

Clinical Effect on the Patient with Orofacial Pain through Electro-acupuncture Stimulation Therapy(EAST)

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I. INTRODUCTION

One of most common orofacial pain conditions is temporomandibular disorders(TMDs). The term, temporomandibular disorders, which has been suggested by Bell, includes all disturbances associated with the function of the masticatory system¹⁾. Temporomandibular problems are often viewed as being multi-factorial and multi-etiological disorders. This is in part because temporomandibular problems encompass many possible disorders of the masticatory system. They generally include disorders related to the dysfunction of the temporomandibular joint (TMJ) and the muscles of mastication. It is therefore necessary to evaluate conditions and functions not only of TMJ but also of masticatory muscles for the diagnosis of

TMDs. It is also necessary for the evaluation of treatment efficacy.

Treatment options of TMDs include patient education and self-care, cognitive intervention, physical therapy, pharmacological therapy, orthopedic appliances, occlusal therapy, and surgery. Because all of these treatment modalities have been reported to have a similar treatment efficacy, less invasive, less expensive and more reversible one should be chosen first. Patient education and self-care including some kinds of physical therapy such as moist heat application can be easily performed at home without any invasiveness and professional skills. Therefore patient education and self-care including moist heat application could be used as an initial treatment with other kinds of physical therapy such as coolant therapy, ultrasound therapy, laser, acupuncture, etc.

Acupuncture is one of the health care systems in China that can be traced back for at least 2,500 years. The general theory of acupuncture is based on the premise that there is a pattern of energy flow through the body that is essential for health. Imbalances of this flow are believed to be responsible for diseases. Acupuncture may correct imbalances of energy flow at identifiable points close to skin²⁾. Acupuncture therapy was intended by ancient Korean oriental medical

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doctor to correct blockages or excess in the flow of the vital life force and elements on which physiologic function depended³). In modern Chinese acupuncture, low frequency electrical stimulation of the inserted needles is often used instead of classical method of twirling⁴). Moreover, electroacupuncture performed via surface electrodes has been found to be more effective than that via needles⁵), probably because the amount of current passed can be larger and the seemingly necessary muscle twitches in adjacent regions therefore are stronger. A newly developed electro-acupuncture stimulation therapy (EAST) has been widely used these days because of its effectiveness and less invasiveness.

In several experimental clinical studies, an increase in the pain threshold during acupuncture stimulation and a decrease in pain sensitivity sufficient to allow major surgical events have been reported⁵⁻⁷). It has been reported that EAST has analgesic effects on mandibular anterior teeth and canine^{8,9}). It was suggested that the analgesic effect of EAST was caused by the induction of endorphin release, which increased the pain threshold of whole body. The analgesic action is probably multi-factorial, comprising segmental mechanism at the entry region in the central nervous system, supraspinal descending effects, including the release of endogenous opioids and other neuromodulatory substances and psychological mechanisms.

Orthopedic appliances introduce an optimum functional occlusion that reorganizes the neuromuscular reflex activity while encouraging more normal muscle function. Orthopedic appliances for TMDs have been widely used and reported to be effective by many researchers. An extensive clinical review of the literature revealed that its effectiveness is 70-90%¹⁰). Although an orthopedic appliance is the most common treatment for TMDs, it needs more skillful care and is expensive, compared to the above treatments.

Although all of the above mentioned treatments are included in conservative treatments, they are different from each other with its time and effort consuming. However the comparison of their clinical efficacy in treatment of TMDs have rarely been reported.

Furthermore, the effectiveness of EAST for the long-term relief of chronic pain is still controversial¹¹⁻¹³). The present study is intended to evaluate short-term and long-term clinical efficacy of EAST in comparison with other two types of conservative treatments in TMDs: 1) Patient education and self-care including moist heat application (home-care, HC); 2) EAST treated group (EG); 3) Orthopedic appliance treated group (OA). From this investigation, we expect to suggest a guideline for the treatment planning of TMDs within conservative treatments.

