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Additional Ultrasound Therapy after Myofacial Trigger Point Injection for the Management of Postinjection Soreness

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Objective: The purpose of this study was to investigate the effectiveness of trigger point injection (TPI) and combined treatment on an active myofascial trigger point (MrP).

Design: A controlled clinical trial

Setting: Our study was performed in a rehabilitation outpatient clinic.

Participants: One hundred and sixty-two patients with active MrPs in the upper trapezius were investigated over a two year period, from 1995 to 1996. Forty-six healthy adults were included as the control group.

Control study: The healthy subjects were assigned into three different groups which included healthy subjects without treatment (control group), patients without treatment (patient group) and patients accepting zero-intensity ultrasound treatment (placebo group).

Therapeutic study: Eighty-four patients were treated by TPI. Among these, 43 patients had strong postinjection soreness (PIS) and thus were also treated by ultrasound (combined treatment).

Main Outcome Measures: The pain threshold (PT) of a MrP, on the upper trapezius muscle, was measured by an algometer. The “Index of threshold change” (ITC) was defined as the ratio of post-treatment to pre-treatment PT. The range of motion (ROM) of side flexion of the cervical spine (X-ray) was measured by an goniometer. The “Index of ROM change” (IRC) was defined as the ratio of post-treatment to pre-treatment ROM. ITC and IRC were used to measure the outcome of the different methods.

Results: Both therapeutic groups revealed significant increases (P<0.05) in ITC and IRC, (Table 2 and 3). The combined treatment group had greater increases in ITC and IRC (P<0.05) than the other groups. PIS disappeared about 48 hrs after additional ultrasound therapy.

Conclusion: Both kinds of treatment could relieve myofascial pain caused by MrPs. The combined treatment was the most beneficial method in this study, especially for patients with strong PIS (J Rehab Med Assoc ROC 1998; 26(3): 111 – 118)

Key words: myofascial pain, trigger point, pain threshold, range of motion, postinjection soreness
pain and local twitch responses (LTRs) are two additional characteristics of MrPs and valuable to confirm the diagnosis of myofascial pain.

The principle for treating myofascial pain syndrome is to relieve the pain and tightness by inactivating the active MrPs [7]. TPI had been widely used for such purpose [6,7,13-14]. The TPI is a very effective procedure to control the pain due to MrPs if LTRs are elicited during injection [6,13]. However, PIS (different from the pain due to MrPs) is one of the common complication [6,13]. In clinical practice, we found that combination of treatments with TPI and ultrasound has better effect than TPI only, especially for patients with strong PIS. This study was designed to compare the effectiveness of combined treatment with TPI.

METHODS

Subjects:

From 1995 to 1996, 162 outpatients (32 males, 130 females with average age of 43.7±12.9 y/o) with a mean duration of pain-complaint for about 9 months (8.9±7.6months) were selected from a rehabilitation out patient clinic. All of patients had active MrPs at the location of Tp1 or Tp2 (defined by Simons) [7] in the upper trapezius muscle. Forty-six healthy volunteers (male:17, female:29) with an average age of 46±14.6 years recruited from the hospital staffs were also studied as controls.

Totally, 208 subjects (male:49, female:159) with an average age of 44.1±19.7 years were included in this study.

The diagnosis of a myofascial pain in the upper trapezius muscle is based on the following criteria [7]: 1) a tender spot in a palpable taut band; 2) typical referred pain pattern distributed in the ipsilateral posterolateral upper thoracic paraspinal area; 3) palpable or visible local twitch responses on snapping palpation of the trigger point; 4) restricted range of motion in side bending of the cervical spine (opposite to the involved upper trapezius muscle). Forty six normal subjects were selected with the following criteria: no significant medical problems and no past history of neuromuscular disorder or other chronic pain disorders.

General Experimental Design

In general practice, pain and tightness of the involved muscles are the major clinical complaints of patients with active MrPs [6,7,11]. Therefore, the degree of tenderness and ROM were used as parameters to monitor the result of treatments.

At the first visit and before treatment, three measurements of PT and active ROM of cervical spine read from X-ray films were performed for each subject. Except for control groups, each patient received TPI two times at an interval of one week. Forty patients treated by TPI had strong PIS and they were subsequently treated by ultrasound [7] (combined treatment). Two weeks after the first injection, another three readings of PT in the MrPs and ROM were performed to assess the effectiveness of the treatments. The examiners (trained assistants) were blind to what kind of therapy patient received.

