

# Clinical Evolution in Patients with Carpal Tunnel Syndrome Treated with Ultrasound or Corticosteroid Infiltration

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## OPEN ACCESS

### Evolución clínica en pacientes con síndrome del túnel carpiano tratados con ultrasonido o infiltración con corticoesteroides

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#### Abstract

**Introduction.** Carpal tunnel syndrome is the most common compressive peripheral neuropathy of the upper extremity, which is caused by compression of the median nerve. Mild and moderate cases can be treated with conservative methods such as therapeutic ultrasound or corticosteroid infiltration. **Objective.** To describe the clinical evolution of patients with carpal tunnel syndrome treated with ultrasound therapy and corticosteroid infiltration. **Methodology.** A prospective open clinical trial was conducted in patients with mild and moderate carpal tunnel syndrome who consulted from October 1, 2021 to May 30, 2022. Two groups were formed: the group that received ultrasound treatment with 12 cases and the group treated with corticosteroid infiltration with six cases. Both groups were treated at the initial consultation and then at four and eight weeks after the start of treatment. **Results.** The descriptive results related to the intensity of pain, evaluated with the Visual Numeric Scale, are shown. Infiltration obtained two cases without pain and four with moderate pain, contrary to ultrasound which was maintained with four mild, three moderate and five intense cases. In symptoms, infiltration reduced the number of cases in four of the symptoms studied, while ultrasound reduced the number of cases in only two. In severity, assessed with the Boston carpal tunnel questionnaire, with infiltration, there were two asymptomatic cases and none with ultrasound. Regarding clinical signs, Tinel's sign disappeared in four cases in both groups, while Phalen's sign disappeared in four cases in ultrasound and two in infiltration. **Conclusion.** Infiltration produced asymptomatic patients and reduced more symptoms than ultrasonography in terms of pain intensity and severity. Clinical symptoms were less common with both treatments.

#### Keywords

Carpal Tunnel Syndrome, Ultrasonic Therapy, Pain, Adrenal Cortex Hormones, Conservative Treatment.

#### Resumen

**Introducción.** El Síndrome del túnel carpiano es la neuropatía periférica compresiva más común de la extremidad superior, que se produce por la compresión del nervio mediano. Los casos leves y moderados pueden tratarse con métodos conservadores como ultrasonido terapéutico o infiltración con corticoesteroides. **Objetivo.** Describir la evolución clínica de pacientes con síndrome de túnel carpiano tratados con terapia por ultrasonido e infiltración de corticoesteroides. **Metodología.** Ensayo clínico abierto, en pacientes con síndrome del túnel carpiano leve y moderado, que consultaron del 1 de octubre 2021 al 30 de mayo 2022. Se formaron dos grupos; el que recibió tratamiento con ultrasonido con 12 casos y el grupo tratado con infiltración con corticoesteroides con seis casos. Ambos grupos fueron intervenidos en la consulta inicial, y luego, en las cuatro y ocho semanas posteriores al inicio del tratamiento. **Resultados.** Se muestran los resultados descriptivos relacionados con la intensidad de dolor, valorada con la Escala Visual Numérica, la infiltración obtuvo dos casos sin dolor y cuatro con dolor moderado, contrario a ultrasonido que se mantuvo con cuatro casos leves, tres moderados y cinco intensos. En los síntomas, la infiltración redujo el número de casos en cuatro de los síntomas estudiados, en cambio el ultrasonido únicamente en dos. En severidad, valorada con el cuestionario de Boston para túnel carpiano, con infiltración se obtuvieron dos casos asintomáticos y ninguno con ultrasonido. Respecto a los signos clínicos, el signo de Tinel desapareció en cuatro casos en ambos grupos, mientras que signo de Phalen desapareció en cuatro casos en ultrasonido y dos en infiltración. **Conclusión.** En intensidad de dolor y grado de severidad, la infiltración generó casos asintomáticos y redujo mayor cantidad de síntomas que el ultrasonido. Ambos tratamientos disminuyeron la presencia de signos clínicos.

#### Palabras clave

Síndrome del Túnel Carpiano, Terapia por Ultrasonido, Corticoesteroides, Tratamiento Conservador.

