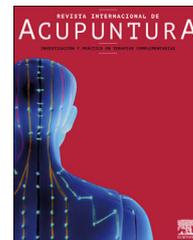




REVISTA INTERNACIONAL DE  
**ACUPUNTURA**

[www.elsevier.es/acu](http://www.elsevier.es/acu)



ORIGINAL ARTICLE

## Effects of classical acupuncture in the treatment of carpal tunnel syndrome: A clinical study



Larry Alexander Ibarra Fredes<sup>a,1</sup>, Jorge Magalhães Rodrigues<sup>b,c,d,\*,1</sup>,  
Lara Teixeira Lopes<sup>b,c,d</sup>, Jorge Pereira Machado<sup>b,c,e</sup>

<sup>a</sup> IETC - Clinical department, European Institute of Traditional Chinese Studies, Rua Dom João IV 399, Porto, 4000-302, Portugal

<sup>b</sup> ICBAS-UP - Traditional Chinese medicine department, Institute of Biomedical Sciences Abel Salazar – University of Porto, Rua de Jorge Viterbo, 228, Porto, 4050-313, Portugal

<sup>c</sup> CBSin - Center of BioSciences in Integrative Health, Atlântico Business School, Vila Nova de Gaia, 4405-604, Portugal

<sup>d</sup> Research Department in Complementary Medicines, Portuguese Institute of Taiji and Qigong – Urbanização da Bouça Grande Rua E, n° 102, Maia, 4470-765, Portugal

<sup>e</sup> LABIOMEPE - Biomechanics Laboratory – University of Porto, Rua Dr. Plácido Costa, 91, Porto, 4200-450, Portugal

Received 27 August 2021; accepted 31 August 2021

Available online 26 October 2021

### KEYWORDS

Carpal tunnel syndrome;  
Acupuncture;  
Traditional Chinese medicine;  
Paresthesia;  
Pain

### Abstract

**Objective:** The purpose of this clinical study is to demonstrate the effect of classical acupuncture on the Carpal Tunnel Syndrome (CTS) and the relationships that integrate the view of classical acupuncture treatment with current anatomical-physiological knowledge.

**Design:** A clinical study was carried out with patients with CTS.

**Setting:** The treatments were conducted in a private healthcare practice by a licensed acupuncturist.

**Participants:** The five participants presented symptomatology for a period of no less than 6 months, had been diagnosed through electromyography, and additionally showed a positive test for Phalen's maneuver test. All the patients had surgical indications.

**Interventions:** Classical Chinese acupuncture was applied during a cycle of treatments.

**Main measurements:** The Visual analog scale (VAS) was used to assess the level of discomfort regarding daytime paresthesia, nighttime paresthesia, pain, decrease in strength, and a proposed converted value of pressure pain threshold.

**Results:** All the parameters showed significant improvement. The mean difference was negative for pain (−7,4 points), daytime paresthesia (−5,2 points), nighttime paresthesia (−6,2 points),

\* Corresponding author.

E-mail address: [dep.investig-iptc@outlook.pt](mailto:dep.investig-iptc@outlook.pt) (J. Magalhães Rodrigues).

<sup>1</sup> Co-first authorship

and loss of strength (-4,6 points), whereas the estimation for the pressure pain threshold was positive (+0,683 kgf/cm<sup>2</sup>).

**Conclusions:** In the analysis of the results obtained through the classical acupuncture therapy, all parameters showed an improvement, which suggests and supports evidence of clinical efficacy on the CTS.

© 2021 Elsevier España, S.L.U. All rights reserved.

## PALABRAS CLAVE

Síndrome del túnel carpiano;  
Acupuntura;  
Medicina tradicional China;  
Parestesia;  
Dolor

## Efectos de la acupuntura clásica en el tratamiento del síndrome del túnel carpiano: un estudio clínico

### Resumen

**Objetivo:** El propósito de este estudio clínico es demostrar el efecto de la acupuntura clásica en el síndrome del túnel carpiano (STC) y las relaciones que integran la visión del tratamiento de acupuntura clásica con el conocimiento anatómico-fisiológico actual.

**Diseño:** Estudio clínico con pacientes con STC.

**Emplazamiento:** Los tratamientos fueron guiados en una clínica privada de salud por un acupunturista acreditado.

**Participantes:** Los cinco participantes habían tenido síntomas durante un período no inferior a 6 meses, habían sido diagnosticados por electromiografía y, además, mostraron una prueba positiva para la maniobra de Phalen. Todos los pacientes fueron indicados para cirugía.

**Intervenciones:** Se aplicó la acupuntura china clásica durante un ciclo de tratamientos.

**Mediciones:** Se utilizó la Escala Visual Analógica (EVA) para evaluar el nivel de malestar en relación con la parestesia diurna, parestesia nocturna, dolor, disminución de la fuerza y un valor umbral de dolor por presión convertido propuesto.

**Resultados:** Todos los parámetros mostraron una mejora significativa. La diferencia de medias fue negativa para dolor (-7,4 puntos), parestesia diurna (-5,2 puntos), parestesia nocturna (-6,2 puntos) y pérdida de fuerza (-4,6 puntos), mientras que la estimación de la presión umbral del dolor fue positivo (+0,683 kgf/cm<sup>2</sup>).

