The Effects of Transcutaneous Electrical Nerve Stimulation and Electroacupuncture Stimulation Therapy on the Current Perception Threshold of Orofacial Region

Jin-Woo Chung, D.D.S., M.S.D., Ph.D.

Department of Oral Medicine and Diagnosis, College of Dentistry, Kangnung National University

CONTENTS

I. INTRODUCTION

Orofacial pain can be explained as pathology or disorders related to intracranial and extracranial structures, neuropathic, vascular, and psychogenic pain disorders. One of the effective treatments of extracranial disorders (including temporomandibualr disorders and muscular disorders) and neuropathic pain disorders is electrotherapy. Many clinicians became interested in the electrotherapy since Melzack and Wall[1] proposed Gate Control Theory in 1965. The theory provided a rational basis for many of the theories regarding the long observed clinical effectiveness of electrotherapy. Regular activation of afferent nerve fibers under pain threshold by electrical stimulation have been used as an effective method to relieve pain, to reduce inflammation and muscle spasm, to decrease abnormal metabolism, and to promote the repair of damaged nerve tissues. Electrotherapy devices that are used for the treatment of orofacial pain and the restoration of function are divided into high-voltage galvanic stimulation therapy, low-voltage AC generation therapy, interferential currents stimulation therapy, transcutaneous electrical nerve stimulation, and electroacupuncture stimulation therapy.

These numerous types of electrotherapies must be used differently to each patient and disease because they have their own wave forms, polarity, and range of stimulation. But it is not clear that certain types of pain respond better to one of theses therapies than to the

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others. It is, therefore, important to classify and define the effect of each therapy. One of the reasons that the indications of these electrotherapies are still unclear is because the method to quantify sensory abnormalities or pains has been developed insufficiently.

Objective diagnostic measurement of pain can be frustrating for both patients and clinicians because it is not visible and subjective. The most commonly employed diagnostic pain measure is the Visual Analog scale (VAS). The VAS represents a patient's subjective internal measurement of their pain which may not correlate with the severity of their pathology[2]. The evaluation of pressure pain threshold (PPT) is a accurate measurement of pain in response to pressure stimuli. PPT means the minimum pressure value by which a subject feels pain and it can be used as an objective method to evaluate tenderness of muscles in patients with myofascial pain and musculoskeletal dysfunction [3]. It is suspected that PPT measures the responses of mechanical nociceptive sensory fibers which are primarily sensitized to pressure stimuli. Sensory electrodiagnostic procedures provide an objective measure that may be compared to established normative values which permit to grade the severity of the neuropathology. Current Perception Threshold (CPT) tests are functional tests which provide an objective method to measure the functional integrity of sensory nerve from the periphery to the central nervous system[4),5)]. CPT means the minimum amount of a transcutaneously applied current which a subject perceives consciously. The CPT tests can be performed by a Neurometer® CPT/C device. (Fig. 1) The Neurometer can generate three different specific electrical stimuli (2000 Hz, 250 Hz, and 5 Hz) for each large and small myelineated and unmyelineated nerve fibers selectively. The 2000 Hz stimulus evokes responses from the Aβ fibers, the 250 Hz from the Aδ fibers, and the 5 Hz from the C fibers. Each stimulation frequency of CPTs is neuroselective due to differences in rates of accommodation of each nerve fibers. Each nerve fiber has a characteristic neuro-physiological profile[6-8)].

The purpose of this study was to investigate CPT changes of three different nerve fibers on orofacial region following two similar types of electrotherapies, low frequency transcutaneous electrical nerve stimulation (TENS) and electroacupuncture stimulation therapy (EAST), and to evaluate the effect of these two electrotherapies on each nerve fiber.

II. MATERIALS AND METHODS

This study was performed to twenty-nine healthy subjects. Their age ranged from 21 to 28 years with the mean of 24.7±1.5 years. Twenty were males and nine females. Low frequency TENS and EAST were applied for 45 minutes to each subject and the CPTs obtained from three different frequencies were measured before and after stimulation. As a control group, 24 of the 29 subjects received sham-TENS and

Figure 1. Neurometer® CPT/C device (Neurotron Inc., Baltimore, Maryland, U.S.A.)

sham-EAST which were identical to TENS and EAST, respectively, except the electrical stimulation. The CPTs were measured before and after sham-TENS and sham-EAST. Each CPT measurement was done with at least 1 week intervals.