Measurement of pain threshold (PT):

For standardization, the measured MrPs were located within the area of upper trapezius muscle (Tp1 or Tp2 as defined by Simons) [7]. A pressure algometer (Pain Diagnostics & Thermography, Great neck, NY 11023) was used to measure the PT. The algometer has been widely used to assess PT on MrPs [14-18]. It has been proven to be a reliable measurement on PT in either normal or painful muscle [20-22]. The algometer is a force gauge copped with a rubber plate (area – 1 cm²), the pressure exerted on the rubber plate is transmitted to move indicator (scale: kg/cm²). After each measurement of muscle, all subjects were asked to sit relaxedly with feet flat on the floor and hips and knees flexed at 90°. The subject was then instructed to round his/her shoulders. The tester palpated the upper trapezius muscle and located the identified MrP on the muscle which was marked to make sure that the next measurement would be applied on the same site. Pressure was applied at 90° angle to the surface. The increasing rate of pressure was 1-2 mm per second. Subject was asked to say “Yes” when he or she began to feel pain or discomfort, and the compression was stopped immediately. The measurement was repeated twice to obtain a consistent value. Totally, three measurements at 20-60 seconds of interval were taken. The average value of three readings was taken for data analysis.
Measurement of active range of motion (ROM):

Because of the multiplicity of participating joints, the lack of reliable landmark, and the bulk of soft tissue, the measurement of spinal motion would be more reliable \[159\] by measuring the angle on the X-ray film. Subjects were asked to bring his or her ear to the shoulder of the opposite side of MrP as much as possible and AP view of cervical spine X-ray was taken. On the X-ray film, one line drawn between spinous process of T1 and T2 (line A), and another line from C3 to C7 (line B) was also drawn (fig 1). The angle between line A and B was measured by a goniometer and was considered as the active ROM of cervical spine. Spinal X-ray study in extreme of lateral bending was performed for each subject before the treatment and two weeks after the first treatment.

**CONTROL STUDIES**

**Normal control:**

In the normal group, 46 subjects were measured for PT of the MrP at the upper trapezius (left:17, right:29) by algometer; all of them had latent MrPs. They were also measured for ROM. There were two sets of measurements performed between an interval of two weeks, three readings of PT or ROM were taken for each set of measurement, and 46 pieces of normal data were collected.

Patient control: 40 randomly selected patients without treatment were measured by algometer three times at the beginning and the end of two weeks. The average value of three readings were collected for analysis.

Placebo control: 38 patients accepted a course of ultrasound shame therapy with zero intensity (0 watt/cm\(^2\)) for 5 minutes at MrP per day for two weeks. These patients were not informed about this placebo therapy. The PT measurements were performed three times before and after two weeks of therapy, the average values were obtained for statistical analysis.

**Therapeutic procedure:**

Trigger point injection (TPI): Patients in this group were injected with 2-5 ml of 0.5% lidocaine at the MrP. Repeated injection was given one week later. Using the method described by Hong \[6,15,16\], a 23-gauge and 1.25 inches needle was inserted into MrP with multiple insertions to elicit LTRs from the sensitive loci within MrP region. When no more LTRs could be elicited, the needle was withdrawn and the injection site was compressed for two minutes for hemostasis. Each patient was injected twice.

Combined treatment: Among the 84 patients accepted first TPI, 43 patients still felt uncomfortable after injection (strong PIS). All of them were reluctant for another TPI. The ultrasound treatment was given at a dose of 1.2-1.5 watt/cm\(^2\) continuous mode, 5 minutes per treatment, 6 treatments per week for 2 weeks. Therefore, each patient in this group was treated by TPI at the beginning followed by ultrasound on the next day for two
weeks (5 minutes each time, 11 times totally).

**DATA ANALYSIS**

The average value of three readings for each algometer measurement and the angle of ROM were recorded as pre-treatment and post-treatment data. The data were normalized to express the degree of improvement. The "Index of PT change" (ITC) was defined as the ratio of post-treatment to pre-treatment PT. The "Index of ROM change" (IRC) was defined as the ratio of post-treatment to pretreatment ROM. Both ratios were used to indicate the effectiveness of therapy. For example: an ITC or IRC value higher than 1.0 is considered to be "improved", lower than 1.0 to be "worsening" and equal to 1.0 means "unchanged". Two-side analysis of variance (ANOVA) was used to determine the statistical significance. The P value of less than 0.05 was considered as statistically significant.

