

SOUTH BAYLO UNIVERSITY

**Effects of Traditional Acupuncture with Electric Stimulation on Carpal Tunnel
Syndrome: Case series**

by

Soojung Jeong

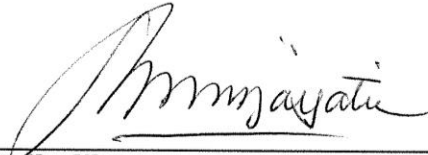
**A RESEARCH PROJECT SUBMITTED
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE**

Doctor of Acupuncture and Oriental Medicine

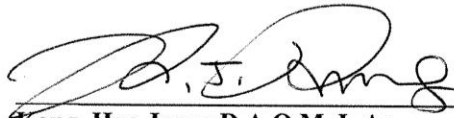
ANAHEIM, CALIFORNIA

March 2019

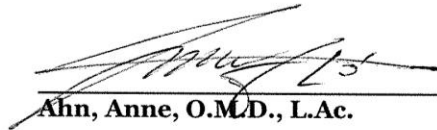
APPROVED BY RESEARCH PROJECT COMMITTEE



Trikadibusana, Sandjaya, D.A.O.M., L.Ac.



Kang, Hyo Jeong D.A.O.M. L.Ac.



Ahn, Anne, O.M.D., L.Ac.



El-Habbal Rabiha, D.A.O.M., L.Ac.



Cho, Ki Haeng, Ph.D., L.Ac.

South Baylo University

Anaheim, California

March 9, 2019

COPYRIGHT

BY

SOOJUNG JEONG

2019

Effects of Traditional Acupuncture with Electric Stimulation on Carpal Tunnel

Syndrome: Case series

Soojung Jeong

SOUTH BAYLO UNIVERSITY, ANAHEIM, 2019

Research Advisor: Qiwei Zheng, OMD, L.Ac.

ABSTRACT

Carpal tunnel syndrome, which is caused by compression of the median nerve at the wrist. It passes from the forearm to the palm, finger. In order to investigate the effects of Acupuncture with electric stimulation in the treatment of Carpal Tunnel Syndrome (CTS), a case series trial with 10 participants was conducted. Participants were treated once a week for 5 weeks. The acupuncture points selected are PC7, SJ5, LU5 and LI5 with electric stimulation on PC7 and SJ5. Visible Analogue Scale (VAS) and Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) were used to evaluate the progress and outcome of the treatments. The mean value of VAS score decreased significantly from 6.3 ± 0.62 to 3.3 ± 0.46 which showed clinical significance ($p=0.000$) by the paired *t*-test. From the analysis of VAS, dichotomous data showed 0.6 and 1.5 for Risk and Odds of Pain respectively and the improvement of treatment rate was calculated as 40.0%. The

mean score of BCTQ symptom was improved from 33.1 ± 3.84 to 19.80 ± 5.64 and the mean change was 13.30 ± 5.64 , which showed clinical significance ($p=0.001$), by the paired t -test. The mean score of BCTQ function was improved from 28.5 ± 3.98 to 15.9 ± 3.28 and the mean change was 12.6 ± 3.06 , which showed clinical significance ($p=0.001$), by the paired t -test. From the analysis of BCTQ, dichotomous data showed 0.3 and 0.42 for Risk and Odds of pain respectively and the improvement of treatment rate was 70.0%. Although this trial was completed after the 5th treatments, the regression analysis showed with one more treatment, we can expect to reach the level of VAS less than 3, the tolerable pain level as well as the goal of treatment. It was concluded that acupuncture treatment with electric stimulation is effective for carpal tunnel syndrome.

Keywords: Carpal Tunnel Syndrome, Acupuncture, Electric Stimulation, VAS, BCTQ

TABLE OF CONTENTS

ABSTRACT	
I. INTRODUCTION	1
OBJECTIVES OF STUDY	5
LITERATURE BACKGROUND	6
II. MATERIALS AND METHODS	9
III. RESULTS	20
IV. DISCUSSION	38
V. CONCLUSION	40
REFERENCES	42
APPENDICES	45

LIST OF TABLES

Table 1. Boston Carpal Tunnel Syndrome Questionnaire (BCTQ)	16
Table 2. General Characteristics of Patients	22
Table 3. Dichotomous result of acupuncture treatment with electric stimulation in VAS for carpal tunnel syndrome.	26
Table 4. Reduced risk and odds pain in terms of the VAS score after acupuncture treatment for CTS.	26
Table 5. Cumulative treatment effect and treatment rate on VAS	28
Table 6. Difference of BCTQ symptom and function questionnaires'	34
Table 7. Treatment Rate of BCTQ before and after treatment.	36
Table 8. Dichotomous result of acupuncture treatment with electric stimulation in BCTQ total score difference for carpal tunnel syndrome.	38
Table 9. Reduced risk and odds pain in terms of the BCTQ total score after acupuncture treatment for CTS.	39

LIST OF FIGURES

Figure 1. Tinel's sign	3
Figure 2. Phalen's Test	4
Figure 3. Schematic Diagram of Research Design	11
Figure 4. Acupuncture points location	14
Figure 5. Visual Analogue Scale (VAS)	16
Figure 6. Boxplot of VAS before and after each treatment	24
Figure 7. Bar graph of Cumulative treatment rate (%) on VAS	28
Figure 8. Linear regression of treatment before and after with VAS values	31
Figure 9. Boxplot of BCTQ before and after each treatment	33
Figure 10. Treatment Rate of BCTQ before and after treatment	35

I. INTRODUCTION

In the United States, an estimated 2.7 million people made an appointment with doctor for complaining about finger, hand or wrist problem. Carpal tunnel is a narrow passageway on the palm side of your wrist made up of bones and ligaments. The median nerve, which controls sensation and movement the thumb and first three fingers, runs through this passageway along with tendons to the fingers and thumb. [1]

Carpal tunnel syndrome (CTS) is caused by compress nerve, median nerve, in the carpal tunnel. If they are congenitally limited carpal tunnel or wrist swelling from wrist traumatic like to be rheumatism patient, hypothyroidism patient, stagnation fluid of pregnant or stress from working. In most common diagnosis in patients with burning, tingling, or itching numbness in the palm of the hand and three fingers.

CTS is about to occur in 3.8% of the general population with an incidence rate of 276:1000000 per year and happens more frequently in women than in men. [2] Some Scientists says most women's wrist bone is smaller than men's. or women also deal with strong hormonal changes during pregnancy and menopause. These make them more suffer from CTS. [3] And These days, people use their desktop computers or laptops at their work or study. That means we all uses hands/finger in long time.

Carpal tunnel syndrome can be divided as surgical and non-surgical. [4] Surgical treatment is various incision techniques of open carpal tunnel surgery. Non-surgical is injections of anti-inflammatory rugs, vitamins, cortical steroid and ultrasound therapy, manual therapy and acupuncture. Treatment decisions on carpal tunnel syndrome are

based on the severity of the symptoms. The abnormal pressure on the nerve can result in pain, numbness, tingling, and weakness in the hand.

Western medicine there are several tests your doctor will do for diagnosing carpal tunnel syndrome. Tinel test and Phalen test are most popular test. Tinel sign and Phalen test are a wrist examination procedure that identifies the presence of carpal tunnel syndrome. One of test of first flexion test known as Phalen's Test (sensitivity = 57%-91%; specificity = 33%-86%) [5] that involves the patient placing their elbows on a flat surface, maintaining their forearms vertically and allowing their wrists to fall into flexion for up to one minute. And the other Test known as Tinel sign is carpal and ulnar tunnels are tapped with fingertips or with the use of a reflex hammer. And treatment is resting your wrist and wearing a brace to limited movement and taking a medicine for reducing pain. [Figure 1,2] Its good efficient treating with Exercises for carpal tunnel syndrome.

Oriental medicine has acupuncture, acupuncture with electric stimulation, herbal medicine and moxa treatment for CTS. [6] The effect of stimulation acupuncture used to adjust the frequency and intensity of the impulse being delivered, depending on the condition being treated. Electroacupuncture uses two needles at time so that the impulses can pass from one needle to the other. Several pairs of needles can be stimulated simultaneously, usually for no more than 30 minutes at a time. [7]