(1) Low Frequency TENS

Low frequency TENS was applied to all subjects by Myomonitor J-4® (Myotronics Inc., Tukwila, WA, U.S.A.) which had been developed for the treatment of orofacial pain. The Myomonitor used in this study was programmed to deliver stimuli of approximately 500 microseconds duration, at 1.5 second intervals. After scrubbing the skin with alcohol sponge, active electrodes were placed on each coronoid notch anterior to the external auditary meatus for the simultaneous stimulation of the V and VII cranial nerves. Dispersing (nonactive) electrode was situated posteriorly at the midline suboccipital area, just below the hairline. Following to the operation guide of Myomonitor, the amplitude was adjusted until the patient's initial muscle contraction occurred. The Myomonitor was performed for 45 minutes in each subject. The CPTs were measured before and after stimulation.

(2) EAST

EAST was performed using a PG-8® (Ito Co., Tokyo, Japan). The PG-8 was adjusted to 120 microsecond duration at a mixed frequency of 3 x 15 Hz in this study. The current intensity was slowly increased until the subject felt a strong, but not painful, tingling sensation at the electrodes. One channel in the PG-8 had two electrodes, positive and negative. After scrubbing the skin with alcohol sponge, three pairs of electrode were attached three acupoints (LI14, S7, and SI19) which had been known to have the analgesic and therapeutic effect of the orofacial region. Each negative electrode was attached to the right acupoint and positive electrode on the same left acupoint. The three acupoints employed in this study are as follows;

- LI4 (Hap Gok) : between the thumb and index finger
- S7 (Ha Kwan) : the deep portion of the masseter muscle just below the zygomatic arch and anterior to the temporomandibular joint
- SI19 (Chung Goong) : the middle of the anterior portion of external auditory meatus

The EAST was also performed for 45 minutes in each subject. The CPTs were measured before and after stimulation.

(3) CPT Measurement

CPT measurement was performed using a Neurometer® CPT/C device (Neurotron Inc., Baltimore, Maryland, U.S.A.) which was described previously. The Neurometer could generate three different sine wave stimulation frequencies (2000 Hz, 250 Hz, and 5 Hz) with a stimulus of constant alternating current (0 to 10 mA). Each frequency gives a CPT value which corresponds to Aβ, Aδ, or C fiber sub-populations. The current was delivered to the skin surface by a pair of 1 cm diameter gold electrodes separated by 1.7 cm and joined by a mylar spreader. A pair of electrodes were located on Trigeminal nerve test sites of orofacial region. CPT measurement was done only on the right side of the subject. The Trigeminal nerve test sites are as follows.

- CN V (Trigeminal nerve) : anterior to the tragus of the ear
- CN V_1 (Ophthalmic division): 1cm superior to the eyebrow in the transverse line
- CN V_2 (Maxillary division) : over the zygomatic arch in the transverse line
- CN V_3 (Mandibular division): over the middle of the lateral mandible in the transverse line

(4) Statistical analysis

Statistical analysis was performed to compare the CPT values of before TENS, EAST, sham-TENS, and sham-EAST using ANOVA. The main response variable, CPT change, was calculated as a delta value for the CPT change of after therapy when it was compared to before therapy. Statistical analyses using t-test were performed to compare the mean values and to examine the effects of variables.

Ⅲ. RESULTS

(1) Comparisons of CPT values of before therapy in each groups

There were no significant differences in the CPT values of before therapies among sham-TENS, sham-EAST, TENS, and EAST groups in all trigeminal nerves and nerve fibers. (Table 1)

(2) CPT changes between before and after TENS

Generally, delta values of CPT between before and after TENS were higher than those of CPT between before and after sham-TENS in all trigeminal nerves and nerve fibers. There were significant differences in delta values of CPT between TENS and sham-TENS groups in Aβ-fibers of V ($p<0.005$) and V2 ($p<0.05$). The delta values of CPT also showed siginificant differences between TENS and sham-TENS groups in the Aδ-fibers of V1 ($p<0.005$) and V3 ($p<0.01$), and in the C-fibers of V ($p<0.05$) and V3 ($p<0.005$). (Table 2)