**Conclusiones:** En el análisis de los resultados obtenidos mediante la terapia de acupuntura clásica, todos los parámetros mostraron una mejoría que sugiere y respalda la evidencia de la eficacia clínica en el STC.

© 2021 Elsevier España, S.L.U. Todos los derechos reservados.

## Introduction

The Carpal Tunnel Syndrome (CTS) is a peripheral neuropathy and the most common of the compressive neuropathies of the upper limb.<sup>1</sup>

The carpal tunnel is the space that extends along the palmar aspect of the wrist; it is surrounded and limited by the scaphoid tubercle and the trapezium in the radial aspect, by the hamate halo and by the pisiform bone in the ulnar aspect, and by the transverse ligament of the carpal on the palmar aspect. Through the tunnel passes the superficial and deep flexor tendons of the fingers and the median nerve.<sup>2</sup>

In this syndrome, the median nerve is compressed in the wrist region due to the reduced carpal tunnel space or the increase in the size of any of the nine structures that cross it.<sup>3</sup>

There is a relationship between this syndrome and repetitive manual work<sup>4</sup> and so, it may be considered an occupational disease. However, CTS has also been associated with diabetes, obesity, pregnancy, and menopause,<sup>5</sup> as well as with hypothyroidism.<sup>6</sup> It predominantly affects the female gender; however, it seems that an equivalent risk between genders exists when the occupational exposure is identical.<sup>7,8</sup>

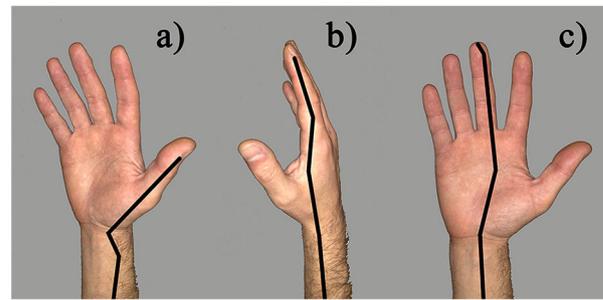
Symptomatology is diverse, including paresthesia, hypoesthesia, anesthesia, decreased strength and coordination in the first finger of the hand, eventually leading to thenar muscle atrophy, interfering with the patient's ability to deal with daily activities.<sup>9</sup>

In conventional medicine, its treatment consists of several conservative methods, which include drugs, physiotherapy, and the modification of daily and professional activities. In cases where there is no favorable response to these treatments, or when there is muscular atrophy or denervation, surgery may be used.<sup>10</sup> However, available data suggest that there are long-term enduring abnormalities in a large percentage of patients after undergoing surgery,<sup>11</sup> with the rate of re-occurrence of symptoms as high as 57%.<sup>12</sup>

In classical traditional Chinese medicine (CTCM), the carpal tunnel disorder may be understood according to two perspectives: 1) the symptomatic perspective, centered on paresthesia and atrophy; and 2) the traditional Chinese perspective of tendon pathology, which in ancient times included the nerves.

Paresthesia is defined in the classic Chinese medical literature, under the term: "insensitivity" (不仁 *bù rén* or 麻木 *má mù*), and its causes can be:

- Failure to transmit nerve impulses. Described in antiquity as: *"The failure of the movement of defensive energy."*<sup>13</sup>
- Poor nutrition and failure in blood irrigation, described in the text *"The Elementary Questions"* as: *"When the nutritive Qi is empty, there is numbness."*<sup>14</sup>
- Chronic injury of the nervous and circulatory system, described in antiquity as: *"When there is no pain, but there is swelling, the disease has lingered and gone deep. The circulation of the nutritive and the defensive is rough and the channels and collateral occasionally relax. Therefore, they are obstructed. The skin lacks nutrition. Therefore, there is numbness."*<sup>15</sup>
- Neurasthenia, described in antiquity as: *"When the body frequently is startled and fearful, and tendons and vessels are obstructed, it generates numbness disease."*<sup>16</sup>
- Diabetes, described in antiquity as: *"When there is heat in the Spleen Qi, the Stomach dries and there is thirst. There is numbness in the muscles and the flesh, manifesting the atrophy of the flesh."*<sup>17</sup>
- Prolonged contraction of cold, described as: *"When cold and bi (block) become diseases, and are retained without being eliminated, occasionally there is pain and numbness in the skin"*.<sup>18</sup>



**Figure 1** Path of hand Tai Yin, Yang Ming, and Governor of the Heart tendon channels.

Concerning tendon atrophy, classical literature refers to many causes, however the most common is inflammation (heat) and malnutrition (dryness) in tendons: *"When there is heat in the Liver Qi, the Gallbladder drains and the mouth is bitter and tendons and membranes dry. When the tendons and membranes dry, the tendons become tense and constrict, manifesting as tendons atrophy."*<sup>17</sup>

In the case of neuropathies, nerve damage is classified in traditional Chinese medicine as "tendon injury". In the theory of traditional Chinese medicine, there is a particular histological categorization, known as: "the five bodies" (五體 wǔ tǐ). The five categories of tissues are: 1) Skin and hair; 2) Vessels; 3) "Flesh" or muscles and fat; 4) Tendons and membranes and 5) Bones and bone marrow.