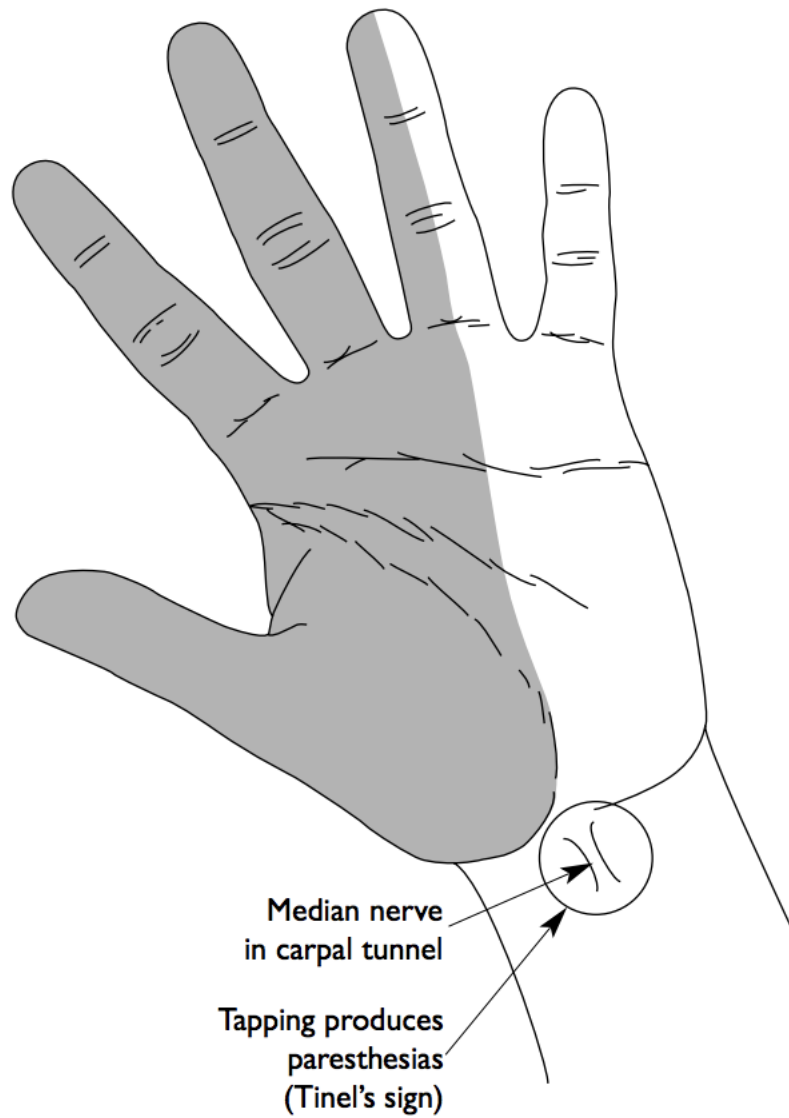


Figure 1. A positive Tinel's sign for suspected carpal tunnel syndrome results in distribution of paresthesia (shaded area) when the median nerve is compressed by swelling in the wrist. [8]

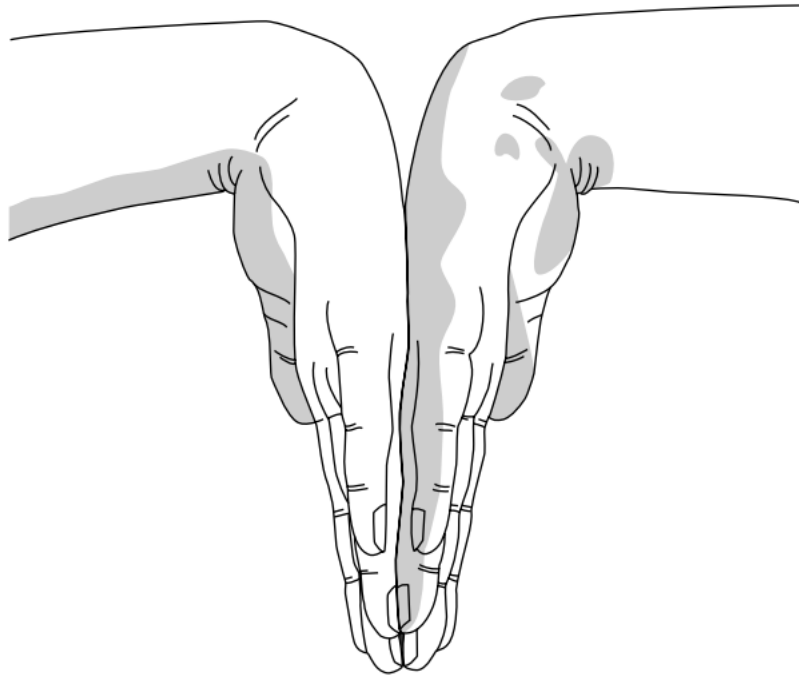


Figure 2. A positive response to Phalen's maneuver produces paresthesia's in the distribution of the median nerve when hands are held in forced flexion for 60 seconds or more. [8]

OBJECTIVES OF STUDY

The purpose of this study is verifying the effects of Acupuncture with electric stimulation in the treatment of carpal tunnel syndrome. In order to get this purpose, the objectives are as follows:

1. To investigate the Effects of Traditional Acupuncture with Electric Stimulation on improving the pain of CTS.
2. To investigate the Effects of Traditional Acupuncture with Electric Stimulation on improving the function and symptom of CTS.
3. To determine the Effects of Traditional Acupuncture with Electric Stimulation on improving the quality of life of CTS patients.

LITERATURE BACKGROUND

Carpal Tunnel Syndrome described by Paget in 1854, puzzling and disabling condition commonly presented to Rheumatologists and Orthopedic Hand clinicians. The American Academy of Orthopedic Surgeons (AAOS) Clinical Guidelines on the Diagnosis of CTS defines it as a symptomatic compression neuropathy of the median nerve at the level of the wrist. [10]

CTS is the most well-known and frequent form of median nerve problem, [11] and accounts for 90% of all entrapment neuropathies. [12] Many patients report symptoms outside the distribution of the median nerve as well, which has been confirmed by a systematic study conducted by Stevens et al., [13]

In Oriental medicine, the most common modalities for treating CTS are acupuncture, herbal medicine, moxibustion, and more recently electric acupuncture. Journal of Acupuncture and Meridian Studies. Mohammadjaved et al., studied efficacies of acupuncture and anti-inflammatory treatment for carpal tunnel syndrome. The result showed that patients with CTS who received acupuncture had greater improvement in pain reduction than patients who received medicine. [14]

Mukherjee M et al., [15] studied the effect of electro-acupuncture on spasticity of the wrist joint in chronic stroke survivors. And it showed a combination of electro-acupuncture and muscle strengthening exercise for 6 weeks significantly reduced spasticity. The effect of spasticity reduction was consistent across different joint positions and different velocities of passive stretch.

Unver S el al., studied the effect of hand exercise on reducing the symptoms in hemodialysis patients with carpal tunnel syndrome. It showed that recovery was performed from physical examination results, grip strength, and Boston questionnaire scores. About 21.4% of patients' electrophysiological results were negative at the end of the 1st month and 32.1% of them at the end of the 3rd month. [16]

There is treatment of CTS in western medicine, wrist injections. its dorsal approach to the radiocarpal and ulnocarpal joints is preferred. these joints can easily be palpated, and the needle entry site marked. care should be taken to avoid the extensor tendons. [17]

There are few studies that examine the effects of acupuncture treatment for CTS. And it showed greatly reduction pain control. TCM differential diagnostic categories for carpal tunnel syndrome include wind-invasion of the muscles, cold-dampness affecting the ligaments, or qi and blood stasis blocking the channels. Local acupoint selections are commonly implemented to enhance the microcirculation of blood to the median nerve and carpal tunnel. The treatment principle is to restore the flow of qi and blood to the area, relieve pressure, promote regeneration, dredge the channels, and reduce tension.

Oriental medicine has six exogenous pathogenic factors to causes of diseases. Wind, cold, summer heat, damp, dryness and fire are the six climatic changes. These six types of qi will only cause disease either the climatic changes are extreme or sudden, or if the body's resistance is low. Wind is the leading causative factor of many diseases. Wind evil not only can combine with other five kinds of exogenous pathogenic factors, but also with phlegm to form wind phlegm. Summer heat is only in summer. It

can be only an exogenous PF, not an endogenous PF. It is transformed from fire, characterized by extreme heat. Damp evil is easily obstructing qi circulation. it is characterized by heaviness and turbidity; it tends to settle in the lower Jiao. It is characterized by viscosity and stagnation. It is very difficult to get rid of due to its sticky nature and it tends to be intractable and prolonged, manifesting in frequent, recurrent bouts. Dryness obviously dries body fluid. It consumes body fluid easily. Fire caused by excess of yang qi. It is characterized by burning and flaring upward direction. if fire evil disturbs the mind, mental disorders may occur.

CTS diagnosis as oriental medicine make in identification of patterns according to the eight principles. Liver-blood deficiency with phlegm, wind-phlegm, liver-wind, dampness, damp-heat, stagnation of qi and stasis of blood or invasion of external wind for numbness or tingling of the hands. [18]

Effects of electric acupuncture at wrist is useful for clinical practice. SJ 5 has more effect on auditory than on visual cortex. when electric acupuncture goes on with acupuncture points, acetylcholine is important mediator. ACh and acetylcholinesterase have been applied to the skin at acupoints, with clinically interesting results. [19]

Economy impact of acupuncture treatment on Carpal Tunnel Syndrome is average cost per patient was \$ 1,500. However Open Carpal Tunnel Release is Average cost per patient was \$3,820. It resulted in greater economic benefit per patient of ACTS than OCTR. [20]

II. MATERIALS AND METHODS

1. MATERIALS

Sterilizing with iodine and alcohol, a tube needling technique was used. Tubes were purchased from DONGBANG ACU Prime (0.3mm x 40.0 mm). electric stimulation is IC-1107 + from ITO co., LTD. Using two frequency 23 Hz.