(3) CPT changes between before and after EAST

In case of EAST, the delta values of CPT in EAST groups were also higher than those in sham-EAST group in all trigeminal nerves and nerve fibers. There were significant differences in delta values of CPT between TENS and sham-TENS groups in Aβ-fibers of V ($p<0.005$), V1 ($p<0.01$), and V2 ($p<0.05$). The delta values of CPT also showed significant differences between TENS and sham-TENS groups in the Aδ-fibers of V ($p<0.01$) and V3 ($p<0.01$), and in the C-fibers of V1 ($p<0.01$). (Table 3)

(4) Comparisons of delta values of CPT between TENS and EAST groups

There were no significant differences in the delta values of CPT between TENS and EAST groups. (Table 4)

Ⅳ. DISCUSSION

Acupuncture and electroneedling treatments have been used predominantly in the Eastern countries for the management of patients with variety of pains. Similarly, neuromuscular electrical stimulation is commonly employed in Western countries to modulate pain, augment muscle strength and enhance blood flow in many types of patients. Long and expanding history of electrical stimulation in medicine has made it a

Table 1. Comparisons of CPT values of before therapy in the case of control, TENS, and EAST.

Nerve	Nerve Fiber	Therapy	Mean±S.D.	Significance	Nerve	Nerve Fiber	Therapy	Mean±S.D.	Significance
V	Aβ	Sham-TENS	80.3±37.5	N.S.	V2	Aβ	Sham-TENS	95.5±31.2	N.S.
		Sham-EAST	79.7±36.8				Sham-EAST	95.5±30.7	
		TENS	87.3±38.5				TENS	106.3±40.6	
		EAST	90.0±34.1				EAST	117.1±44.4	
	Aδ	Sham-TENS	18.9±11.2	N.S.		Aδ	Sham-TENS	20.3±10.9	N.S.
		Sham-EAST	17.6±11.0				Sham-EAST	19.0±6.8	
		TENS	21.0±12.5				TENS	22.5±12.3	
		EAST	19.5±10.8				EAST	26.1±18.4	
	C	Sham-TENS	9.0±6.9	N.S.		C	Sham-TENS	13.5±5.6	N.S.
		Sham-EAST	8.5±6.2				Sham-EAST	14.2±6.7	
		TENS	13.6±9.2				TENS	13.3±8.7	
		EAST	11.7±8.3				EAST	14.2±10.3	
V1	Aβ	Sham-TENS	90.3±34.5	N.S.	V3	Aβ	Sham-TENS	85.0±28.6	N.S.
		Sham-EAST	95.7±38.9				Sham-EAST	88.5±31.2	
		TENS	110.0±32.0				TENS	96.8±39.6	
		EAST	102.3±36.1				EAST	101.0±34.5	
	Aδ	Sham-TENS	26.5±14.3	N.S.		Aδ	Sham-TENS	20.0±11.9	N.S.
		Sham-EAST	24.9±13.6				Sham-EAST	22.4±13.4	
		TENS	24.8±10.7				TENS	22.9±16.7	
		EAST	23.2±12.7				EAST	21.3±9.8	
	C	Sham-TENS	13.8±8.3	N.S.		C	Sham-TENS	12.8±8.5	N.S.
		Sham-EAST	14.6±9.1				Sham-EAST	13.5±9.6	
		TENS	11.5±5.3				TENS	11.6±7.4	
		EAST	12.9±8.4				EAST	13.8±10.2	

N.S.: *not significant*

familiar modality in the everyday practice of neurology, cardiology, and physical medicine.

Transcutaneous electrical nerve stimulation (TENS) is a popular form of electrical stimulation pain control. The classical TENS employed a low intensity current at high frequency (50 to 100 Hz) to the skin. This method is designed to stimulated the large myelineated afferent Aβ fibers that activate the descending inhibitory mechanism without

Table 2. Delta value between before and after TENS in each Trigeminal nerve.