In CTCM, the term "tendons" (筋 jīn) is comprehensive and includes various forms of connective, muscular, and nervous tissue. The "tendons" are organized in 12 strings or chains of muscular, nervous, tendinous and ligamentous tissues, which are called the "tendinous channels" (經筋 jīng jīn). In the theory of the channels and collateral vessels of traditional Chinese medicine, there are also 12 vessel systems, each associated with an internal organ. Of these channels, six are associated with the hands and the remaining six with the feet. The "tendinous channels" are associated with the 12 regular channels and collateral, according to the path of both structures. For example, the "Tài Yīn Lung channel" of the hand circulates from the abdomen and chest to the first finger of the hand. The "hand Tài Yīn tendon channel" circulates from the first finger to the thorax, and there is a coincidence in its path.

In CTS, the affected areas often concern the path of three "tendon channels"<sup>19</sup> (see fig. 1):

- The "hand Tai Yin tendon channel", with its path starting at the first finger it reaches the thenar eminence and passes through the radial and palmar aspect of the wrist;
- The "hand Yang Ming tendon channel", with its path from

- the second finger to the first interosseous muscle and the radial and dorsal aspect of the wrist;
- The "hand governor of the Heart tendon channel", with its path from the third finger, passing through the center of the palm and the central region of the wrist in its palmar aspect.

Traditional Chinese medicine has several approaches:

- Acupuncture at the affected site itself or *"Use [the site] of pain as [a cavity of] transport"*;<sup>19</sup>
- Acupuncture at distal places;
- The application of *"decoctions, poultices, fire, moxa, and puncture"*.

The purpose of this clinical study is to demonstrate the effect of classical acupuncture in this syndrome, as well as the relationships that integrate the view of classical acupuncture treatment with current anatomical-physiological knowledge.

## Material and methods

Five patients were studied in this clinical study. All patients had a medical diagnosis of CTS confirmed by electromyography. Additionally, patients showed positive for the Phalen's maneuver diagnostic test, and all patients had symptomatology for a period longer than 6 months.

The study followed the ethical guidelines mandated by the authors' respective licensing bodies regarding experimental techniques and procedures, which follows The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans. Written informed consent was obtained from each patient.

Concerning the evaluation method, the patients were asked to describe the degree of discomfort on a scale of 0-10 (VAS), where 0 represents the absence of discomfort and 10 represents the maximum discomfort, for daytime paresthesia, nighttime paresthesia, pain, and decrease in strength. The status of the patient's complaints related to CTS in these four parameters was measured before and after a cycle of 5-6 acupuncture treatments.

According to a study by Seca, Miranda<sup>20</sup> using acupuncture, the decrease of pain levels assessed by the VAS is

Visual Analog Scale (Pain)	Pressure Pain Threshold (Kgf/cm <sup>2</sup> )
10	N/A
9,5	N/A
9	0,080
8,5	0,078
8	0,126
7,5	0,174
7	0,222
6,5	0,269
6	0,317
5,5	0,365
5	0,413
4,5	0,461
4	0,509
3,5	0,557
3	0,605
2,5	0,653
2	0,701
1,5	0,748
1	0,796
0,5	0,844
0	0,892

**Figure 2** Proposed scale for the relation between VAS pain levels and pressure pain threshold. N/A means that the manifestation of pain is permanent and/or no pressure is necessary to elicit pain.

correlated to improvements in the pressure pain threshold in patients with rheumatoid arthritis of the hand. This allows us to propose that pain levels assessed by the VAS on CTS can be approximately quantified in kgf/cm<sup>2</sup>, and estimate the improvement of the pressure pain threshold for patients receiving the acupuncture treatment in this study. The scale is presented in [fig. 2](#).

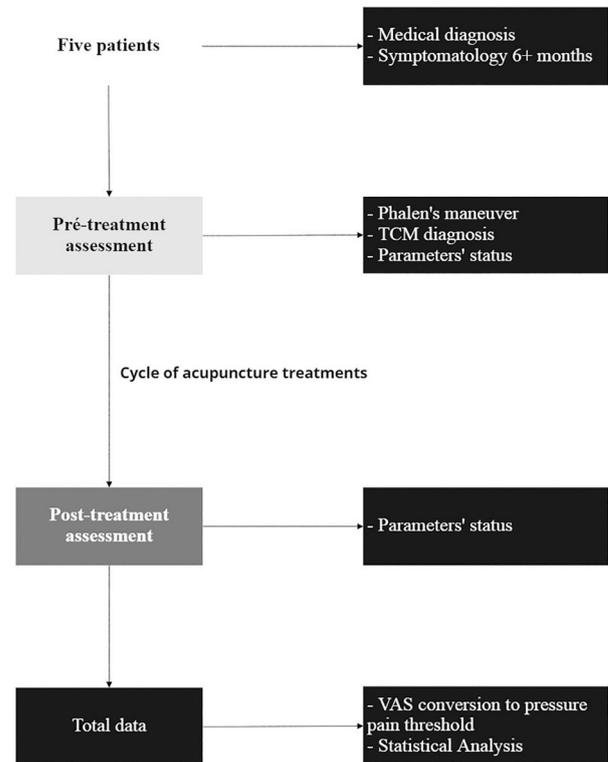
The overall study outline can be seen in [fig. 3](#).

Filiform needles with a length of 25, 30, or 40 mm were used. A needle diameter of 0,25 mm or 0,30 mm was used according to the case.