2. Methods

Subjects will receive total Ten (10) sessions of acupuncture with electric stimulation once a week. Outcomes assessed at baseline and the end of treatment protocol by Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) [21] used before Treatment and after treatment. Visual analog scale (VAS) evaluated before and after treatment to monitor the changes of pain level.

1) Participants

Participants were Ten (10) carpal tunnel syndrome patients, who is suffering from CTS under 2 years and never receive acupuncture treatment for CTS. The participants aged 22 – 65. It will be assigned acupuncture with electric stimulation from October 2018 to February 2019 [22], [23] at Orange clover Acupuncture Clinic.

- Exclusion Criteria of Participant

Participants who present any of the following criteria were excluded;

- Women who are pregnant or breastfeeding
- Pacemaker
- Epilepsy
- who has dermatosis
- Electric implants
- Acupuncture needle phobia
- Got a surgery for CTS

2) Study Design

As shown in Figure 3, this trial was designed as a case series with a total of 10 participants. Each participant received acupuncture on PC7, LI5, LU5 and SJ5 with electric stimulation on SJ5 and PC7. [24] And these participants may not receive other treatment, medications or conventional medicine treatment. Outcomes measured were VAS before and after each treatment, respectively, BCTQ Function, BCTQ Symptom, and BCTQ Total, before and after the 5th treatment, respectively.

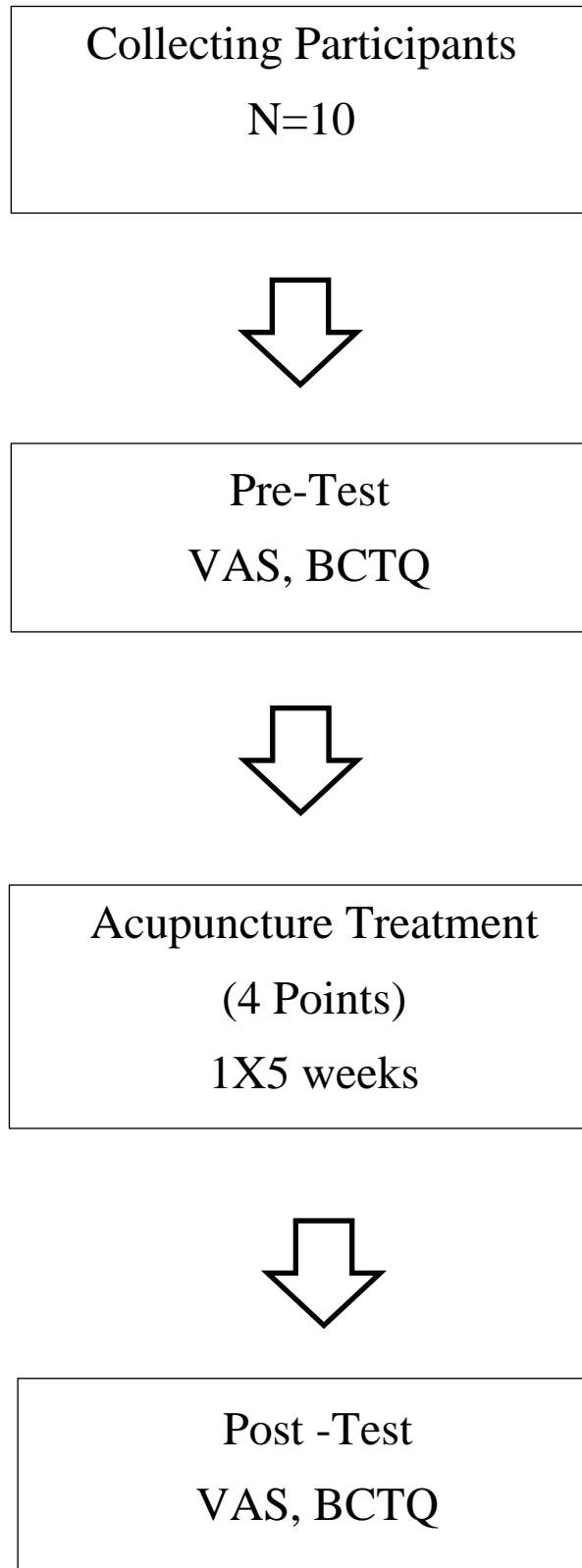


Figure 3. Schematic Diagram of Research Design

3) Point Location (Figure4)

As shown in Table 1, four acupuncture points: PC7, LU5, LI5 and SJ5 were selected to treat CTS in this trial. [24]

Table 1. Acupuncture selected points [25]

Acupoints	Location	Action	Indication
PC7	At the wrist joint, between the tendons of palmaris longus and flexor carpi radialis, level with Shenmen HT7.	Clears heat and fire from the heart and calms the spirit. Clears the Ying level and cools blood. Heart pain.	palpitations, pounding sensation of the Heart, Heat in the body that feels like fire, eczema of the hand, wind rash, pain and contraction of the elbow, wrist pain, heat in the palms, intercostal neuralgia, weariness, Summer-Heat diseases, hysteria, anxiety, panic attack
LI5	On the radial side of the wrist, in the centre of the hollow formed by the tendons of extensor pollicis longus and brevis.	Clears heat and alleviates pain, clears YangMing fire, Calms the spirit, Benefits the wrist joint.	Weakness and pain of the wrist, contraction of the five fingers, heat in the palms, difficulty in raising the elbow.
LU 5	On the cubital crease of the elbow, in the depression at the radial side of the tendon of biceps brachii.	Clears Lung-Heat. Stimulates the descending of Lung-Qi. Regulates the water passages, Activates the channel, Relaxes the sinews and alleviates pain.	Coldness of the shoulder, pain of the upper arm and shoulder, inability to raise the arm to the head, wandering painful obstruction of the elbow and upper arm, restricted movement of the elbow, elbow pain, difficulty in opening and extending the hand, the five types of lumbar pain, crane's knee swelling and pain.
SJ5	2 cun proximal to the dorsal wrist crease between the radius and ulna, close to the radial bone.	Expels Wind and releases the exterior, benefits the head and ears, opens the Yang Wei vessel, clears Heat, activates the channel and alleviates pain, strengthens Wei Qi	Numbness and pain of the elbow, arm and hand, contraction of the elbow, flaccidity of the elbow, soreness and heaviness of the elbow and wrist, swelling and redness of the arm, severe pain of the fingers with inability to grasp objects, coldness, numbness and pain of the hand and feet, tremor of the hand.

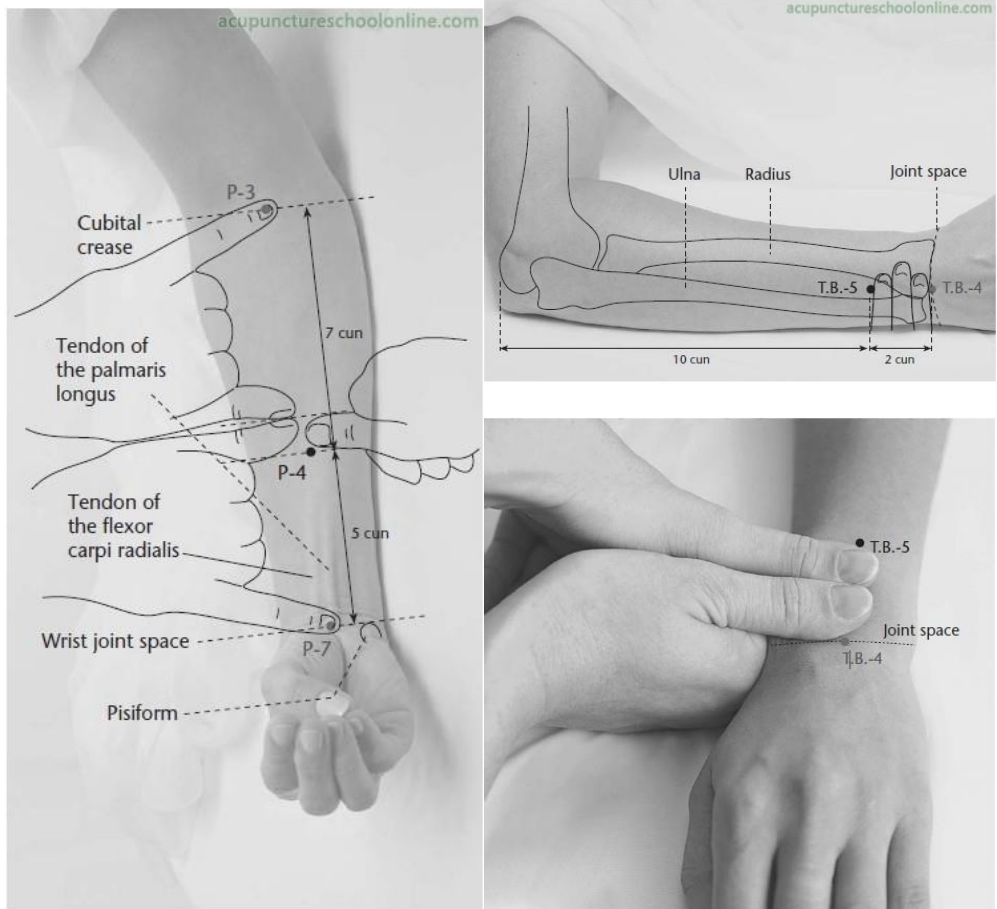


Figure 4. Acupuncture points location [26]

4) Goal of the treatment

When the VAS is to reach the level less than 3, the goal of this treatment. If the VAS is not under 3 and treatment continues until the five times treatment.