Nerve	Nerve Fiber	Therapy	Both (n=24)		Male (n=18)		Female (n=6)	
			Mean±S.D.	Significance	Mean±S.D.	Significance	Mean±S.D.	Significance
V	Aβ	Sham-TENS	-17.4±25.7	***	-19.1±28.1	***	-12.2±17.2	*
		TENS	26.1±31.3		28.7±34.1		18.2±21.0	
	Aδ	Sham-TENS	-4.6±12.2	N.S.	-3.9±12.9	N.S.	-6.7±12.2	N.S.
		TENS	4.0±16.1		4.5±18.1		2.3±8.6	
	C	Sham-TENS	-1.3±6.4	*	-1.4±6.9	*	-0.8±5.0	N.S.
		TENS	3.6±10.1		5.6±10.7		-2.3±4.5	
V1	Aβ	Sham-TENS	6.7±32.1	N.S.	7.0±36.6	N.S.	5.8±12.7	N.S.
		TENS	22.9±29.6		26.0±31.7		13.5±21.5	
	Aδ	Sham-TENS	-5.6±9.6	***	-6.5±10.4	***	-2.8±6.4	N.S.
		TENS	6.3±11.6		8.2±11.6		0.7±10.7	
	C	Sham-TENS	-1.4±6.1	N.S.	-1.2±6.3	N.S.	-1.8±6.1	N.S.
		TENS	4.3±8.9		4.8±8.9		2.7±9.3	
V2	Aβ	Sham-TENS	-5.6±30.3	*	-4.5±31.1	*	-8.8±30.2	N.S.
		TENS	20.2±40.5		22.2±46.0		14.0±16.9	
	Aδ	Sham-TENS	0.2±12.1	N.S.	1.1±13.2	N.S.	-2.7±8.2	N.S.
		TENS	4.7±11.7		3.8±12.4		7.2±10.1	
	C	Sham-TENS	-0.9±6.0	N.S.	-0.9±6.4	N.S.	-1.0±5.2	*
		TENS	3.0±10.4		2.0±11.8		6.1±3.4	
V3	Aβ	Sham-TENS	1.1±25.8	N.S.	1.6±29.5	N.S.	-0.5±10.0	N.S.
		TENS	15.6±32.4		15.9±37.1		14.5±11.7	
	Aδ	Sham-TENS	-1.2±8.5	**	-1.6±9.2	*	0.0±6.4	N.S.
		TENS	7.1±11.0		7.0±11.9		7.3±8.8	
	C	Sham-TENS	-3.5±7.8	***	-4.1±8.6	***	-1.8±4.6	N.S.
		TENS	4.4±8.4		5.1±7.8		2.3±10.3	

N.S.: not significant , *: $p<0.05$, **: $p<0.01$, ***: $p<0.005$

involving the opioid peptides[9]. Classical high frequency TENS is characterized by fast onset of relief and short therapeutic effect. There is little or no endogenous opiate liberation and no reversal by naloxone[10]. The effect of high frequency TENS can be explained by primarily a local CNS effect. Low frequency TENS (0.5 Hz to 10.0 Hz) activates small nociceptive afferent

Table 3. Delta value between before and after EAST in each Trigeminal nerve.

Nerve	Nerve Fiber	Therapy	Both (n=24)		Male (n=18)		Female (n=6)	
			Mean±S.D.	Significance	Mean±S.D.	Significance	Mean±S.D.	Significance
V	Aβ	Sham-EAST	-19.8±28.3	***	-20.9±30.7	***	-16.7±21.2	N.S.
		EAST	28.8±46.3		30.9±44.7		22.2±54.6	
	Aδ	Sham-EAST	-2.9±9.5	**	-2.3±9.6	*	-4.7±10.0	N.S.
		EAST	6.3±13.3		7.4±14.1		2.8±11.0	
	C	Sham-EAST	-2.0±6.4	N.S.	-2.3±7.2	N.S.	-1.0±3.3	N.S.
		EAST	2.7±9.0		3.2±10.0		1.4±5.7	
V1	Aβ	Sham-EAST	0.5±25.0	**	1.1±28.6	*	-1.2±9.6	N.S.
		EAST	23.2±34.9		23.1±34.6		23.5±39.3	
	Aδ	Sham-EAST	-1.0±11.1	N.S.	-2.1±12.2	N.S.	2.5±7.1	N.S.
		EAST	4.5±12.1		2.6±11.9		10.0±11.9	
	C	Sham-EAST	-2.1±5.4	**	-1.3±5.1	*	-4.3±6.2	N.S.
		EAST	3.3±7.0		3.2±7.3		3.7±6.6	
V2	Aβ	Sham-EAST	-10.8±34.6	*	-13.6±35.5	*	-2.5±33.0	N.S.
		EAST	14.4±33.5		16.6±37.0		7.8±21.1	
	Aδ	Sham-EAST	2.5±13.2	N.S.	3.2±14.8	N.S.	0.3±6.8	N.S.
		EAST	3.3±10.9		4.6±11.4		-0.8±9.0	
	C	Sham-EAST	-0.7±11.1	N.S.	-0.1±12.5	N.S.	-2.3±5.2	**
		EAST	4.6±7.0		3.2±7.2		8.6±4.3	
V3	Aβ	Sham-EAST	-1.8±26.1	N.S.	-1.3±27.5	N.S.	-3.0±23.5	N.S.
		EAST	13.1±47.6		13.3±54.2		12.7±20.8	
	Aδ	Sham-EAST	-4.5±10.1	**	-5.3±9.9	*	-1.8±11.1	N.S.
		EAST	4.3±10.0		4.3±11.3		4.2±4.8	
	C	Sham-EAST	-1.7±10.2	N.S.	-1.9±11.1	N.S.	-1.2±7.7	N.S.
		EAST	1.5±7.5		1.0±8.5		2.8±2.8	