## Introduction

Carpal Tunnel Syndrome (CTS) is the most common compressive peripheral neuropathy of the upper extremity. It is a condition resulting from the compression of the median nerve, varying between 32 and 110 mmHg compared to the normal 2 to 31 mmHg.<sup>1</sup> This condition may result in pain in the wrist area and middle, index, and thumb fingers, accompanied by paresthesia and loss of strength.<sup>2-4</sup>

The exact cause of CTS is not yet known; however, multiple risk factors have been found, including pregnancy, obesity, diabetes *mellitus*, rheumatoid diseases, and other local factors such as trauma and repetitive activities of the wrist joint, mainly related to occupational activities, and currently represents one of the health problems affecting the working capacity of the population.<sup>1,3,5,6</sup>

Women between the ages of 40 and 50 are four times more likely to suffer from CTS than men.<sup>3</sup> The prevalence of CTS in the United States is 5 % per year. In the United States, CTS has an annual prevalence of 5 %.<sup>6</sup> It has been observed that there is an association between age and sex because it occurs more frequently in the female population.<sup>1</sup> In the United Kingdom, a prevalence of 88 per 100 000 was recorded in men, in contrast to women, in whom an incidence of 193 per 100 000 was recorded.<sup>3</sup>

According to the morbidemographic profile system of the outpatient medical consultation of the Salvadoran Social Security Institute in El Salvador, CTS is one of the top ten causes of outpatient consultation at the Physical Medicine and Rehabilitation Unit of the Salvadoran Social Security Institute.

The neurophysiological scale of carpal tunnel syndrome compromise takes into account the clinical criteria of the disease, such as the duration of symptoms, the present symptomatology, and the electrodiagnostic findings to determine the degree of nerve compromise; CTS is classified as mild when the symptoms have less than one year of evolution, there are no symptoms, the sensory conduction is abnormal, and the motor conduction is normal; moderate CTS is classified as moderate when the time of evolution is less than or more than one year, there are minimal symptoms, and there are alterations in sensory and motor conduction; Severe CTS is lasting longer than a year, having noticeable symptoms, alterations in sensory and motor conduction, and denervation.<sup>2,7,8</sup>

There are multiple treatment options; surgery is recommended in severe cases and when there has not been a satisfactory evolution with conservative treatment.<sup>4</sup>

The initial management consists of non-surgical or conservative management, such as the use of wrist splints, which due to the effect of limiting the flexion and extension movements of the wrist, reduce the pressure of the median nerve inside the carpal tunnel; corticosteroid infiltration produces the deflation of the tenosynovial tissue that passes through the carpal tunnel, with the consequent decrease in local pressure; ultrasound therapy, the local application of high-frequency waves decreases inflammation and stimulates nerve regeneration through increased blood flow; the use of oral non-steroidal anti-inflammatory drugs has not shown a clear benefit; and acupuncture, which aims to stimulate trigger points, to optimize the energy pathway that generates symptom relief without acting on the pressure inside the carpal tunnel.<sup>1,2</sup>

Previous comparative studies refer to the effectiveness of different types of treatment, but there are no significant differences between them to establish a suitable treatment. The effectiveness of ultrasound is not proven to be superior to other treatments. Infiltration is more effective than some physical methods.<sup>2,7,9,11</sup>

In El Salvador, according to the Salvadoran Social Security Institute's (ISSS) "Physiatry Management Guidelines, 2004"<sup>12</sup> and the "Manual of Physical Therapy Procedures, 2006",<sup>4</sup> the conservative treatments are therapeutic ultrasound<sup>2,13-15</sup> and infiltration with corticosteroids, such as triamcinolone acetonide,<sup>9,10,12,16-18</sup> which is registered in the Official List of Medications of the ISSS.<sup>19</sup>

Patient follow-up and clinical evolution of patients with mild or moderate CTS could be performed according to the application of the Boston Carpal Tunnel Questionnaire<sup>20-22</sup> (BCTQ) and the Numerical Rating Scale (NRS) for pain.<sup>23</sup>

Since it refers to a health problem that most frequently affects the economically active population, their quality of life due to the severity of their symptoms, limiting their daily activities, and their work performance,<sup>24</sup> it is important to establish an adequate and effective treatment that allows the patient's recovery in a shorter time, with a decrease in treatment costs and periods of incapacity. This study aimed to describe the clinical evolution of mild or moderate CTS in patients treated with two conservative treatment methods: triamcinolone acetonide infiltration and ultrasound therapy.