The treatment is terminated after the treatment is completed up to five times, and the treatment effect is evaluated during the period

When After last treatment, the BCTQ (symptom/ function) total score is to reach the score less than 40. It's goal of the treatment.

5) Outcome Measurement

Boston carpal tunnel scale (BCTQ) is the patient-oriented evaluation are significantly influenced by the communication of the assessment results. [27] [Table 2]

The pain VAS is a unidimensional measure of pain intensity, which has been widely used in pain problem diseases. (Figure 4)

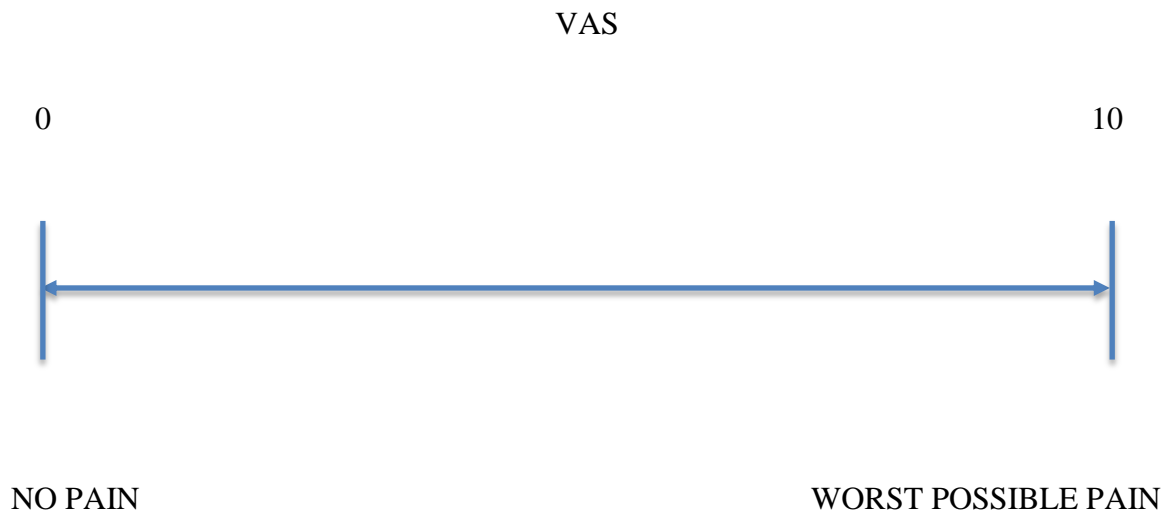


Figure 5. Visual Analogue Scale (VAS) [28]

Table 2. Boston Carpal Tunnel Syndrome Questionnaire (BCTQ)

1) Symptom severity scale (11 items)

	1	2	3	4	5
1. How severe is the hand or wrist pain that you have at night?	Normal	Slight	Medium	Severe	Very serious
2. How often did hand or wrist pain wake you up during a typical night in the past two weeks?	Normal	Once	2 to 3times	4 to 5 times	More than 5 times
3. Do you typically have pain in your hand or wrist during the daytime?	No pain	Slight	Medium	Severe	Very serious
4. How often do you have hand or wrist pain during daytime?	Normal	1-2 times/day	3-5 times/day	More than 5 times	Continued
5. How long on average does an episode of pain last during the daytime?	Normal	<10minutes	10~60 continued	>60minutes	continued
6. Do you have numbness (loss of sensation) in your hand?	Normal	Slight	Medium	Severe	Very serious
7. Do you have weakness in your hand or wrist?	Normal	Slight	Medium	Severe	Very serious
8. Do you have tingling sensations in your hand?	Normal	Slight	Medium	Severe	Very serious
9. How severe is numbness (loss of sensation) or tingling at night?	Normal	Slight	Medium	Severe	Very serious
10. How often did hand numbness or tingling wake you up during a typical night during the past two weeks?	Normal	once	2 to 3 times	4-5 times	More than 5 times
11. Do you have difficulty with the grasping and use of small objects such as keys or pens?	Without difficulty	Little difficulty	Moderately difficulty	Very difficulty	Very difficulty

2) Functional status scale (8 items)

	No difficulty	Little difficulty	Moderate difficulty	Intense difficulty	Cannot perform the activity at all due to hands and wrists symptoms
Writing	1	2	3	4	5
Buttoning of clothes	1	2	3	4	5
Holding a book while reading	1	2	3	4	5
Gripping of a telephone handle	1	2	3	4	5
Opening of jars	1	2	3	4	5
Household chores	1	2	3	4	5
Carrying of grocery basket	1	2	3	4	5
Bathing and dressing	1	2	3	4	5

6) STATISTICAL ANALYSIS

SPSS (Statistical Program for Social Science) 22.0 for Window and R version 3.5.1 (Feather Spray) were used for statistical computing and graphics.

Paired Sample t-test or Wilcoxon Signed rank Test were performed according to the Normality test of data to see the significance of the difference between before and after treatment.

III. RESULTS

This clinical trial was conducted from October 1st, 2018 to February 13rd, 2019 at Orange clover Acupuncture Clinic to investigate the effects of traditional acupuncture with electric stimulation on Carpal Tunnel Syndrome. Ten (10) participants were recruited, and their baseline characteristics are summarized in Table 3.

Table 3 shows ratio of female vs male Carpal tunnel syndrome participants was 7:3, which shows higher (prevalence of CTS) for female. The highest (prevalence of CTS) of age range was 60% for over 40's.

Table 3. General Characteristics of Patients

Gender	Female	7
	male	3
Age	20's	2
	30's	2
	40's	4
	50's +	2
Race	Asian	7
	Hispanic	2
	Caucasian	1
Duration	6month +	2
	1 year +	4
	2year +	3

VAS \pm SD*	6.3 \pm 0.6
BCTQ(Symptom) \pm SD*	33.1 \pm 3.8
BCTQ(Functional) \pm SD*	28.5 \pm 4.0
BCTQ(Total) \pm SD*	61.6 \pm 5.9

* Standard Deviation

1. Effects of traditional acupuncture with electric stimulation on Visual Analogue Scale (VAS) for Carpal Tunnel Syndrome.

1) Visual Analogue Scale (VAS) before and after treatment

To evaluate the effectiveness of acupuncture in Carpal tunnel syndrome, the VAS values were measured before and after each treatment. Table 4 showed the results of the effectiveness after the treatments when the assumption of normality was met, the VAS values before and after treatment were evaluated using the paired t-test. When assumption of normality was not met, the Wilcoxon signed-Rank Test was used. As shown in Table 4 the VAS values in before the treatment was higher than VAS after the treatment. The values were decreased from 8.7 ± 0.82 to 6.3 ± 0.82 after the first treatment, showing a decrease of 2.3 ± 0.52 ($p = 0.023$). After the second treatment, the scores went down to 6.8 ± 1.17 to 4.2 ± 1.33 indicating a decrease of 2.6 ± 1.63 ($p = 0.0$). After the third treatment, the values were measured at 5.0 ± 1.55 to 3.3 ± 1.37 indicating a decrease of 1.6 ± 1.03 ($p = 0.023$). After the fourth treatment, the values were measured at 3.3 ± 2.73 to 1.8 ± 1.83 indicating a decrease of 1.5 ± 1.76 ($p=0.034$). After the fifth treatment, the values were measured at 2.7 ± 1.75 to 1.0 ± 1.67 indicating a decrease of 1.7 ± 1.36 ($p=0.041$). After the six treatment, the values were measured at 2.0 ± 1.26 to 0.7 ± 1.03 indicating a decrease of 1.3 ± 1.03 ($p=0.046$). In the effects of VAS after each treatment, the values were distinctively decreased from the treatment before. The results for the VAS were statistically significant. Boxplots of VAS before and after each treatment especially on Figure 6 show no overlap on the graph that there is a significant difference between treatments.