The acupuncture cavities (or points) of the “hand Tai Yin channel”, the “hand Governor of the Heart channel” and the “hand Yang Ming channel” were selected as the main areas for treatment.

Some of the acupuncture cavities generally used as a base treatment were ([fig. 4](#)):

- “Rupture of the Sequence” (L 7 列缺 Liè Qūe);
- “Union of Valleys” (LI 4 合谷 Hé Gǔ);
- “Great Hill” (PC 7 大陵 Dà Líng).



**Figure 3** Location of the Lu7, Li4, and Pc7 cavities.

Other cavities were selected based on the constitutional balance in the perspective of CTCM.

Cases II, III, IV, and V continued their regular professional activities during the treatments.

The Wilcoxon sign test in IBM SPSS Statistics 26 software was used to compare overall pre- and post-treatment VAS results and the estimated pressure pain threshold levels. The significance level was fixed at 5%.

## Results

### Case I

Female patient, 65 years. Retired teacher. Showed complaints of bilateral CTS for more than 1 year, with a severe degree of demyelination. Generalized pain in the palm and the first three fingers, with more aggravated pain at the base of the first finger and muscular atrophy of the thenar eminence of the right hand, with loss of strength, and both daytime and nighttime paresthesia. The patient was indicated for surgery.

There were concomitant pieces of evidence of “Liver Blood insufficiency and Liver Qi depression” pattern.

It was applied the base treatment at the cavities: “Rupture of the Sequence” (L 7 列缺 Liè Qūe), “Union of Valleys” (LI 4 合谷 Hé Gǔ) and “Great Hill” (PC 7 大陵 Dà Líng). Additionally, some acupuncture cavities were used to treat the pattern evidence of “Liver Blood insufficiency and Liver Qi depression”, such as “Curved Spring” (Li 8 曲泉 Qū Quán), “Big and Solid” (Li 1 大敦 Dà Dūn), and “Crossing of the Three Yin” (Sp 6 三陰交 Sān Yīn Jiāo).



**Figure 4** Representation of the location of the acupuncture cavities.

As we can observe on [table 1](#), all parameters improved.

This patient had a very effective outcome in the eradication of pain and paresthesia as well as a good result in the treatment of loss of strength.

**Case II**

Female, 60 years old, a nurse, presented severe symptoms of bilateral CTS for 1 and a half years. Severe pain in the first two fingers and wrist that worsens with regular work activities. Slight muscular atrophy of the right hand's thenar eminence, with loss of strength. Slight daytime paresthesia and severe nocturnal paresthesia. The patient was indicated for surgery.

Concomitant pieces of evidence of "Liver Blood insufficiency and Liver Qi depression, and Spleen and Kidney Qi deficiency with dampness retention" pattern were present. It was applied the base treatment at the cavities "Rupture of the Sequence" (L 7 列缺 Liè Qūe), "Union of Valleys" (LI 4 合谷 Hé Gǔ) and "Great Hill" (PC 7 大陵 Dà Líng). At the same time, some acupuncture cavities to treat the concomitant patterns were used, such as "Curved Spring" (Li8 曲泉 Qū Quán), "Big and Solid" (Li 1 大敦 Dà Dūn), "Crossing of the Three Yin" (Sp 6 三陰交 Sān Yīn Jiāo), "Supreme White" (Sp 3 太白 Tàì Bái), "Spring of the Yin Hill" (Sp 9 陰陵泉 Yīn Líng Quán) and "Return of The Swift Flow" (K 7 復溜 Fù Liū).

As we can observe on [table 2](#), all parameters showed improvements.

This patient had an effective result in the treatment of pain and night paresthesia and a very effective result in the complaints of loss of strength and day paresthesia.

**Case III**

Woman, 51 years old, teacher, with symptoms of right CTS for 10 months on a moderate to a severe degree. Pain,

**Table 1** Pre- and Post-treatment parameter values for the case I.

	Pre-treatment	Post-treatment
Pain	10	0
Pressure pain threshold	0	0,892 kgf/cm <sup>2</sup>
Daytime paresthesia	7	0
Nighttime paresthesia	9	0
Loss of strength	9	2

**Table 2** Pre- and Post-treatment parameter values for case II.

	Pre-treatment	Post-treatment
Pain	10	1
Pressure pain threshold	0	0,796 kgf/cm <sup>2</sup>
Daytime paresthesia	5	0
Nighttime paresthesia	10	2
Loss of strength	2	0

paresthesia, and loss of strength. The patient was indicated for surgery.

This patient presented accessory evidence of "Liver Qi depression" and "Spleen Qi deficiency". It was applied the base treatment at the cavities "Rupture of the Sequence" (L 7 列缺 Liè Qūe), "Union of Valleys" (LI 4 合谷 Hé Gǔ) and "Great Hill" (PC 7 大陵 Dà Líng), as well as "Liver Transport" (B 18 肝俞 Gān Shū), "Supreme Path" (Li 3 太衝 Tàì Chōng), "Supreme White" (Sp 3 太白 Tàì Bái) and "Hidden White" (Sp 1 隱白 Yīn Bái), were used as a complementary treatment to address the "Liver Qi depression" and the "Spleen Qi deficiency" patterns.

On [table 3](#), we can observe improvements in all parameters. This patient had an outstanding result in the treatment of pain, daytime paresthesia, and loss of strength. The effect was less evident in the night paresthesia.