## Methodology

Open clinical trial was conducted to evaluate the clinical evolution of patients with

mild or moderate CTS after conservative treatment with therapeutic ultrasound and corticosteroid infiltration.

The population consisted of patients with mild or moderate CTS who consulted for the first time at the Physical Medicine and Rehabilitation Unit of the ISSS in San Salvador over eight months, from October 1, 2021, to May 30, 2022, and who voluntarily agreed to participate in the study (Figure 1).

There were trained health personnel accessible for this study. A certified physiatrist performed triamcinolone infiltration in the locations selected for each treatment, while a certified physical therapist performed ultrasound therapy.

Adults who agreed to participate in the study and who had a diagnosis of mild or moderate CTS, symptomatic, i.e., presenting at least two symptoms or one symptom accompanied by a clinical sign present and who had not received treatment with infiltrations or previous surgical management for CTS and with a time of evolution greater than three months were included.

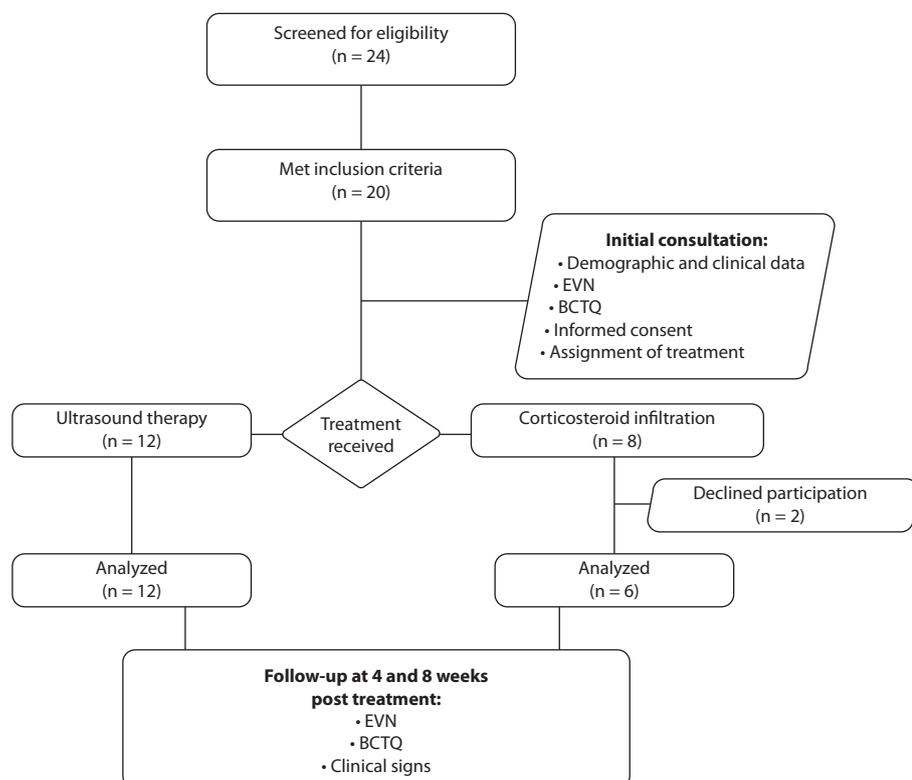
Patients who presented contraindications for the use of corticosteroids (sensitivity, infection, or skin lesion at the injection site) or contraindications for the use of therapeutic ultrasound (history of cancer in organs or structures close to the treatment area, bleeding tissues, or that could present bleeding) were excluded, as well

as patients who presented conditions that could simulate symptoms of CTS, such as the diagnosis of polyneuropathies, cervical radiculopathy, among others.