II. MATERIALS AND METHODS

Subjects

Forty-five patients, of which 12 were males and 33 were females, participated in this study. The mean age was 29.1 years, ranging from 19 to 60 years. All subjects were examined clinically and a comprehensive history was taken. Inclusion criteria were signs and symptoms of TMD - pain, noise and limitation of jaw motion. Exclusion criteria were pregnancy, patients with a complex psychosocial situation, patients with too many uncontrolled factors, patients with illness or conditions that might influence TMD symptoms, and patients not interested in participating in this study.

Apparatus

EAST was performed with Pulse Generator (PG)-12 (ITO Co. Tokyo, Japan) at the meridians. PG-12 produced a biphasic wave current (120 μ s pulse width) of 3 Hz for 1 second, 15 Hz for 1 second and the current was slowly increased to cause a strong, but not painful, tingling sensation at the electrode attached area.

The electronic algometer type I (Somedic, Stockholm, Sweden) used in this study consists of a gun shaped application handle with a round rubber tip, a main body that has a digital display panel, calibration knob and control knob of application rate slope, and a patient-operated switch. The pressure pain threshold

(PPT) was measured in kPa by algometer. The algometer handle was applied perpendicularly to the sites and application speed was maintained at 40 kPa/sec.

Procedure

Subjects were randomly assigned to three groups: HC, EG, and OA. Before any treatments, all of the subjects were evaluated their pain intensity with visual analogue scale (VAS), palpation index(PI), dysfunction index (DI) and pressure pain thresholds (PPTs) of masticatory muscles including anterior temporal, anterior masseter, deep masseter, inferior masseter, and TMJ capsules. Every evaluation after treatment was performed in the same manner.

Fifteen subjects were included in HC. They were explained about contributing factors of TMDs. They were then instructed to avoid these factors and to apply moist heat 3 times a day for 15 minutes on their face including TMJ area. They were re-evaluated after one week and other treatments were added according to their symptoms. Another 15 subjects were included in EG. EAST was applied on their S2(HA GWAN), S3(HYUP GEO), and Li4(HAP GOK) for 30 minutes

on their each visit. EAST was applied three times for the first week and then once a week. The subjects were re-evaluated after one week and after one month. The other 15 subjects were included in OA. A splint was applied immediately after the initial evaluation. They were also re-evaluated after one week and after one month.

Statistical Methods

Paired samples t-test was performed to evaluate the differences of VAS, PI, DI, and PPTs between before treatment, one week after treatment, and one month after treatment.

III. RESULTS

Table 1 shows the treatment effect of HC after one week. Statistically significant difference was found in pain intensity, PI and DI. No significant difference was found in PPTs of masticatory muscles.

Table 2 shows the treatment effect of EG after one week and after one month. Statistically significant difference was only found in pain intensity after one week but in pain intensity and PI after one month.

Table 1. Treatment effects of HC after one week.

	Before treatment	One week after treatment
Pain intensity (VAS)	5.2 ± 1.9	4.2 ± 1.7**
PI	0.22 ± 0.24	0.16 ± 0.19**
DI	0.21 ± 0.08	0.18 ± 0.09*
Ant. temporal (PPT)	89.2 ± 20.2	85.3 ± 19.5
Ant. masseter (PPT)	59.5 ± 15.1	63.5 ± 13.1
Deep masseter (PPT)	75.6 ± 20.7	78.5 ± 20.5
Inf. masseter (PPT)	60.8 ± 14.9	63.7 ± 13.8
TMJ capsule (PPT)	73.9 ± 24.8	70.8 ± 20.6

HC : patient education and self-care including moist heat application, home care

VAS : Visual analogue scale

PI : Palpation index

DI : Dysfunction index

PPT : Pressure pain threshold

* : p < 0.05

** : p < 0.01

Table 2. Treatment effects of EG after one week and after one month.