**RESULTS**

In this study, there were three control groups (normal control, patient control and placebo control) and two therapeutic groups. There was no statistical difference of the mean ages of subjects or the pain-durations of patients among all groups. (Table 1)

For statistical analysis, the values of ITC and IRC were listed in Tables 2 and 3. We found that both therapeutic methods in this study could effectively increase PT and ROM (P<0.05), and PIS was eliminated within 48 hours after injection.

Either ITC or IRC value was very close to 1.0 (Table 2 and 3) in normal control group. No significant difference was found between right and left side values (P>0.05) or between males and females (P>0.05). Therefore, the measurements of PT or ROM are considered as a reliable and valid assessment. In the patient control group, forty patients were measured on the MrPs, and ITC or IRC values were not significantly different (P>0.05) from the normal group (Tables 2 and 3). Therefore, the measurements of PT and ROM in patients without treatment are as reliable as normal subjects.

In the placebo group, 38 patients were measured on the MrPs, and ITC or IRC in placebo group were not statistically different (P>0.05) from normal or patient control group (Table 2 and 3). Therefore, no placebo effect could be identified in this study.

Forty one patients received TPI. ITC or IRC values in this group were significantly greater (P<0.05) than the control group (Tables 2 and 3).

Combined treatment: Forty three patients received combined treatment and their ITC or IRC values were significantly greater (P<0.05) than the control groups. Comparing with the TPI group, they had significantly greater (P<0.05) ITC or IRC values (Tables 2 and 3).

**DISCUSSION**

The pathophysiology of MrP is still unclear. Recent studies explored many basic findings, including the

<table>
<thead>
<tr>
<th>Group</th>
<th>Number subjects</th>
<th>Male</th>
<th>Female</th>
<th>Age (year) Mean ± SD</th>
<th>Duration (month) Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>46</td>
<td>17</td>
<td>29</td>
<td>46.0±14.6</td>
<td>15.6±5.8</td>
</tr>
<tr>
<td>Pain</td>
<td>40</td>
<td>5</td>
<td>35</td>
<td>44.3±17.8</td>
<td>10.2±5.8</td>
</tr>
<tr>
<td>Placebo</td>
<td>38</td>
<td>3</td>
<td>35</td>
<td>43.1±14.4</td>
<td>6.7±3.6</td>
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<tr>
<td>Treatment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TPI</td>
<td>41</td>
<td>10</td>
<td>31</td>
<td>43.2±19.5</td>
<td>8.9±4.3</td>
</tr>
<tr>
<td>Combined</td>
<td>43</td>
<td>14</td>
<td>29</td>
<td>44.2±18.3</td>
<td>9.7±8.5</td>
</tr>
</tbody>
</table>

TPI = trigger point injection;
Combined treatment = trigger point injection (1st day) followed by ultrasound treatment (2nd day to end)
Table 2.  ITC values of control and treatment groups

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Normal</td>
<td>46</td>
<td>1.00 ± 0.13</td>
</tr>
<tr>
<td>Control Pain</td>
<td>40</td>
<td>0.99 ± 0.13</td>
</tr>
<tr>
<td>Control Placebo</td>
<td>38</td>
<td>1.05 ± 0.17</td>
</tr>
<tr>
<td>Trigger Point</td>
<td>41</td>
<td>1.24 ± 0.38*</td>
</tr>
<tr>
<td>Combined treatment</td>
<td>43</td>
<td>1.53 ± 0.66*</td>
</tr>
</tbody>
</table>

*Significantly higher than all three control groups (P<0.05); †significantly higher than all the other groups (P<0.05). ITC = ratio of post-treatment to pre-treatment pain threshold.

Table 3. IRC values of control and treatment groups

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>Mean ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Normal</td>
<td>46</td>
<td>1.01 ± 0.10</td>
</tr>
<tr>
<td>Control Pain</td>
<td>40</td>
<td>1.00 ± 0.24</td>
</tr>
<tr>
<td>Control Placebo</td>
<td>38</td>
<td>1.03 ± 0.26</td>
</tr>
<tr>
<td>Trigger Point</td>
<td>41</td>
<td>1.25 ± 0.58*</td>
</tr>
<tr>
<td>Combined treatment</td>
<td>43</td>
<td>1.60 ± 0.71*</td>
</tr>
</tbody>
</table>

*Significantly higher than all three control groups (P<0.05); †significantly higher than all the other groups (P<0.05). IRC = ratio of post-treatment to pre-treatment range of motion.