**Case IV**

A woman, 42 years old, medical dentist, presented symptoms of bilateral CTS for 2 years, with aggravated symptoms in the right hand to a serious degree. Pain, paresthesia, with aggravation of paresthesia during nighttime. Loss of strength, difficulty in handling work tools. With surgical indication.

This patient had concomitant evidence of "Liver Blood insufficiency and Blood Stasis and Spleen Qi deficiency". It was applied the base treatment at the cavities of: "Rupture of the Sequence" (L 7 列缺 Liè Qūe), "Union of Valleys" (LI 4 合谷 Hé Gǔ) and "Great Hill" (PC 7 大陵 Dà Líng). At the same time, to treat the above-stated patterns, it was used acupuncture cavities such as "Curved Spring" (Li 8 曲泉 Qū Quán), "Big and Solid" (Li 1 大敦 Dà Dūn), "Supreme White" (Sp 3 太白 Tàì Bái), "Crossing of the Three Yin" (Sp 6 三陰交 Sān Yīn Jiāo), as well as bleeding and cupping at "Diaphragm Transport" (B 17 膈俞 Gé Shū).

Regarding this case, [table 4](#) presents that all parameters improved.

**Table 3** Pre- and Post-treatment parameter values for case III.

	Pre-treatment	Post-treatment
Pain	8	0
Pressure pain threshold	0,126 kgf/cm <sup>2</sup>	0,892 kgf/cm <sup>2</sup>
Daytime paresthesia	6	0
Nighttime paresthesia	7	3
Loss of strength	5	0

**Table 4** Pre- and Post-treatment parameter values for case IV.

	Pre-treatment	Post-treatment
Pain	9	4
Pressure pain threshold	0,030 kgf/cm <sup>2</sup>	0,509 kgf/cm <sup>2</sup>
Daytime paresthesia	5	2
Nighttime paresthesia	9	3
Loss of strength	4	2

This patient had a good result in the treatment of all the symptoms, but with an incomplete effect in all the parameters. The best response was in the symptoms of paresthesia.

### Case V

Woman, 49 years old, florist. Symptoms of bilateral CTS for 4 years were present, with aggravated symptoms in the right hand at a serious degree. Pain, paresthesia, with aggravation of pain at night. She also developed pain in both the elbow and arm during the previous year. Loss of strength with difficulty in handling work tools. The patient was indicated for surgery.

The patient also presented concomitant evidence of "Liver Blood insufficiency and Blood Stasis". So, it was applied the base treatment at the cavities "Rupture of the Sequence" (L 7 列缺 Liè Qūe), "Union of Valleys" (LI 4 合谷 Hé Gǔ) and "Great Hill" (PC 7 大陵 Dà Líng). At the same time were used some acupuncture cavities to treat the pattern "Liver Blood insufficiency and Blood Stasis", such as "Curved Spring" (曲泉 Qū Quán Li 8) with acupuncture and moxibustion, "Big and Solid" (Li 1 大敦 Dà Dūn) with moxibustion, "Crossing of the Three Yin" (Sp 6 三陰交 Sān Yīn Jiāo) with acupuncture and moxibustion, and with bleeding and cupping at "Diaphragm Transport" (B 17 膈俞 Gé Shū) and bleeding at "Curved Pond" (LI 11 曲池 Qū Chí).

Case V achieved improvements in all parameters, as we can observe on table 5.

The effect was most noticed in the treatment of loss of strength and daytime paresthesia. The result was not complete in the treatment of pain and night paresthesia, although there was a decrease in pain and daytime symptoms.

### General results

As we can see in table 6, all parameters showed significant differences ( $p < 0,05$ ) between pre- and post-treatment cycle values.

**Table 5** Pre- and Post-treatment parameter values for case V.

	Pre-treatment	Post-treatment
Pain	9	4
Pressure pain threshold	0,030 kgf/cm <sup>2</sup>	0,509 kgf/cm <sup>2</sup>
Daytime paresthesia	5	0
Nighttime paresthesia	7	3
Loss of strength	7	0

The mean difference was negative for pain (-7,4 points), daytime paresthesia (-5,2 points), nighttime paresthesia (-6,2 points), and loss of strength (-4,6 points), whereas the estimate for the pressure pain threshold was positive (+0,683 kgf/cm<sup>2</sup>).

### Discussion

CTS is the most common of the incarceration neuropathies presenting the most varied and complex incidence and prevalence expressed by a diagnostic method based on physical exams for neurological deficits, which may involve assessments of impaired sensitivity, discrimination of two points in the distribution of the median nerve or thenar weakness.<sup>21-23</sup>

Surgical decompression is still a definitive treatment for CTS in an advanced situation, e.g., the release of the carpal tunnel in the USA is one of the most performed procedures, about 200,000 each year.<sup>24</sup> In these cases, the surgical treatment seems to be more effective for CTS symptoms than immobilization, which has been the basis of conservative treatment.<sup>25</sup> However, conservative treatment for CTS proves to be effective and the modification of activity is reasonable in patients with tolerable symptoms and absence of progressive neurological or functional deficits.<sup>23</sup>

Some people improve spontaneously and may frequently use nonsurgical interventions involving splinting, medications, exercises, modalities, and alternative therapies. Conservative treatment may include physical therapy (Hand/occupational therapy), bracing,<sup>26</sup> iontophoresis and ultrasound,<sup>27</sup> steroid injections,<sup>28</sup> and mobilization exercises (e.g., tendon gliding and nerve gliding).<sup>29</sup> However, surgical decompression (carpal tunnel release) is often elected. Alternative therapies are also frequently used, such as needles and low-level lasers acupuncture, static magnetic field (SMF), specific yoga, and Qi-Gong exercises.<sup>23</sup>

In the present research work, from the data analysis obtained through the acupuncture therapy of CTCM, we can observe that all parameters showed improvement. In agreement with recent research,<sup>30</sup> we suggest that our results support the evidence of clinical efficacy.