Table 4. Difference of VAS before and after Each Treatment

Treatment	Before	After	Difference	p-value *
1st	6.3 ± 0.62	5.6 ± 0.64	0.7 ± 0.58	0.004
2nd	6.0 ± 0.65	5.2 ± 0.48	1.1 ± 0.69	0.010
3rd	5.3 ± 0.44	4.9 ± 0.54	1.4 ± 0.92	0.001
4th	4.6 ± 0.63	4.2 ± 0.51	2.1 ± 0.65	0.036
5th	4.0 ± 0.59	3.3 ± 0.46	3.0 ± 0.67	0.000

* Paired Samples T-Test

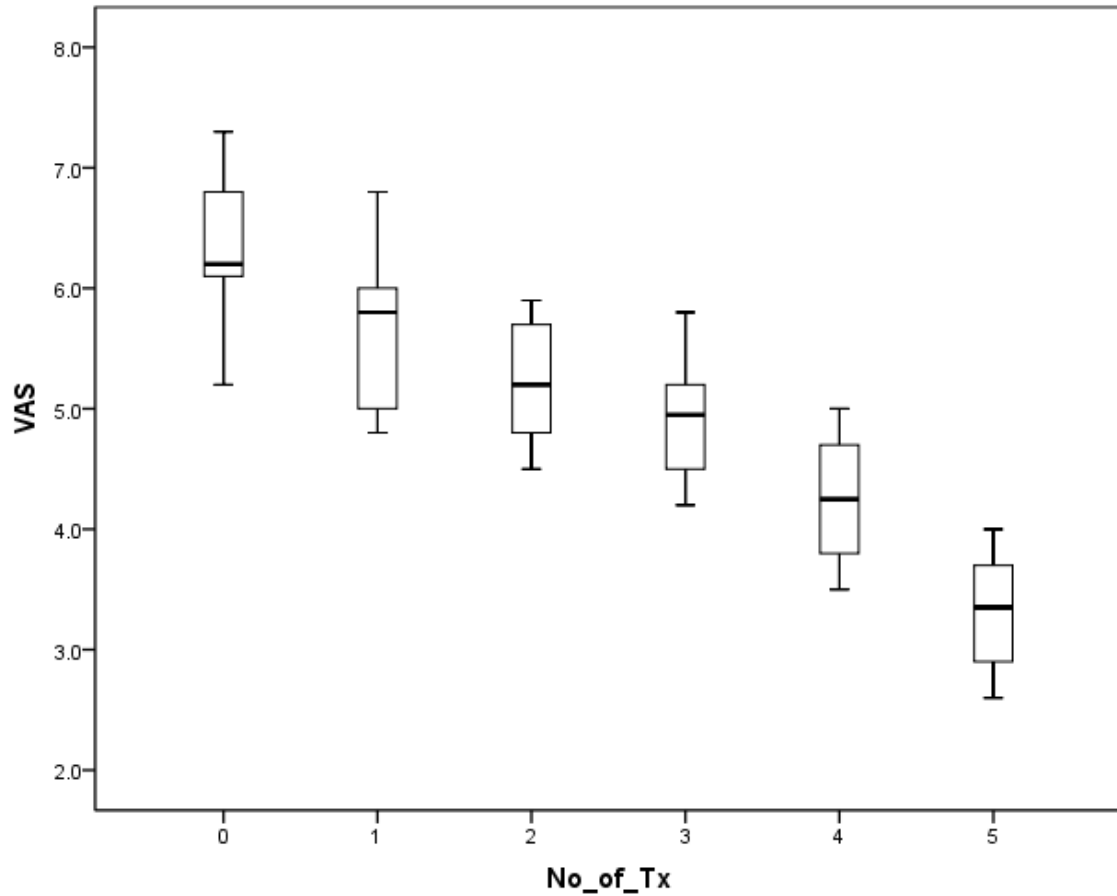


Figure 6. Boxplot of VAS before and after each treatment

2) Dichotomous result in VAS for CTS.

With Table 5, CTS participants evaluated VAS for treating 5times treatment with acupuncture and electric stimulation. VAS score over 3 for 6 people, VAS score under 3 for 4 people.

Table 5. Dichotomous result of acupuncture treatment with electric stimulation in VAS for carpal tunnel syndrome.

	VAS >3	VAS <3	Total
Treatment group N=10	6	4	10

The reduced risk and odds of pain in terms of the VAS score is following Table 6. From the analysis of Visual Analogue scale (VAS), dichotomous data showed 0.6 and 1.5 for Risk and Odds of Pain respectively and the improvement of treatment rate was 40.0% and not cured participants odds is 1.5.

Table 6. Reduced risk and odds pain in terms of the VAS score after acupuncture treatment for CTS.

Statistic items	Calculation process	Summarized statistics
Risk (of pain) =	No. of Pt not cured / Total No. of Pt	0.6 (60.0%)
Odds (of pain) =	No. of Pt Not cured / No. of Pt cured	1.5 (150.0%)

3) Cumulative treatment effect

Nth cumulative treatment effect = (pre-treatment VAS value of before treatment value) - (VAS value of after treatment the Nth treatment)

In comparing the Visual Analogue Scale (VAS) values of the treatment effect after the first session was 0.7 ± 0.58 ($p = 0.039$). After the second session, the treatment effect was 1.1 ± 0.69 ($p = 0.006$). After the third session, the treatment effect was 1.4 ± 0.92 ($p = 0.008$). After the fourth session, the treatment effect was 2.1 ± 0.65 ($p = 0.000$). After the fifth session, the treatment effect was 2.1 ± 0.65 ($p = 0.000$). The treatment showed a higher cumulative treatment effect in all cases, but the results were also statistically significant according to Paired Sample t-Test [Table 7]. In the effects of VAS after each treatment, the values were distinctively decreased from the before treatment. The results for the VAS were statistically highly significant. Figure 8 shows bar graph of the cumulative treatments before and after each treatment as determined by VAS values.

Table 7. Cumulative treatment effect and treatment rate on VAS

Treatment	Difference	Rate (%)	p-value*
1st -1st	0.7± 0.58	10.9± 8.93	0.0039
1st-2nd	1.1± 0.69	17.1±9.73	0.0006
1st-3rd	1.4 ± 0.92	21.9 ±12.29	0.0008
1st-4th	2.1±0.65	32.7 ± 9.30	0.0000
1st-5th	3.0± 0.67	47.6 ± 8.09	0.0000

* Paired Sample t-Test

Treatment Effect = VAS 1 Before Tx - VAS n After Tx

Treatment Effect is the cumulative difference of VAS

Rate = 100 * (VAS after nth treatment - VAS before 1st Treatment) / VAS before 1st Treatment

4) Cumulative treatment rate

Nth VAS cumulative treatment rate (%) = (VAS before 1st treatment – Nth VAS after treatment)/ VAS before 1st treatment x 100

In comparing the Visual Analogue Scale, (VAS) values of the treatment effects after the first session were a percentage of rate of $10.9 \pm 8.93\%$. After the second session, the treatment effect in the percentage of rate was $17.1 \pm 9.73\%$. After the third session, the treatment effect in the percentage of rate was $21.9 \pm 12.29\%$. After the fourth session, the treatment effect in the percentage of rate was $32.7 \pm 9.30\%$. After the fifth session, the treatment effect in the percentage of rate was $47.6 \pm 8.09\%$. Figure 7. represents bar graph of the cumulative treatments rates are effective after each treatment as determined by VAS values.

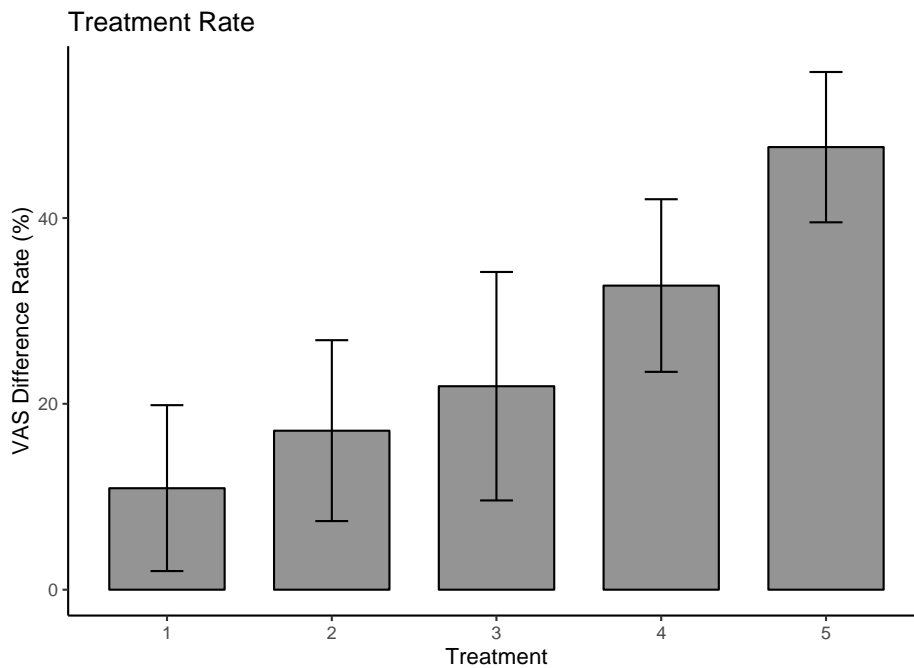


Figure 7. Bar graph of Cumulative treatment rate (%) on VAS

After a total of 5th treatments, the more numbers of treatments that increased, the rate on VAS were increased also. [Table 7] After the final treatment, the rate of treatment was increased 37%.

4) Linear regression of visual analogue signal (VAS)

In analysis of linear regression, $F(1, 4) = 141$, $R^2 = 0.972$ and $p = 0.00028$ close to 0, which is significance coefficient and is less than 0.05. It explains well that significant value is statistically significant.

$X =$ Number of Treatment

$Y =$ VAS values

$$Y = 6.34 - 0.56 * X$$

Goal of Treatment, $P/L = 3$

$$3 = 6.34 - 0.56 * X$$

$$X = 5.96 \cong 6 \text{ times}$$

After each treatment, the visual analogue scale (VAS) value was reducing 0.56 each time, therefore, the treatment was effective.