N.S.: not significant , *: $p<0.05$, **: $p<0.01$, ***: $p<0.005$

and motor efferent fibers. It can produce endogeneous opiate liberation, naloxone reversal, and long therapeutic effect[11]. The low frequnecy TENS also produces relaxation of muscles and increasing local blood circulation. The low frequency TENS has been reported to be effective in treating the patients with myofascial pain dysfunction syndrome[12].

Table 4. Comparisons of delta value between TENS and EAST therapy in each Trigeminal nerve.

Nerve	Nerve Fiber	Therapy	Both (n=29)		Male (n=20)		Female (n=9)	
			Mean±S.D.	Significance	Mean±S.D.	Significance	Mean±S.D.	Significance
V	Aβ	TENS	27.4±32.4	N.S.	32.2±34.4	N.S.	16.9±26.3	N.S.
		EAST	22.8±46.3		29.9±43.5		6.9±50.9	
	Aδ	TENS	4.5±15.4	N.S.	5.2±17.3	N.S.	3.0±11.0	N.S.
		EAST	5.4±13.4		7.5±14.6		1.0±9.8	
	C	TENS	3.3±9.3	N.S.	5.1±10.3	N.S.	-0.7±5.0	N.S.
		EAST	3.6±9.5		4.4±10.8		1.7±5.5	
V1	Aβ	TENS	22.1±27.9	N.S.	23.8±31.1	N.S.	18.6±20.2	N.S.
		EAST	19.6±33.6		22.2±33.4		13.7±35.2	
	Aδ	TENS	6.1±10.7	N.S.	8.0±11.1	N.S.	2.0±8.8	N.S.
		EAST	3.5±11.6		2.8±11.5		4.9±12.5	
	C	TENS	4.2±8.2	N.S.	4.9±8.6	N.S.	2.6±7.6	N.S.
		EAST	3.2±7.3		3.7±7.9		2.2±5.9	
V2	Aβ	TENS	21.0±38.7	N.S.	24.9±45.3	N.S.	12.4±15.8	N.S.
		EAST	16.2±33.3		19.5±37.4		9.0±21.6	
	Aδ	TENS	4.8±11.4	N.S.	3.4±11.9	N.S.	7.8±10.2	N.S.
		EAST	3.4±10.5		5.4±11.1		-1.2±7.6	
	C	TENS	2.7±9.8	N.S.	2.1±11.1	N.S.	4.3±6.0	N.S.
		EAST	4.8±7.1		3.9±8.0		6.8±4.4	
V3	Aβ	TENS	15.8±29.8	N.S.	14.9±35.5	N.S.	17.9±11.2	N.S.
		EAST	12.1±43.6		12.4±51.5		11.6±18.1	
	Aδ	TENS	5.7±10.7	N.S.	6.5±11.3	N.S.	3.8±9.6	N.S.
		EAST	3.7±10.1		4.3±10.8		2.4±8.8	
	C	TENS	4.3±8.1	N.S.	5.0±7.4	N.S.	2.7±9.8	N.S.
		EAST	0.5±8.1		-0.1±9.5		1.9±4.3	