In terms of the CTCM treatment method, different approaches were used:

- Local approach being, in the CTCM perspective a tendon problem, in some cases it was adopted the principle: "Use the pain [local] as the transport [cavity]" and the technic "restorative puncture" (恢刺刺 *huī cì*);<sup>30</sup>
- Distal approach: Being a tendon pathology, the best approach seems to be the local one. However, due to the patient's constitution, the pattern evidence, and the theoretical interrelationship between internal organs and body tissues, some distal points associated with the Liver channel and other related channels were used.

On both approaches, regarding the CTS, Napadow, Liu<sup>31</sup> showed that acupuncture either at the affected hand, or distally at the ankle, improved nerve impulses in the wrist. Those who received local treatment also experienced brain remapping linked to long-term improvement in CTS.

Overall, after the treatment cycle patients showed significant improvements on the evaluated parameters,

**Table 6** Pre- and Post-treatment overall differences for the evaluated parameters and approximate pressure pain threshold

	Pre-treatment		Post-treatment		Mean difference	Z-score	Sig.
	Mean	Standard deviation	Mean	Standard deviation			
Pain (VAS)	9,2	0,837	1,8	2,049	-7,4	-2,032	0,042
Pressure pain threshold (kgf/cm <sup>2</sup> )	0,037	0,052	0,720	0,196	0,683	-2,032	0,042
Daytime paresthesia (VAS)	5,6	0,894	0,4	0,894	-5,2	-2,032	0,042
Nighttime paresthesia (VAS)	8,4	1,342	2,2	1,304	-6,2	-2,032	0,042
Loss of strength (VAS)	5,4	2,702	0,8	1,095	-4,6	-2,041	0,041

similarly to other studies using acupuncture.<sup>32–34</sup> Specifically, our study showed that there was an average improvement rate of 80% regarding pain intensity and an improved average on the estimated pressure pain threshold of 0,682 kgf/cm<sup>2</sup>. Regarding daytime paresthesia, it was achieved an improvement average rate of 93%, while nocturnal paresthesia obtained an improvement average of 74%. In addition, the impairment related to the decrease in strength levels improved at an average of 85%.

Some studies already demonstrate that acupuncture improves clinical and neurophysiological findings of CTS alone<sup>31,34,35</sup> or in complement to other methods.<sup>36–38</sup> It seems to be associated with no serious adverse events<sup>39,40</sup> and provides an alternative for patients who have oral steroid intolerance/contraindication or choose to avoid early surgery.<sup>41,42</sup> Researchers often find it difficult to understand the mechanisms through which traditional Chinese medicine acts on the body. However, some have been demystifying these techniques, bridging Western understanding,<sup>43–47</sup> allowing Chinese medicine to be considered a traditional model of vegetative system biology with a systemic therapeutic approach,<sup>48,49</sup> employing vegetative reflex therapies such as acupuncture<sup>50</sup> to regulate the nervous, circulatory, endocrine, and exocrine systems, achieving an improved state of well-being.<sup>51</sup>

This clinical study was performed to unveil the rationale behind the classic texts of Chinese medicine and the relationships that integrate the view of classical acupuncture treatment with current anatomical-physiological knowledge, applying it to specific cases of CTS and, of course, to understand its effectiveness.

Despite our positive results regarding the application of classical acupuncture in patients with CTS, there still is doubt as to what the outcome would be in terms of effectiveness with longer treatment periods and the complementary prescription of Chinese Phytotherapy. Larger samples and control groups would also improve the methodological quality of future studies.

## Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Declarations of interest

None.

## Acknowledgments

We would like to thank all the patients involved in this study, Diana Queirós for designing fig. 2 “Proposed scale for the relation between VAS pain levels and pressure pain threshold”, Ricardo Moreira for revising the English text, and Mariana Ferreira for the title and abstract translation to Spanish.