Furthermore, it can predict how the treatment's direction will be after the treatment.

If there is one more session of treatment, we expect VAS becoming under 3. [Figure 8]

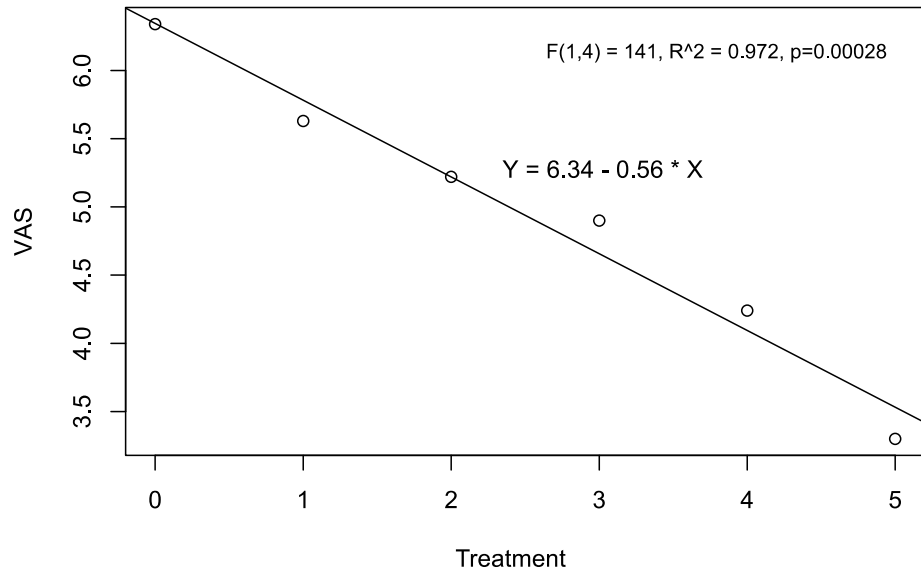


Figure 8. Linear regression of treatment before and after with VAS values

2. Effects of traditional acupuncture with electric stimulation on Boston Carpal Tunnel Syndrome Questionnaire (BCTQ)

1) Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) before and after treatment

To evaluate the effectiveness of acupuncture in Carpal tunnel syndrome, the BCTQ scores were measured before of first treatment and after last treatment. The BCTQ scores has two part of symptom and function questionnaires of participants of wrist and hand. Table 8 showed the results of the effectiveness after the treatments when the assumption of normality was met, the BCTQ scores of symptom and function questionnaire before the first treatment and after last treatment were evaluated using the paired t-test.

When assumption of normality was not met, the Wilcoxon signed-Rank Test was used. As shown in Table 8 the BCTQ score in before the first treatment was higher than BCTQ after the last treatment. The symptom scores were decreased from 33.1 ± 3.84 to 19.8 ± 5.64 after the last treatment, showing a decrease of 13.3 ± 5.64 ($p = 0.000$). The function scores were decreased from 28.5 ± 3.98 to 15.9 ± 3.28 after the last treatment, showing a decrease of 12.6 ± 3.06 ($p = 0.000$). In the effects of BCTQ after last treatment, the score was distinctively decreased from the first before treatment. The results for the BCTQ were statistically, and highly significant. Boxplots of BCTQ before of first treatment and after last treatment especially on Figure 9 show no overlap on the graph that there is a significant difference between treatments

Table 8. Difference of BCTQ symptom and function questionnaires'

BCTQ	Before	After	Difference	p.value*
Symptom	33.1 ± 3.84	19.80 ± 5.64	13.30 ± 5.64	0.000
Function	28.5 ± 3.98	15.9 ± 3.28	12.6 ± 3.06	0.000

* Paired Sample t-Test

Difference =BCTQ Before -BCTQ After

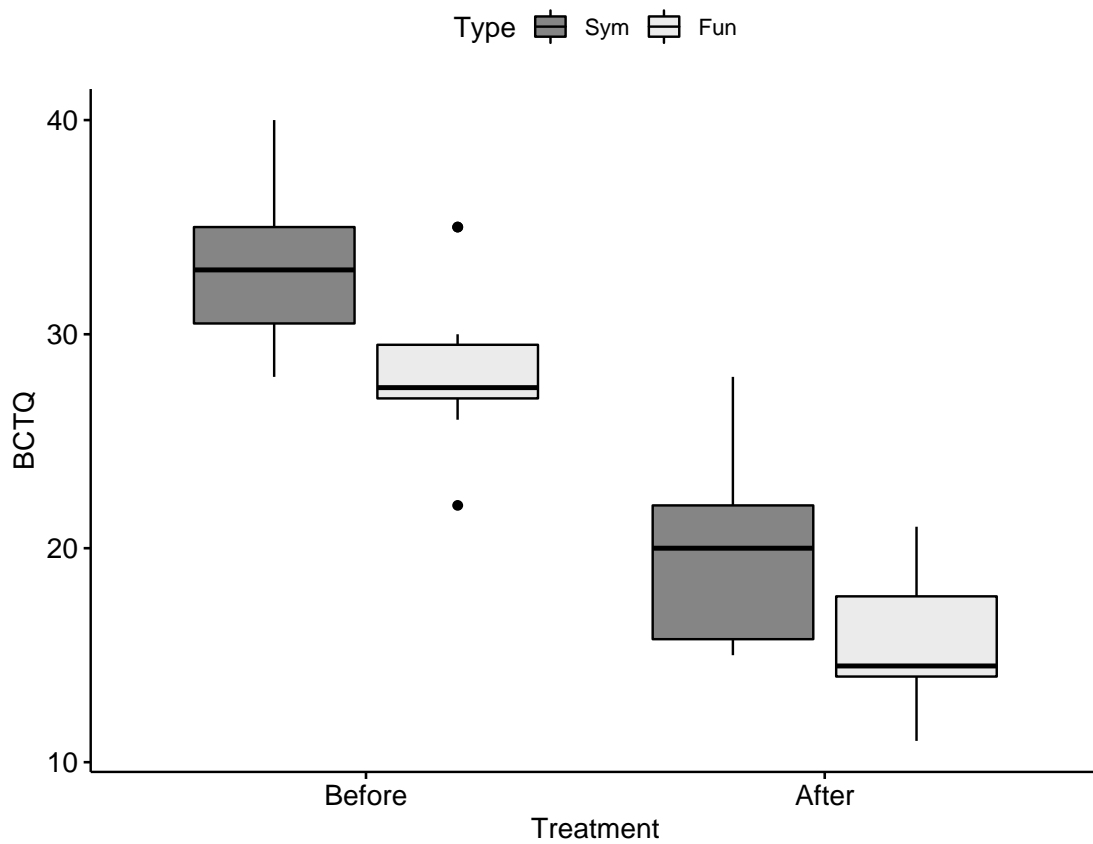


Figure 9. Boxplot of BCTQ before and after each treatment

2) Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) treatment rate

Treatment rate for BCTQ was calculated with following equation.

$$\text{BCTQ treatment rate (\%)} = 100 * (\text{BCTQ Before} - \text{BCTQ After}) / \text{BCTQ Before}$$

From the equation above, treatment rate for BCTQ Symptom was in the percentage of rate was $39.5 \pm 15.30\%$, and BCTQ Function was $44.2 \pm 8.98\%$, respectively [Table 9]. The results for the treatment rate on BCTQ were statistically highly significant. Figure 10 represents bar graph of the Treatment Rate of BCTQ before and after treatment as determined by BCTQ scores.

Table 9. Treatment Rate of BCTQ before and after treatment.

BCTQ	Treatment Rate (%)
Symptom	39.5 ± 15.30
Function	44.2 ± 8.98

$$\text{Rate (\%)} = 100 * (\text{BCTQ Before} - \text{BCTQ After}) / \text{BCTQ Before}$$

