procedure and signed a consent form.

Procedure

Before each subject entered the testing room, we flipped a coin to determine which treatment the subject would receive, either the ICS or the placebo procedure. The placebo procedure was exactly the same as the ICS procedure except that the subjects were told that they would be receiving a subthreshold current sensation; in actuality, the current dial remained at zero. The subjects were positioned so that they did not face the stimulator but could see its lights using peripheral vision.

Before the first treatment, we asked the subjects to complete a questionnaire on duration of symptoms, previous or ongoing treatment, or conditions that would preclude the use of ICS. Because electrotherpay may have a differential effect on local versus referred pain, we used the following procedure to determine whether each subject’s pain was local or referred. Light-to-deep pressure palpation was performed on specific muscles and the TMJ ipsilateral to the painful jaw. We used standardized techniques for all subjects. Palpation over the upper trapezius and sternocleido-mastoid muscles was performed with the subjects in the seated position. Palpation of the superficial and deep masseter, medial pterygoid, and temporalis muscles; extraoral and intrameatal palpation of the TMJ; and introral palpation of the temporalis muscle tendon and lateral pterygoid muscle were performed with the subjects in the supine position. We then asked the subjects to indicate whether they felt pressure, local pain, or pain elsewhere other than the area directly palpated.

The following assessment procedure was the same for each of the three treatment sessions. Before the treatment session, we asked the subjects to shade an area on a pain diagram indicating the location of the present pain. Next, the subjects marked a 10-cm visual analogue scale (VAS) indicating the level of pain perceived for that day. The left extreme of the VAS was labeled “no pain” and the right extreme was labeled “unbearable pain.”13 We measured in millimeters the distance from the left extreme of the VAS to the subject’s slash mark and recorded the data. With the subjects seated facing the examiner, we asked them to open their mouth as wide as possible. Maximum vertical jaw opening was measured three consecutive times with a Boley gauge.* Measurements were taken from the tip of the right lower incisor to the tip of the upper right incisor. We recorded each measurement in millimeters.

If one side of the jaw was painful, then that side was used in the study. If both sides of the jaw were painful, then the most painful side was used. Every treatment was administered and every measurement was taken by the same person (K.T.).

We then placed the subjects on their backs with a thin pillow supporting their heads. The skin overlying the affected jaw was wiped with alcohol. A Cyborg Quick-Stick Flexible Sensor patch† was impregnated with Aquasonic gel‡ was attached to four snap electrode leads and was placed extraorally about 1 to 1.5 cm in front of the tragus of the ear. This placement covered the approximate region of attachment of the four primary muscles of mastication (masseter, temporalis, and lateral and medial pterygoids) and a portion of the TMJ.

We asked each subject to relax and not to have the upper and lower teeth touching. Next, we set the dials on the Endomed 433§ interferential stimulator to 15 minutes with a sweep frequency of 90 to 100 Hz and a six-second rise-six-second fall oscillation cycle. After 15 minutes, we reduced the sweep frequency to 45 to 90 Hz for five minutes. The intensity was adjusted to the patient’s comfort for those subjects in the ICS Group to produce a minimal visible facial muscle contraction. We asked the subjects to signal when they first felt a “buzzing” or “tingling” feeling under the electrode patch. We increased the intensity for each subject until it was “comfortable”, but not “too strong.” When the subject no longer felt the tingling sensation, we increased the intensity until it was comfortable again. The final intensity range was 1 to 7 mA. We used the same procedure for those subjects in the Placebo Group, except that they were told they were receiving a subthreshold intensity that would not produce any sensation.

At the conclusion of the treatment session, the subjects assumed a sitting position, and we measured each subject’s vertical jaw opening three consecutive times and recorded the data. The time between each treatment session ranged from 24 to 72 hours. After the third and final treatment session, each subject rated the intensity of pain, as compared with the initial intensity of pain, according to a verbal rating scale. This subjective scale used the terms “better,” “no change,” and “worse” to describe the different levels of pain intensity.

Data Analysis

A frequency distribution was plotted to determine whether the subjects’ pre-
TABLE 1
One-Tailed t Test Comparing Reduction of Jaw Pain in the Interferential Current Stimulation Versus Placebo Procedure

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Treatment</th>
<th>( \bar{X} )</th>
<th>s</th>
<th>( S^2 )</th>
<th>Difference ( \bar{X} )'s</th>
<th>Pooled ( S^2 )</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICS</td>
<td>20</td>
<td>pretreatment (Day 1)</td>
<td>37.6</td>
<td>17.2</td>
<td>296.0</td>
<td>17.5</td>
<td>385.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>posttreatment (Day 3)</td>
<td>20.1</td>
<td>21.8</td>
<td>475.1</td>
<td></td>
<td></td>
<td>-0.59*</td>
</tr>
<tr>
<td>Placebo</td>
<td>20</td>
<td>pretreatment (Day 1)</td>
<td>28.3</td>
<td>20.1</td>
<td>404.8</td>
<td>20.8</td>
<td>324.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>posttreatment (Day 3)</td>
<td>7.5</td>
<td>8.0</td>
<td>64.2</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Statistically not significant at \( p < .05 \).