The study began with 24 patients eligible to participate; 20 patients were selected to participate in the study. Initially, informed consent was requested; then, demographic and clinical data were obtained, the EVN and BCTQ questionnaires were applied, and they were distributed, using convenience sampling, in two treatment groups: the first one received continuous therapeutic ultrasound at a frequency of 3 MHz and intensity of 1 W/cm<sup>2</sup>, with a transducer with a 5 cm<sup>2</sup> head, for 5 min, distributed twice a week, for five weeks, for a total of ten treatment sessions. The second group received one dose of infiltration in the palmar area of the wrist with 10 mg of triamcinolone acetonide and 1 mL of 2% lidocaine in a 3 mL disposable syringe. Of this group, two patients decided to withdraw from the study.

Three evaluations were performed, the first one at the beginning of the treatment and two subsequent follow-ups at four and eight weeks.

The study included as independent variable, the type of treatment selected; therapeutic ultrasound or corticosteroid infiltration, and as dependent variable, the clinical evolution of carpal tunnel syndrome. Other variables taken into account were



**Figure 1.** Patient flow

the patient's personal and clinical data, including age, time of evolution of CTS, affected hand, risk factors, including occupational risk and obesity, which was measured by calculating the body mass index;<sup>20</sup> pain intensity, according to the NBS and symptom intensity according to the BCTQ; and the evaluation of the clinical signs present. (Tinel and/or Phalen)<sup>7,20</sup>

The checklist for this study was elaborated according to the variables identified in Microsoft Word. Then, the data were analyzed using Microsoft Excel.

The research complied with internationally established ethical principles to guarantee participant confidentiality. Personal and clinical data were kept confidential by the research team; neither the identity of the patients nor any other data that could identify them were disclosed. The informed consent used for this study was prepared based on the format proposed by the World Health Organization's Committee for the Ethical Evaluation of Research. This study was approved by the Ethics Committee for Health Research ISSS 2020-2023, dated 20/07/2021, and identified CEIS ISSS 2021-041 version 2.

## Results

This study shows only descriptive data. Regarding the demographic data of the patients evaluated, the 18 cases corresponded to the female sex, with a higher frequency in those over 60 years of age (Table 1).

The time of evolution between 2 and 3 years was the most frequent, with seven cases reported. The most frequent risk factor was occupational hazards related to repetitive movements of the wrist joint, and obesity was identified in three of the 18 cases (Table 1).

The frequency of CTS was the same in both hands based on the affected hand's laterality. According to the findings of the electrophysiological study before therapy began, slight or moderate involvement was in 16 CTS patients, and one patient had a normal study.

Concerning pain intensity using the EVN scale, the group managed with ultrasound began with five cases of moderate intensity and seven cases of intense pain and ended the eight weeks of follow-up with four mild, three moderate and five intense cases. The infiltration group started with one case of mild intensity and five cases of moderate intensity, and ended the follow-up with two cases without pain and four cases of moderate intensity.

**Table 1.** Demographic and clinical data of patients with carpal tunnel syndrome

Variable	n
<b>Age</b>	
18 to 29 years old	2
30 to 39 years old	3
40 to 49 years old	4
50 to 59 years old	2
> 60 years old	7
Total	18
<b>Treatment method</b>	
Infiltration	6
Ultrasound	12
Total	18
<b>Time of evolution</b>	
< 1 year	4
1 to 2 years	5
2 to 3 years	7
3 or more years	2
Total	18
<b>Risk factors</b>	
Occupational factors	11
Obesity	3
Other	4
Total	18
<b>Hand evaluated</b>	
Right	9
Left	9
Total	18
<b>Result of previous electrophysiological study</b>	
No study presented	1
Normal	1
Mild	9
Moderate	7
Total	18

Regarding the presence of CTS symptoms checked in the BCTQ questionnaire, the group treated with ultrasound presented a reduction of two specific symptoms after eight weeks of treatment, in the symptom of loss of sensitivity in one case and in the symptom of functional difficulty in three cases. In the infiltrated group, hand/wrist pain, dysesthesias/paraesthesias, loss of sensation and functional difficulty at eight weeks post-treatment showed a decrease of one case each.

The severity of CTS, evaluated using the BCTQ questionnaire, presented eight mild cases and four moderate cases in the ultrasound group at the beginning of the

study and ended with nine mild cases, two moderate cases, and one severe case. Contrary to the infiltrated group, which had two asymptomatic cases, there were three mild and one moderate cases in the infiltrated group. (Table 2)

The clinical sign of Tinel was found to be present in six of the ten patients who presented it at the beginning of the study and were treated with ultrasound; similarly, in the infiltrated group, it was found to be present in two of the six cases that presented it before treatment.