## Literature references

1. Skinner H. Cirurgia da mão.. In: editor. In: Hill MG, editor. *Ortopedia Diagnóstico e Tratamento*. 3rd ed. Brazil: Interamericana de Brasil Ltda; 2005. p. 456. p.
2. Moore K, Dalley A. *Anatomia Orientada para a Clínica*. 5th ed. Brazil: Guanabara Koogan; 2007.
3. Serra LMA. Cervico-braquialgia e doenças várias do membro superior. Critérios fundamentais em fracturas e ortopedia. 2nd ed. Lisboa: Lidel Edições Técnicas, Lda; 2001.
4. Violante FS, Farioli A, Graziosi F, Marinelli F, Curti S, Armstrong TJ, et al. Carpal tunnel syndrome and manual work: the OCTOPUS cohort, results of a ten-year longitudinal study. *Scand J Work Environ Health*. 2016;42(4):280–90.
5. Zyluk-Gadowska P, Zyluk A. Factors affecting the outcomes of carpal tunnel surgery: a review. *Handchir Mikrochir Plast Chir*. 2016;48(5):260–5.
6. Shiri R. Hypothyroidism and carpal tunnel syndrome: a meta-analysis. *Muscle Nerve*. 2014;50(6):879–83.
7. McDiarmid M, Oliver M, Ruser J, Gucer P. Male and female rate differences in carpal tunnel syndrome injuries: personal attributes or job tasks? *Environ Res*. 2000;83(1):23–32.
8. Staples JR, Calfee R. Cubital tunnel syndrome: current concepts. *J Am Acad Orthop Surg*. 2017;25(10):e215–24.
9. Chammas M, Boretto J, Burmann LM, Ramos RM, Dos Santos Neto FC, Silva JB. Carpal tunnel syndrome - Part I (anatomy, physiology, etiology and diagnosis). *Rev Bras Ortop*. 2014;49(5):429–36.
10. Jarvik JG, Comstock BA, Kliot M, Turner JA, Chan L, Heagerty PJ, et al. Surgery versus non-surgical therapy for carpal tunnel syndrome: a randomised parallel-group trial. *Lancet*. 2009;374(9695):1074–81.
11. Louie D, Earp B, Blazar P. Long-term outcomes of carpal tunnel release: a critical review of the literature. *Hand (NY)*. 2012;7(3):242–6.
12. Nancollas MP, Peimer CA, Wheeler DR, Sherwin FS. Long-term results of carpal tunnel release. *J Hand Surg Br*. 1995;20(4):470–4.
13. Anonymous. Puncture for the regulation of the genuine and the evil.. In: editors. In: Gan ZW, Wang XY, editors. *The spirit axis of the inner canon of the divine Yellow Emperor*. Beijing: Xue Yuan Press; 2016. p. 183. p.
14. Anonymous. Discussion of the inverted regulation.. In: editors. In: Gan ZW, Wang XY, editors. *The spirit axis of the inner canon of the divine Yellow Emperor*. Beijing: Xue Yuan Press; 2013. p. 164. p.