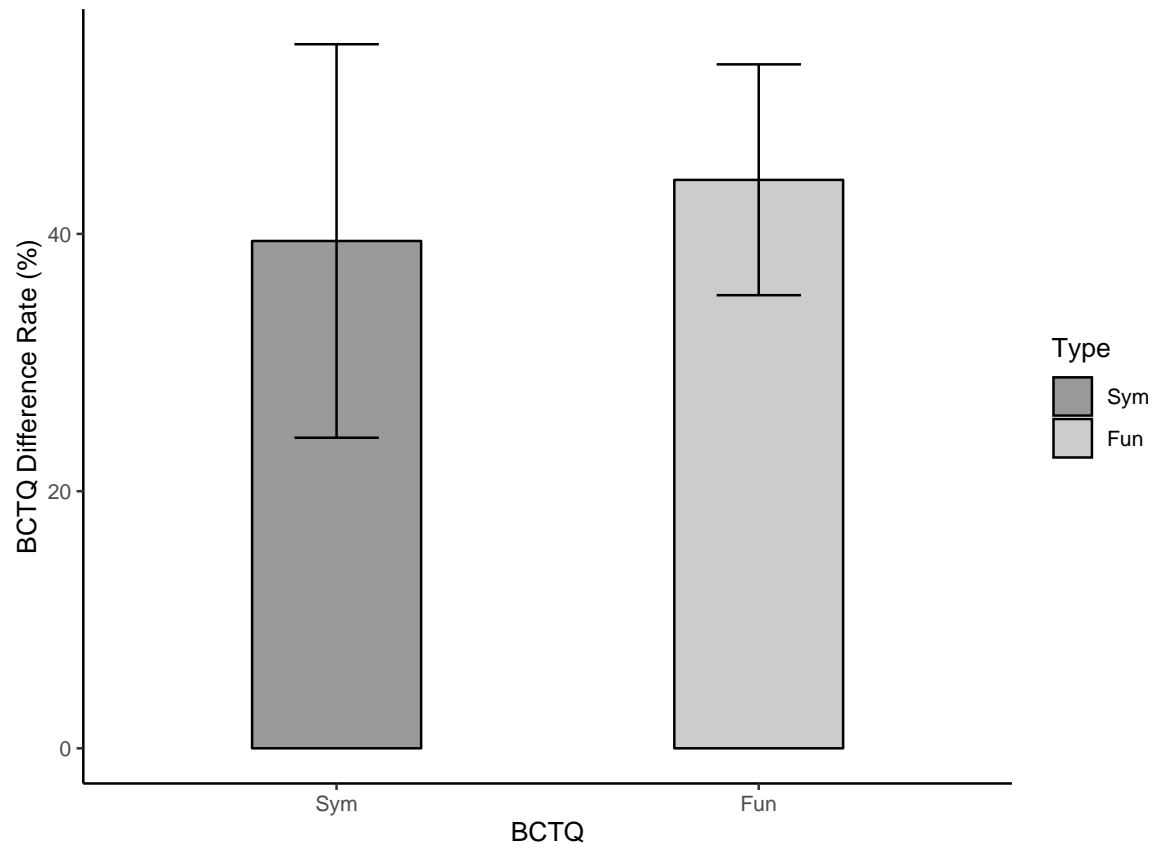


Figure 10. Treatment Rate of BCTQ before and after treatment.

3) Dichotomous result in BCTQ total score difference for CTS

With Table 10. CTS participants evaluated BCTQ for treating 5times treatment with acupuncture and electric stimulation. BCTQ total difference score over 40 for 3 people, under 40 for 7 people.

Table 10. Dichotomous result of acupuncture treatment with electric stimulation in BCTQ total score difference for carpal tunnel syndrome.

	BCTQ total score difference >40	BCTQ total score difference <40	Total
Treatment group N=10	3	7	10

From the analysis of BCTQ, dichotomous data showed 0.3 and 0.42 for Risk and Odds of pain respectively and the improvement of treatment rate was 70.0%. [Table 11.]

Table 11. Reduced risk and odds pain in terms of the BCTQ Total score after acupuncture treatment for CTS.

Statistic items	Calculation process	Summarized statistics
Risk (of pain) =	No. of Pt not cured / Total No. of Pt	0.3 (30.0%)
Odds (of pain) =	No. of Pt Not cured / No. of Pt cured	0.42 (42.0%)

V. DISCUSSION

Wrist pain is common in elderly group. Carpal Tunnel Syndrome (CTS), which is caused by compression of the median nerve at the wrist. It shows in higher female percentage in general.

Ten (10) participants were treated once a week for five weeks. The acupuncture points selected are PC7, SJ5, LU5 and LI5 with electric stimulation on PC7 and SJ5. [24] These points from '*Rewiring the primary somatosensory cortex in carpal tunnel syndrome with acupuncture*' journal. I reselected with function as 'clear heat'.

After fifth treatment, the mean VAS changed from 6.3 ± 0.62 to 3.3 ± 0.46 , which is a significant change. From the analysis of VAS, dichotomous data showed 0.6 and 1.5 for Risk and Odds of Pain, respectively, and the improvement of treatment rate was calculated as 40.0%. The mean score of BCTQ symptom improved from 33.1 ± 3.84 to 19.80 ± 5.64 , and the mean change was 13.30 ± 5.64 , which is a significant change. From the analysis of BCTQ, dichotomous data showed 0.3 and 0.42 for Risk and Odds of pain, respectively, 70% rate of improvement after treatment.

Although this trial was completed after the fifth treatments, we can expect to reach the level of VAS less than 3, the tolerable pain level as well as the goal of treatment, the regression analysis goes through with one more treatment,

Normality test of data to see the significance of the difference between before and after treatment, but it didn't show good significance with Ten (10) participants. for significant improvement, I need to recruit more participants for this clinical trial research.

I did not choose to add control group for this clinical trial since I wanted to determine if the effect of treatment with electric acupuncture and selected acupuncture points work.

Using four acupuncture points for the clinical trial should limitation for full treatment. It was hard to treat lots of point for the wrist. However, the supporting Oriental Chinese Medicine, I had to studied with Identification of patterns according to the eight principles of CTS. Moreover, there are many formulas that can be applied to the same traditional Chinese medicine diagnosis. It needs more studies to find out which formula works better with acupuncture treatment for CTS. If treatment with add herbal formulas, this study will be effect acupuncture treatments good view of Traditional Chinese Medicine protocol.

Longer periods for following up and putting into consider for various external causes of disease should be considered in future study. I might be implemented designed protocols should be performed in the future as well for traditional Chinese medicine.

IV. CONCLUSION

This study is 10 carpal tunnel syndrome patients who were treated acupuncture treatment with electric stimulation.

The findings were as follows:

1. This study showed Carpal tunnel syndrome participants are female percentage is higher than male. 7:3 (female: male)
2. The higher part of age range is over 40th. (60%)
3. The study concludes that treatment with selected acupuncture points for CTS with electric stimulation showed over 40% success rates. If I added 3 months after treatment BCTQ for examine this study, it may show certain result.
4. . The mean value of VAS score decreased significantly from 6.3 ± 0.62 to 3.3 ± 0.46 which showed clinical significance ($p=0.000$).
5. The mean score symptom of BCTQ increased from 33.1 ± 3.84 to 19.80 ± 5.64 and the effect of treatment was 13.30 ± 5.64 , which showed clinical significance
The mean score function of BCTQ increased from 28.5 ± 3.98 to 15.9 ± 3.28 and the effect of treatment was 12.6 ± 3.06 , which showed clinical significance.

6. This study showed acupuncture treatment was effective on CTS. Especially it showed great improvement on BCTQ function of Gripping of a telephone handle. Before treatment total score 39 out of 50 to 19 out of 50. Its 40% reduced score.
7. After a total of 5th treatments, the more numbers of treatments that increased, the rate on VAS were increased also. Therefore, if there is 5 more session of treatment, we expect result of VAS is becoming under 1.

It is difficult to treat all CTS with selected acupuncture points. However, by using the selected acupuncture points, further study can be done to treat great effectiveness of CTS. And it was not enough of time for study. Further study added 3 months after treatment BCTQ for examine this study, it may show certain result.

REFERENCES

1. Ibrahim I, Khan WS, Goddard N, Smitham P. Carpal tunnel syndrome: a review of the recent literature. *Open Orthop J.* 2012; 6:69–76.
2. Katz JN, Simmons BP. Clinical practice. Carpal tunnel syndrome. *N Engl J Med.* 2002; 346:1807–1812.
3. Women’s Health [<https://www.womenshealth.gov/a-z-topics/carpal-tunnel-syndrome>]
4. Ibrahim I, Khan WS, Goddard N, Smitham P. Carpal tunnel syndrome: a review of the recent literature. *Open Orthop J.* 2012; 6:69–76.
5. Shi Q, MacDermid JC. Is surgical intervention more effective than non-surgical treatment for carpal tunnel syndrome? A systematic review. *J Orthop Surg Res.* 2011
6. Mohammad G et al, A handy review of carpal tunnel syndrome: From anatomy to diagnosis and treatment
7. Kumnerddee W, Kaewtong A. Efficacy of acupuncture versus night splinting for carpal tunnel syndrome: a randomized clinical trial. *J Med Assoc Thai.* 2010
8. <https://www.sonexhealth.com/>
9. D. Gould et al. Visual Analogue Scale (VAS). *Journal of Clinical Nursing* 2001; 10:697-706

10. American Academy of Orthopaedic Surgeons Work Group Panel. Clinical guidelines on diagnosis of carpal tunnel syndrome. 2007.
11. The history of carpal tunnel syndrome. Pfeffer GB, Gelberman RH, Boyes JH, Rydevik BJ *Hand Surg Br.* 1988 Feb; 13(1):28-34.
12. Carpal tunnel syndrome. Aroori S, Spence RA *Ulster Med J.* 2008 Jan; 77(1):617.
13. Symptoms of 100 patients with electromyographically verified carpal tunnel syndrome. Stevens JC, Smith BE, Weaver AL, Bosch EP, Deen HG Jr, Wilkens JA
14. Hadianfard M et al. Efficacies of acupuncture and anti-inflammatory treatment for carpal tunnel syndrome. *J acupuncture meridian stud.* 2015
15. Mukherjee M et al., the effect of electro-acupuncture on spasticity of the wrist joint in chronic stroke survivors., *arch phys med rehabil* 2007
16. Unver S. et al., The Effect of Hand Exercise on Reducing the Symptoms in Hemodialysis Patients with Carpal Tunnel Syndrome. *Asian J Neurosurg* 2018
17. Warfield B. et al., *Principles & Practice of Pain Medicine* Second Edition.
18. Giovanni M. et al., *Diagnosis in Chinese Medicine* Second Edition.
19. David F M. et al., *Electroacupuncture A practical manual and resource.*