N.S.: not significant

During the past decade, many clinicians became interested in Oriental acupuncture methods. Acupuncture stimulates certain points on or near the surface of the body by inserting needles. As an ancient Oriental therapeutic art, it has been practiced in China for more than 5000 years. This method initiated a nociceptive research to explain its mechanism. In 1975, the discovery of the endogeneous antinociceptive system can explain the some actions of acupuncture[13]. At that time the research into electroacupuncture could be established[14]. This method utilizes low frequency but high intensity electric current. It is applied at specific cutaneous sites, so-called acupoints. The acupoint can be explained by low impedance, highly innervated and vascularized region. Many textbooks of acupuncture therapy demonstrate the specific acupoints which have the therapeutic and analgesic effect of specific body area[15),16]. Many pain specialists believe that electrical stimulation of acupoints with surface electrodes can elicit the same physiological and therapeutic effects as those produced by acupuncture and electroneedling techniques[17]. Electrical stimulation of acupoints with surface electrodes is a non-invasive treatment with potential clinical application in the management of patients with pain. There are controversies in the literature regarding the effects of traditional acupuncture, electroneedling and surface electrode electrical stimulation treatments of pains. The antinociceptive action of electroacupuncture therapy can be explained at the segmental or general levels. Bell suggested that the segmental relief of pain is thought to involve the CSF ehkephalin level, while the general effects appear to involve the hormonal action of endorphins secreted by the pituitary gland into the blood stream[9].

Both EAST and low frequency TENS have proven to be effective in treating nociceptive pain conditions and have analgesic effect. In the treatment of chronic orofacial pain, low frequency TENS and EAST have gained considerable interest. Many studies apparently have demonstrated its therapeutic effectiveness in these applications. Hansson and Ekblom[18] previously reported that about 40% of patients with acute orofacial pain showed a reduction in pain intensity after TENS. Chen et. al.[19] reported that TENS at ST36 points decreased the opioid analgesic requirement of postoperative patients. Chung et. al.[20] reported that the sensory and pain thresholds of mandibular posterior teeth were increased after EAST at LI4 points. Wilderstrom et. al.[21] demonstrated an elevated pain threshold after the treatment with low frequency TENS in patients suffering from chronic musculoskeletal pain in the neck and shoulder region. They also showed an elevated pain threshold after the acupuncture stimulation at ST7, ST6, SI18, ST8, and GB14 points[22]. In the present study, both low frequency TENS and EAST equally induced CPT elevations of three types of nerve fibers in overall trigeminal nerves. This indicates that both low frequency TENS and EAST have analgesic and antinociceptive effects on peripheral nerves.

There are many studies about the mechanisms of analgesic and antinociceptive effects of peripheral afferent nerve stimulation by either low frequency TENS on special acupoints or EAST. Pert et. al.[23] demonstrated that auricular EAST to rats produced a significant depletion of the endogeneous opiates in several brain regions as well as a concomitant increase of endorphin-like substance in the CSF. Luo[24] reported that changes in the releasing rate of spinal substance P, cholecytokinin octopeptide, and met-5-enkephalin were presented after repeated EAST on rats. Jeong et. al.[25] suggested that the endogeneous opioid system is profoundly related to the stimulation of peripheral nerve with low frequency and high intensity, but the relation is decreased when the peripheral nerve stimulation is applied with high frequency and high intensity. They also suggested that the GABAergic system may have been partially associated with the analgesic action of high frequency peripheral nerve stimulation. Han et. al.[26] reported low frequency TENS produced a marked increase of met-enkephalin level in CSF whereas high frequency TENS did not. Jansen et. al.[27] explained the peripheral mechanisms of EAST and TENS. They suggested that antidromic stimulation of afferent nerve fibers resulted in the release of vasoactive substances.

In this study, the author investigated the effects of Myomonitor and EAST which are frequently used for the treatment of orofacial pain on the neuroselective CPT changes. The Myomonitor application used in this study can be explained as low frequency TENS at low intensity on non-acupoints whereas the EAST application in this study can be explained as low frequency TENS at high intensity on special acupoints. However, the location which the electrodes of Myomonitor were placed on is near the S7 point of EAST application in this study. Although the nerve fibers which showed significant CPT elevations after two applications did not coincide, the two types of electrical stimulation had general CPT increasing effects on Aβ, Aδ and C-fiber and there were no significant differences between the effects of two electrical stimulations.