15. Anonymous. Discussion of block [disease].. In. editors. In: Gan ZW, Wang XY, editors. The spirit axis of the inner canon of the divine Yellow Emperor. Beijing: Xue Yuan Press; 2013. p. 207. p.
16. Anonymous. Discussion of the nine needles.. In. editors. In: Gan ZW, Wang XY, editors. The spirit axis of the inner canon of the divine Yellow Emperor. Beijing: Xue Yuan Press; 2016. p. 194. p.
17. Anonymous. Discussion of atrophy [disease].. In. editors. In: Gan ZW, Wang XY, editors. The spirit axis of the inner canon of the divine Yellow Emperor. Beijing: Xue Yuan Press; 2013. p. 208. p.
18. Anonymous. Longevity, die early and the strong and the soft.. In. editors. In: Gan ZW, Wang XY, editors. The spirit axis of the inner canon of the divine Yellow Emperor. Beijing: Xue Yuan Press; 2016. p. 24. p.
19. Anonymous. The tendons of the channels.. In. editors. In: Gan ZW, Wang XY, editors. The spirit axis of the inner canon of the divine Yellow Emperor. Beijing: Xue Yuan Press; 2016. p. 51. p.
20. Seca S, Miranda D, Patricio M, Correia R, Kirch S, Cabrita AS, et al. New pressure algometry device for the quantification of acupuncture induced pain relief. *J Altern Complement Med*. 2017;3(019).
21. Papanicolaou GD, McCabe SJ, Firrell J. The prevalence and characteristics of nerve compression symptoms in the general population. *J Hand Surg Am*. 2001;26(3):460–6.
22. Aroori S, Spence RA. Carpal tunnel syndrome. *Ulster Med J*. 2008;77(1):6–17.
23. Carlson H, Colbert A, Frydl J, Arnall E, Elliot M, Carlson N. Current options for nonsurgical management of carpal tunnel syndrome. *Int J Clin Rheumatol*. 2010;5(1):129–42.
24. Franzblau A, Werner RA. What is carpal tunnel syndrome? *JAMA*. 1999;282(2):186–7.
25. Verdugo RJ, Salinas RS, Castillo J, Cea JG. Surgical versus non-surgical treatment for carpal tunnel syndrome. *Cochrane Database Syst Rev*. 2003(3), Cd001552. <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD001552/full>, Accessed date: 25 February 2021.
26. Maghsoudipour M, Moghimi S, Dehghaan F, Rahimpanah A. Association of occupational and non-occupational risk factors with the prevalence of work related carpal tunnel syndrome. *J Occup Rehabil*. 2008;18(2):152–6.
27. Banta CA. A prospective, nonrandomized study of iontophoresis, wrist splinting, and antiinflammatory medication in the treatment of early-mild carpal tunnel syndrome. *J Occup Med*. 1994;36(2):166–8.
28. Armstrong T, Devor W, Borschel L, Contreras R. Intracarpal steroid injection is safe and effective for short-term management of carpal tunnel syndrome. *Muscle Nerve*. 2004;29(1):82–8.
29. Butler D, Gifford L. The concept of adverse mechanical tension in the nervous system part 2: examination and treatment. *Physiotherapy*. 1989;75(11):629–36.
30. Anonymous. The Tendons of the channels.. In. editors. In: Gan ZW, Wang XY, editors. The spirit axis of the inner canon of the divine Yellow Emperor. Beijing: Xue Yuan Press; 2016. p. 26. p.
31. Napadow V, Liu J, Li M, Kettner N, Ryan A, Kwong KK, et al. Somatosensory cortical plasticity in carpal tunnel syndrome treated by acupuncture. *Hum Brain Mapp*. 2007;28(3):159–71.
32. Khosrawi S, Moghtaderi A, Haghghat S. Acupuncture in treatment of carpal tunnel syndrome: a randomized controlled trial study. *J Res Med Sci*. 2012;17(1):1–7.
33. Ho CY, Lin HC, Lee YC, Chou LW, Kuo TW, Chang HW, et al. Clinical effectiveness of acupuncture for carpal tunnel syndrome. *Am J Chin Med*. 2014;42(2):303–14.
34. Ural FG, Öztürk GT. The acupuncture effect on median nerve morphology in patients with carpal tunnel syndrome: an ultrasonographic study. *Evid Based Complement Alternat Med*. 2017;2017:7420648.
35. Badia M, Santafé MM. Acupuncture and electroacupuncture in the treatment of carpal tunnel syndrome: systematic review. *Rev Fisioter Invasiva*. 2020;03(01):13–25.
36. Wu IX, Lam VC, Ho RS, Cheung WK, Sit RW, Chou LW, et al. Acupuncture and related interventions for carpal tunnel syndrome: systematic review. *Clin Rehabil*. 2020;34(1):34–44.
37. Chung VCH, Ho RST, Liu S, Chong MKC, Leung AWN, Yip BHK, et al. Electroacupuncture and splinting versus splinting alone to treat carpal tunnel syndrome: a randomized controlled trial. *CMAJ*. 2016;188(12):867–75.
38. Salehi S, Hessami O, Rashed A, Hassabi M, PourSaeid Esfehiani M, Abedi Yakta A, et al. The assessment of acupuncture and exercise therapy in patients with carpal tunnel syndrome: randomized clinical trial. *Novelty Biomed*. 2019;7(4):201–9.
39. Choi GH, Wieland LS, Lee H, Sim H, Lee MS, Shin BC. Acupuncture and related interventions for the treatment of symptoms associated with carpal tunnel syndrome. *Cochrane Database Syst Rev*. 2018;12(12), CD011215.
40. Choi GH, Wieland LS, Lee H, Sim H, Lee MS, Shin BC. Acupuncture and related interventions for the treatment of symptoms associated with carpal tunnel syndrome. *Cochrane Database Syst Rev*. 2018;12(12), CD011215.
41. Yang CP, Hsieh CL, Wang NH, Li TC, Hwang KL, Yu SC, et al. Acupuncture in patients with carpal tunnel syndrome: a randomized controlled trial. *Clin J Pain*. 2009;25(4):327–33.
42. Yang CP, Wang NH, Li TC, Hsieh CL, Chang HH, Hwang KL, et al. A Randomized Clinical Trial of Acupuncture Versus Oral Steroids for Carpal Tunnel Syndrome: A Long-Term Follow-Up. *J Pain Res*. 2011;12(2):272–9.
43. Rodrigues JM, Mestre M, Matos LC, Machado J. Effects of taijiquan and qigong practice over behavioural disorders in school-age children: a pilot study. *J Bodyw Mov Ther*. 2019;23(1):11–5.
44. Rodrigues JM, Mestre M, Fredes LI. Qigong in the treatment of children with autism spectrum disorder: a systematic review. *J Integr Med*. 2019;17(4):250–60.
45. Rodrigues JM, Lopes L, Gonçalves M, Machado J. Taijiquan and Qigong as a mindfulness cognitive-behavioural based therapy on the treatment of cothymia in School-age Children – a preliminary study. *J Bodyw Mov Ther*. 2021;26:329–38.
46. Rodrigues JM, Matos LC, Francisco N, Dias A, Azevedo J, Machado J. Assessment of Qigong effects on anxiety of High-school students: a randomized controlled trial. *Adv Mind Body Med*. 2021;35(3):10–9.
47. Matos LC, Lopes LT, Freire VA, Machado JP, Monteiro FJ, Greten HJ. Can the electrical potential of acupoints be used to assess the functional state of meridians and the effects of therapeutics? An exploratory data analysis. *J Bodyw Mov Ther*. 2021;26:309–17.
48. Greten HJ. Chinese medicine as a model of system biology: Diagnosis as the foundation of acupoint selection. *Current Research in Acupuncture*: Springer; 2013;621–57. p.
49. Greten HJ. Chinese medicine as vegetative systems biology. Part II: the structure of TCM diagnosis. *HNO*. 2011;59(12):1165–75.
50. Matos LC, Sousa CM, Gonçalves M, Gabriel J, Machado J, Greten HJ. Qigong as a traditional vegetative biofeedback therapy: long-term conditioning of physiological mind-body effects. *Biomed Res Int*. 2015;2015:6.
51. Santos RV, Rodrigues JM, Jesus MI. Review on the effects of obesity treatment with acupuncture and phytoacupuncture. *World J Acupuncture – Moxibustion*. 2020;30(3):223–8.