The vicious cycle of energy crisis. If the vicious cycle has been broken, the therapeutic effect could be persistent for a longer period [1,2,3]. According to previous reports, TPI could cause an increase of the PT of an active MrP or range of stretching of the involved muscle and had been widely practiced and proved to be effective [5,6,7,35,36,37]. The possible mechanism is that the needle penetrations into the multiple sensitive loci of an MrP can break the vicious cycle of taunt band formation through the spinal cord mechanism [38]. Our findings confirmed the effectiveness of TPI of the MrPs and the active ROM of the involved muscle. To our knowledge, there was no scientific studies to deal with the management of postinjection soreness (PIS). In our studies, 43 patients (84 patients received TPI, 51%) had partial relief, but had strong PIS. They would not accept further injection and shifted to receive the ultrasound. Compared with previous studies [32,36,37], higher percentage of post-injected patients (51%) had PIS. Dr. Simons [7] suggested that the PIS is related to post-injection hemorrhage. Hong [8,36] also found that patients with swelling (hemorrhage) at the injection sites had stronger intensity of soreness. Therefore, the reason why these patients (combined group) didn’t obtain the desirable results of injection was probably due to the needle that we used was 23-gauge instead of 26 or 27-gauge as recommended by Hong [6,12,16]. Larger size of needle may cause more cutting of muscle fibers and capillaries, thus causing more microtrauma, hematoma and inflammatory reaction. For patients who had strong PIS (different from the pain due to MrP itself), subsequent ultrasound was valuable to resolve the hemorrhagic and inflammatory effects.

In this study, the combined treatment was found to be more effective for increasing PT and ROM than TPI only. The PIS disappeared within 48 hours (duration of 2 to 7 days in Hong’s study [12]). It was likely that subsequent ultrasound therapy could resolve the hematoma and inflammatory reaction due to needle insertions. It is our impression that the needle penetrations into the multiple sensitive loci of an MrP can relieve pain and tightness by breaking the vicious cycle of taunt band formation through the spinal cord mechanism, and subsequent ultrasound could resolve the residual needle effects. We suggest that subsequent ultrasound therapy after TPI would be superior than only TPI.
especially when the recommended size of needle was not available.

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板機點注射後以超音波處理注射後酸感對療效的影響

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注射後酸感是板機點注射常見的副作用，本研究目的乃探討注射後以超音波處理酸感對療效的影響。本院自1995至1997年162例肌膚病症候群病患與46例健康成人列入研究。上斜方肌或頸側板機點的痛閾值 (pain threshold) 是以壓力計 (algometer) 測量，Index of Threshold Change (ITC) 定義為治療前後痛閾值比，關節活動度 (Range of Motion, ROM) 為量角器測量頸椎主側屈 X 光所得，Index of ROM change (IRC) 定義為治療前後 ROM 比。三個控制組中正常組46例，病患未治療40例，安慰治療38例。本研究用較粗的23 號針頭，84例注射，43 例(53%)注射後酸感轉以超音波治療 (合併治療組)，41 例注射後酸感未改善 (注射組)，治療期為兩個月。結果：注射組與合併治療組的 ITC, IRC 平均值較三個控制組都具統計差異 (P<0.05)。合併治療組 ITC 與 IRC 平均值統計上大於注射組 (P<0.05)。我們發現注射組與合併治療組能增加上斜方肌板機點痛閾值與關節活動度，合併治療組更優於注射組。酸感經超音波治療後48小時內均消失。本研究注射後酸感比率偏高，推測是注射點造成肌纖維與微血管損傷所致，超音波有助於注射後血腫吸收及抑制炎性反應，建議對有注射後酸感患者採超音波合併治療。（中華復健醫誌 1998; 26(3): 111 - 118）

關鍵詞：肌膜痛 (myofascial pain)，板機點 (trigger point)，痛閾值 (pain threshold)，關節活動度 (range of motion)，注射後酸感 (postinjection soreness)