The CPT evaluation used in this study is a relatively new, quantitative sensory test which provides a reproducible functional assessment of the peripheral sensory nervous system. Painful conditions are almost universally associated with sensory impairments, so the CPT evaluation is a quick, painless, and reproducible neurometric method in the management of the patient suffering from pain. Clinically, abnormal CPT changes of trigeminal nerves were obtained from the patients with temporomandibular dysfunction syndrome, fibromyalgia, and severe fatigue. Each stimulation frequency of the CPT is neuroselective due to differences in rates of accommodation of the major classes of nerve fibers[4)-8)]. The low frequency stimulus detects responses of small unmyelineated nerve fibers and the higher frequency stimulus detects responses of larger fibers. Veves et. al.[28] demonstrated a correlation between high or low frequency abnormalities on CPT testing and electron microscopic changes in sural nerve biopsies from diabetic patients.

TENS and EAST were proved to be effective methods to relive orofacial pain. Further studies are necessary to differentiate the effects of TENS from EAST using many diagnostic applications and altering duration, intensity, and location of stimulation. Pain is a complex phenomenon which challenges clinicians to develop multidisciplinary diagnostic and treatment competencies, therefore, the treatment of pain as a symptom only is likely to fail. There must be objective and standardized diagnostic pain measurements and careful psychosocial evaluations.

V. CONCLUSIONS

This study was performed to investigate CPT changes of three different nerve fibers on orofacial region following two similar types of electrotherapies, low frequency transcutaneous electrical nerve stimulation (TENS) and electroacupuncture stimulation therapy (EAST) which frequently used for the treatment of orofacial pain in present time. The Myomonitor, low frequency TENS was applied to coronoid notch area of each 29 patients and EAST was also done at LI14, S7, and SI19 points to the same patients. As a control group, 24 of the 29 subjects were received sham-TENS and sham-EAST which were identical to TENS and EAST, respectively, except the electrical stimulation. Although the nerve fibers which showed significant CPT elevations after two applications did not coincide, the two types of electrical stimulation had general CPT increasing effects on Aβ, Aδ and C-fiber and there were no significant differences between the effects of two electrical stimulations. This implies both low frequency TENS and EAST can influence on the peripheral sensory nerves and be effective methods to relive pain of orofacial region.

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국문초록

구강안면영역에서의 경피성 신경자극과 전기침자극요법이 전류인지역치에 미치는 영향

강릉대학교 치과대학 구강내과·진단학 교실

정 진 우

구강안면동통 환자의 치료법으로 널리 쓰이는 전기요법은 연조직과 신경계 구조물에 대한 치료 시 중요한 역할을 담당하고 있다. 저자는 현재 구강안면동통의 치료법으로 널리 쓰이고 있는 전기요법들 중 경피성 신경자극(Transcutaneous electric nerve stimulation)과 전기침자극요법(Electroacupuncture stimulation therapy)이 각각의 신경섬유에 미치는 효과를 평가하고자 정상 성인 남녀 29명에게 경피성 신경자극 및 전기침자극을 시행하고 시행 전 및 시행 후 삼차신경 영역의 3가지 종류(Aβ, Aδ, C fiber)의 신경섬유의 전류인지역치(CPT) 변화를 측정하여 그 차이점을 분석하였으며 이를 대조군과 비교하였다. 경피성 신경자극 및 전기침자극 모두에서 대조군에 비해 삼차신경 영역의 모든 신경섬유에 걸쳐 고른 전류인지역치의 증가를 나타내었으며, 경피성 신경자극과 전기침자극 후의 전류인지역치 변화량은 서로 유의할만한 차이를 나타내지 않았다. 이는 경피성 신경자극 과 전기침자극 모두 3가지 종류(Aβ, Aδ, C fiber)의 감각신경섬유의 전류인지역치에 영향을 미치며, 구강안면동통의 감소에 효과적으로 사용될 수 있으리라 생각된다.

Key words : CPT, Transcutaneous Electrical Nerve Stimulation (TENS), Electroacupuncture Stimulation Therapy (EAST)