Fig. 1. Intensity of mean jaw pain experienced by the ICS Group (solid line) as compared with the Placebo Group (dashed line). (Pretreatment and posttreatment indicated by preTx and postTx.)

Results of our study show only a slight increase in mean vertical jaw opening in the ICS Group and no change in mean vertical jaw opening in the Placebo Group. Greene and Laskin studied the effects of meprobamate versus a placebo substance on the subjective symptoms (pain and jaw fatigue) and objective signs (TMJ limitation, deviation, noises) of 90 patients with MPD.15 Their results showed 58% improvement of symptoms with meprobamate and 31% improvement with the placebo substance. The patients' symptoms improved the most, whereas their signs seemed to be less affected by the use of either meprobamate or the placebo substance. Our study, therefore, supports the conclusion made by Greene and Laskin that little, if any, change resulted in vertical jaw opening after either ICS or placebo treatments.16

The existence of a placebo effect in the treatment of a variety of diseases and conditions is well substantiated,17 particularly in research on analgesia. Some studies involving drugs report 30% to 66% improvement using a placebo substance.16,18 Studies of the relative effectiveness of electrical modalities and placebos report similar results.15,19 Moss and colleagues state that a major-
TABLE 3
One-Tailed t Test Comparing Jaw Opening in the Interferential Current Stimulation (ICS) Versus Placebo Procedure

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Treatment</th>
<th>(\bar{x})</th>
<th>s</th>
<th>(s^2)</th>
<th>Difference Between (\bar{x})'s</th>
<th>Pooled (s^2)</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICS</td>
<td>20</td>
<td>pretreatment</td>
<td>38.0</td>
<td>9.3</td>
<td>87.2</td>
<td>-2.9</td>
<td>80.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>posttreatment</td>
<td>40.9</td>
<td>8.6</td>
<td>74.6</td>
<td></td>
<td></td>
<td>-1.04*</td>
</tr>
<tr>
<td>Placebo</td>
<td>20</td>
<td>pretreatment</td>
<td>38.6</td>
<td>8.2</td>
<td>66.7</td>
<td>0</td>
<td>74.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>posttreatment</td>
<td>38.6</td>
<td>9.1</td>
<td>81.9</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

* Statistically not significant at \(p < .05\).

Fig. 2. Amount of mean vertical jaw opening produced by the ICS Group (solid line) as compared with the Placebo Group (dashed line).

Clinical Implications and Future Clinical Research

This study answered the question of the effect of ICS versus a placebo treatment on the intensity of jaw pain and amount of maximum jaw opening in a short-term study. Short-term clinical results have demonstrated that ICS treatment for patients with chronic jaw pain has a high placebo component. In future studies, we suggest extending the treatment time to 10 or more treatment sessions to observe whether 1) the placebo stimulation becomes ineffective, thus re-

...
sulting in the loss of placebo effect; 2) an increased positive effect (analgesia) of ICS will occur over time; and 3) an additive effect of ICS will occur over time. Another aspect to investigate is the separate measurement of affective pain versus intensity of pain. The affective pain scale would measure the level of “unpleasantness” of the pain dimension, whereas the intensity would measure the maximum pain tolerance threshold. Additionally, the differential effect of ICS on referred pain sources as compared with application of ICS to local regions of pain should be investigated. Finally, only one particular ICS treatment protocol with predetermined stimulation characteristics was used in this study. Other treatment protocols involving various combinations of stimulation frequency, intensity, and duration may be more or less effective for the treatment of chronic jaw pain.

CONCLUSIONS

No statistically significant decrease in chronic, recurrent jaw pain occurred between subjects treated with ICS and subjects treated with a similar placebo procedure over three treatment sessions. We also found no statistically significant increase in vertical jaw opening between the two groups of subjects over three treatment sessions. No significant relationship existed between the intensity of jaw pain and the amount of vertical jaw opening, either before or after treatment with ICS or the placebo procedure. We concluded, therefore, that a short-term treatment period of ICS had no greater therapeutic effectiveness than a placebo procedure.

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