20. Economic Benefit of Carpal Tunnel Syndrome Treatment in the Medicare Patient Population 2017 April
21. Luca P, Roberto P, Irene A, Piestro C, Pietro T Boston Carpal Tunnel Questionnaire: the influence of diagnosis on patient-oriented results A Journal of Progress in Neurosurgery, Neurology and Neurosciences 2005
22. Maddali Bonghi S, Signorini M, Bassetti M, Del Rosso A, Orlandi M, De Scisciolo G. A manual therapy intervention improves symptoms in patients with carpal tunnel syndrome: a pilot study. Rheumatol Int. 2013
23. Nalamachu S, Nalamasu R, Jenkins J, Marriott T. An Open-Label Pilot Study Evaluating the Effectiveness of the Heated Lidocaine/Tetracaine Patch for the Treatment of Pain Associated with Carpal Tunnel Syndrome. Pain Pract. 2013: Epub ahead of print.
24. Yumi M. et al., Rewiring the primary somatosensory cortex in carpal tunnel syndrome with acupuncture A Journal of neurology brain 2017
25. Peter D. et al., A Manual Of Acupuncture, Journal of Chinese medicine publication 2007
26. ATLAS OF ACUPUNCTURE 1ST EDITION BY CLAUDIA FOCKS MD
27. LeBlanc KE, Cestia W. Carpal tunnel syndrome. Am Fam Physician. 2011
28. D. Gould et al. Visual Analogue Scale (VAS). Journal of Clinical Nursing 2001; 10:697-706

APPENDICES

Informed Consent Form / 연구 참여 동의서

You are invited to participate in a research study about “Traditional Acupuncture with Electric Stimulation of Carpel Tunes Syndrome”.

Total goal of this research study is to compare combined effect of Traditional Acupuncture with Electric Stimulation of Carpel Tunes Syndrome.

본 연구는 손목 터널 증후군에 대한 전기침의 효과에 대한 연구입니다. 이 연구의 목적은 손목터널 증후군의 치료효과를 측정하기 위함입니다. 또한 이 연구를 통하여 더욱 체계적이고 효율적인 치료방법을 임상에서 적용하고자 합니다.

The study design is that the patients with wrist pain mainly, subject will receive acupuncture with electric stimulation on the wrist respectively. The treatment will be total 5 times, once a week in 5 weeks.

본 연구는 손목 통증 환자를 위해 디자인 되었고 참여자들은 손목 위에 전기침을 반복적으로 받게 될 것입니다. 5 주동안 진행될 것이며 전체 치료 횟수는 5 번입니다.

This study is being conducted by Soo Jung Jeong, L.Ac.

본 연구의 담당자는 Soo Jung Jeong 입니다.

Your participation in this research is entirely voluntary. It is your choice whether to participate or not. Whether you choose to participate or not, all the services you receive at this clinic will continue and nothing will change. If you choose not to participate in this research project, you will be offered the treatment that is routinely offered in this clinic. You may change your mind later and stop participating even if you agreed earlier.

본 연구에 참여하시는 것은 전적으로 본인의 뜻에 따르며, 연구 중 수집한 정보는 모두 기밀이 보장이 되고, 귀하에 대한 개인 정보는 연구집행자 외에 어느 누구도 볼수 없는 곳에 보관될 것입니다. 귀하가 연구에 참여를 결정했다 하더라도 언제든지 결정을 번복 할 수 있습니다.

Participating in this study may not benefit you directly, but it will help to enrich the knowledge on Acupuncture and Asian Medicine.

이 연구에 참여하면 바로 혜택이 없을 수도 있지만 동양의학과 침구의 대한 이해를 넓힐 수 있게 도와줄 것 입니다.

This treatment can have some unwanted effects. It can cause pain. Bleeding, bruise, and some temporary swelling around the place where needles are inserted. It is possible that it may also cause some problems that I am not aware of. However, I will follow you closely and keep track of any unwanted effects or any problem. I may use some other treatments to decrease the symptoms of the side effects or reactions. If this is necessary I will discuss it together with you and you will always be consulted before I move to the next step.

If the treatment is not working and does not reduce your pain, I will give you another acupuncture treatment which will make you more comfortable. While the possibility of this happening is very low, you should still be aware of the possibility.

치료 도중 침 맞은 부위에 통증, 출혈, 멍이나 일시적인 부종 등으로 인한 불편함이 있을 수 있으며, 또한 알지 못하는 다른 문제들을 야기할 가능성도 있습니다.

하지만 귀하의 연구담당자는 귀하를 주의 깊게 살피고 관리하여 어떠한 부작용이나 문제들에 대해 지속적으로 주시할 것입니다. 연구담당자는 부작용

또는 반응에 대한 증상을 감소시키기 위해 다른 치료를 할 수도 있습니다. 이

과정이 필요한 경우 연구 담당자는 귀하와 논의 할 것이며 다음 단계로 넘어가기 전에 항상 귀하와 상의할 것입니다. 이러한 가능성은 매우 낮다고 하여도 귀하는 그

가능성에 대해 인지하고 있어야 합니다.

The information you will share with us if you participate in this study will be kept completely confidential to the full extent of the law. The information that we collect from this research project will be kept confidential. Information about you that will be collected during the research will be put away and no-one, but the researchers will be able to see it. Any information about you will have a number on it instead of your name. Only the researchers will know what your number is, and we will lock that information up with a lock and key. It will not be shared with or given to anyone except Soo Jung Jeong, L.Ac.

본 연구에 참여하게 된다면, 귀하가 담당자와 공유하는 정보는 법의 최대한도 내에서 철저히 기밀로 유지 될 것입니다. 본 임상시험 연구로부터 담당자가 수집하는 정보는 기밀로 유지 될 것이며 연구기간 동안 수집 될 귀하의 관한 정보는 따로 보관 되며 담당자 외에는 누구도 볼 수 없습니다. 귀하에 관한 어떠한 정보 든 지 귀하의 성명 대신 번호가 기재될 것입니다. 단지 연구자 만 귀하의 번호가 무어인지 알게 되며 담당자는 해당 정보를 잠금장치를 이용해 보관할 것입니다. 이것은 Soojung Jeong, L.A.c 를 제외한 그 누구에게도 공유 되거나 제공 되지 않을 것입니다.

If you have any questions about this study, please contact Soo Jung Jeong, L.Ac. at 1-310-579-7774 and researchcrystal5@gmail.com. If you have any questions or concerns regarding your rights as a subject in this study, you may contact Dr. Jae Jong Kim, Chair of the South Baylo University. Institutional Review Board (IRB) at 213-738-0712 or jae-jongkim621@gmail.com.

만약 귀하가 본 연구에 질문이 있으시다면 담당자 Soo Jung Jeong, L.Ac at 310-579-7774 or researchcrystal5@gmail.com 으로 연락하여 주십시오. 본 연구의 참여자로서 귀하의 권리에 대한 문의 또는 우려사항이 있으시면, South Baylo University 의

임상시험연구윤리위원회 (IRB)의 의장 Dr. Jae Jong Kim 에게 전화 213-533-6077

또는 jaejongkim621@gmail.com. 로 연락 할 수 있습니다.

YOU WILL BE GIVEN A COPY OF THIS FORM WHETHER OR NOT YOU AGREE
TO PARTICIPATE.

귀하의 참여여부와 관계 없이 본 양식의 사본이 귀하에게 제공 됩니다.

Certificate of Consent: 동의 확인서

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions that I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this research.

나는 이 동의서를 읽고 이 연구에서 가질 수 있는 이점과 치료와 측정방법에 대한 설명을 들었고, 질문할 기회를 가졌으며 주어진 정보를 이해하고 나의 치료결과에 대한 정보가 연구에 사용 되어 지는 것에 동의 합니다.

Name of Participant (Print)

Name of Witness (Print)

참가자 이름

증인 이름

Signature of Participant

Signature of Witness

참가자 서명

증인 서명

Date: Day/Month/Year

Date: Day/Month/Year

날짜 : 일 / 월 / 년

날짜 : 일 / 월 /

Statement by the researcher/person taking consent: 연구 집행자 / 피험자 동의서
수령인 선서

I have accurately explained the information sheet to the potential participant. I confirm that the participant was given an opportunity to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and the consent has been given freely and voluntarily.

본인은 잠정적 피험자에게 정확하게 전술한 내용을 설명하였습니다. 본인은 피험자에게 연구에 대해 질문할 기회를 부여하였고, 모든 질문에 본인 지식 내에서 가능한 정확하게 답변하였습니다. 본인은 피험자가 동의서에 서명하도록 강요하지 않았으며 동의는 자의적이고 자발적으로 이루어졌습니다.

A copy of this ICF has been provided to the participant.

피험자 동의서 (ICF) 복사본이 피험자에게 제공되었습니다.

Print Name Researcher (Print) / 연구자 이름

Signature of Researcher / 연구자 서명

Date: Day/Month/Year / 날짜: 일/월/년