	Before treatment	One week after treatment	One month after treatment
Pain intensity (VAS)	5.6 ± 1.4	3.8 ± 1.8**	3.1 ± 1.9**
PI	0.21 ± 0.09	0.18 ± 0.07	0.15 ± 0.06**
DI	0.03 ± 0.06	0.03 ± 0.05	0.02 ± 0.05
Ant. temporal (PPT)	89.3 ± 21.1	86.2 ± 23.9	89.5 ± 26.7
Ant. masseter (PPT)	64.3 ± 14.6	65.9 ± 13.3	66.5 ± 14.3
Deep masseter (PPT)	78.7 ± 14.3	78.3 ± 15.7	72.3 ± 16.2
Inf. masseter (PPT)	62.3 ± 19.0	65.4 ± 15.3	63.9 ± 15.8
TMJ capsule (PPT)	70.2 ± 15.4	74.0 ± 13.3	71.6 ± 16.1

EG : EAST treated group

VAS : Visual analogue scale

PI : Palpation index

DI : Dysfunction index

PPT : Pressure pain threshold

** : p < 0.01

Table 3. Treatment effects of OA after one week and after one month.

	Before treatment	One week after treatment	One month after treatment
Pain intensity (VAS)	5.6 ± 1.6	4.7 ± 1.4**	3.4 ± 1.5**
PI	0.25 ± 0.31	0.17 ± 0.21	0.15 ± 0.18*
DI	0.18 ± 0.08	0.15 ± 0.08	0.12 ± 0.05**
Ant. temporal (PPT)	83.8 ± 23.0	85.6 ± 22.6	85.7 ± 16.6
Ant. masseter (PPT)	61.2 ± 15.6	62.2 ± 18.3	65.0 ± 20.3
Deep masseter (PPT)	64.0 ± 17.9	74.4 ± 21.4**	75.6 ± 21.5**
Inf. masseter (PPT)	63.0 ± 22.4	64.4 ± 26.0	61.4 ± 20.0
TMJ capsule (PPT)	72.1 ± 16.1	78.5 ± 22.2	73.9 ± 13.2

OA : Orthopedic appliance treated group

VAS : Visual analogue scale

PI : Palpation index

DI : Dysfunction index

PPT : Pressure pain threshold

* : p < 0.05

** : p < 0.01

Table 3 shows the treatment effect of OA after one week and after one month. Statistically significant difference was found only in pain intensity and PPT of deep masseter muscle after one week but in pain intensity, PI, DI, and PPT of deep masseter muscle after one month.

IV. DISCUSSION

Since the presentation of the gate control theory, numerous reports have been published concerning various methods for the treatment of pain based on activation of afferent nerve fibers by electrical stimulation. EAST is one of the treatment modalities

based on gate control theory.

There are considerable evidences that analgesic effects of acupuncture are mediated by an endogenous opiate-like mechanism, although this idea also remains somewhat controversial¹⁴⁻²⁴. It is reported that stimulation by surface electrodes showed very similar effects obtained via needles on pain threshold. Surface electrodes were used in this study because surface electrodes are not invasive and patient acceptance is better⁵.

One week after treatment, pain intensity reported by the patients reduced in all three different types of treatment groups. We found statistically significant reduction in PI and DI in HC. On the contrary, there was no significant difference in other variables including PI, DI and PPT values of masticatory muscles in EG. It is different from other study, which reported the increase of PPTs as well as the decrease of pain intensity after EAST during 2 weeks²⁵. The difference might be caused by that PPTs of different sites were recorded and the evaluation was performed after 2 weeks in their study. Although all treatment modalities have effect on reducing pain after one week, we could find immediate effect on PI and DI in HC group only. It is suggested from this result that patient education and moist heat application is more effective in immediate treatment than EG and OA.

Because of ethical problem, the fifteen patients of HC group were re-evaluated after one week and received further treatments according to their symptoms. Therefore, the evaluation of treatment was only performed in EG and OA group after one month. There was a significant reduction of pain intensity and PI in EG after one month. Although EAST had effect on pain and SPS, it did not increase PPTs of masticatory muscles and TMJ capsules. It seemed that EAST has analgesic effect and reducing effect on tenderness of craniofacial muscles. But EAST did not induce organic changes of masticatory muscles and failed to increase their PPTs in this study. It is not consistent with other study²⁵, which reported the decrease of CMI (craniomandibular index) after EAST during 2 weeks. It may be caused by that they did not analyze PI and DI separately. Furthermore the initial

DI of EG in this study was significantly low in comparison with that of other studies as well as that of other groups in this study.

On the contrary, we could find significant differences in pain intensity and PPT of deep masseter muscle after one week in OA. A stabilization splint showed effect on pain and induced some organic change on deep masseter muscle immediately after treatment. Furthermore, significant improvements were found in pain intensity, SPS, SDS and PPT of deep masseter muscle in OA after one month. It is suggested from this result that stabilization splints have effect not only on reducing symptoms but also on induction of some changes in masticatory system of TMDs patients.

In this study, we obtained more immediate treatment effects from HC than EG and OA groups. This result suggested that the effects of EAST and stabilization splint were not superior to patient education and moist heat application in short-term treatment for TMDs patients. However the treatment period was only one week and the significant treatment effect of EAST or stabilization splint might be expected after more than one month. Further studies including control group with long-term treatment period more than three months are needed to investigate the real treatment efficacy.

Although EAST showed less effectiveness compared with HC group in this study, many studies reported considerable analgesic effect of EAST with long-term therapy. The analgesic action is probably multi-factorial, comprising segmental mechanism at the entry region in the central nervous system¹⁴, supraspinal descending effects, including the release of endogenous opioids and other neuromodulatory substances^{15, 26} and psychological mechanisms²⁷.

It was also reported that the effect of EAST was superior to spontaneous healing in two weeks for TMDs patients²⁵. EAST is reversible and needs less professional skill compared to orthopedic appliances and other invasive treatments. From these with our results, we could find that EAST is one of important treatment modalities for TMDs patients. However, the effect of EAST as a treatment modality for TMDs needs further study, especially for the long-term effect.

V. CONCLUSIONS

To evaluate the clinical efficacy of three different types of treatment in TMDs, we classified TMDs patients into three groups: 1) Patient education and self-care with moist heat application (HC); 2) EAST (EG); 3) Orthopedic appliance (OA). All of the subjects were evaluated their pain intensity with visual analogue scale (VAS), palpation index (PI), dysfunction index (DI), and pressure pain thresholds (PPTs) of masticatory muscles before and after treatment.

The obtained results were as follows:

1. Significant improvements were found in pain intensity, SPS and SDS in HC group after one week.
2. Significant improvements were found only in pain intensity after one week, in pain intensity and PI after one month in EG group.
3. Significant improvements were found in pain intensity and PPT of deep masseter muscle in OA group after one week, but in pain intensity, PI, DI and PPT of deep masseter muscle after one month.

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국문초록

구강안면동통환자에 대한 전기침 자극요법의 임상효과에 관한 연구

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구강안면 동통증 가장 대표적인 측두하악장애를 치료하는데 있어 전기침 자극요법이 갖는 임상적 치료효과를 평가하기 위하여 측두하악장애 환자군을 환자에 대한 교육 및 온습포를 시행하는 자가치료 환자군, 전기침 자극요법을 시행하는 전기침 자극 환자군, 교합안정장치를 장착하는 구강내 장치장착 환자군, 총 3군으로 구분하였다. 이들 환자군에서 치료전과 치료 1주후 및 1개월 후에 visual analogue scale을 이용한 동통의 정도와 두경부의 근육축진지수, 하악의 기능이상지수 및 저작근들의 압력통각역치를 측정하여 다음과 같은 결과를 얻었다.

1. 자가치료 환자군의 1주일 치료후 동통정도, 근육축진지수 및 기능이상지수가 유의하게 감소되었다.
2. 전기침 자극환자군은 1주일 치료후 동통의 정도가 유의하게 감소하였으며 1개월 치료 후 동통의 정도와 근육축진지수가 유의하게 감소되었다.
3. 구강내 장치장착환자군은 1주일 치료 후 동통의 정도가 유의하게 감소하고 심부교근의 압력통각역치가 유의하게 증가하였으며 1개월 치료 후 동통의 정도와 근육축진지수, 기능이상지수가 유의하게 감소하였고 심부교근의 압력통각역치가 유의하게 증가되었다.