On the other hand, Phalen's sign was identified in 12 cases at the beginning of treatment, and it was present in eight cases after treatment in the ultrasound therapy

group. Finally, it was recorded in six with a reduction to four at the end of treatment in the group that received corticosteroid infiltration. (Table 3)

## Discussion

Some conservative treatment modalities for mild and moderate CTS have evidence of their effectiveness in reducing symptoms, mainly the use of splints and corticosteroid infiltration, which have led to a decrease in pressure in the carpal tunnel area.<sup>1,6,25</sup> The efficacy of manual therapy based on neurodynamic techniques in the conservative treatment of carpal tunnel syndrome has shown significant differences regarding pain

**Table 2.** Results of the EVN scale and the BCTQ questionnaire in the different stages of follow-up of patients with CTS treated with ultrasound or infiltration

Follow-up stage	First appointment		4 weeks		8 weeks	
	Ultrasound	Infiltration	Ultrasound	Infiltration	Ultrasound	Infiltration
Treatment	n	n	n	n	n	n
<b>EVN Intensity</b>						
No pain (0)	0	0	0	1	0	2
Mild (1-3)	0	1	2	1	4	0
Moderate (4-6)	5	5	8	4	3	4
Severe (7-9)	7	0	2	0	5	0
Severe (10)	0	0	0	0	0	0
<b>BCTQ symptoms</b>						
Asymptomatic	0	0	0	0	0	0
Hand/wrist pain	12	6	12	6	12	5
Dysesthesias/Pares- thesias	12	6	12	6	12	5
Loss of sensation	11	3	10	3	10	2
Loss of strength	11	5	10	5	11	5
Functional difficulty	9	4	7	3	6	3
<b>BCTQ severity</b>						
Asymptomatic (1)	0	0	0	0	0	2
Mild (2)	8	3	8	5	9	3
Moderate (3)	4	3	4	1	2	1
Severe (4)	0	0	0	0	1	0
Severe (5)	0	0	0	0	0	0

( ): score.

**Table 3.** Clinical signs present in the different stages of follow-up of patients with Carpal Tunnel Syndrome treated with ultrasound or infiltration

Follow-up stage	First appointment		8 weeks	
	Ultrasound	Infiltration	Ultrasound	Infiltration
Treatment	n	n	n	n
<b>Signo clínico</b>				
Tinel	10	6	6	2
Phalen	12	6	8	4

and symptom severity;<sup>26</sup> in this study, it was observed that patients treated with corticosteroids presented complete pain relief.<sup>24</sup>

Therefore, as in other studies, there is insufficient evidence to support the greater benefit and efficacy of therapeutic ultrasound compared to other non-surgical interventions for CTS.<sup>2,13</sup> In contrast, the evidence suggests that injection with a corticosteroid has better outcomes.<sup>2</sup>

Concerning severity, both groups presented a reduction at the end of follow-up; however, the infiltrated group presented asymptomatic cases, which was not observed in the group treated with ultrasound.

The EVN scale and the BCTQ questionnaire are valid and reliable tools, established and internationally recognized for use in the evaluation of this type of health condition since they are reproducible methods.<sup>21-23</sup> Efficacy studies of corticosteroid therapy have shown to reduce the symptoms of CTS.<sup>2,16</sup> One study reported that 53 % of patients treated with corticosteroids had no symptom recurrence at six months; 31 % were symptom-free after 12 months. Furthermore, they found that patients who received a single injection had significantly better scores on the BCTQ.<sup>2</sup>

The Phalen and Tinel signs are characterized by having a moderate diagnostic value in the diagnosis of CTS. The Tinel sign has a sensitivity between 23 and 67 % and a specificity of 55 to 100 %; the Phalen sign reports a sensitivity of 10 to 91 % and a specificity between 33 to 100 %.<sup>20</sup> In this study, it was observed at the end of follow-up that there was a reduction in both signs, with greater reduction in Tinel's sign in the group treated with corticosteroids, unlike Phalen's sign, which showed a similar reduction in both groups.

Previous studies have found that CTS affects women more than men and that this aspect, together with repeated dynamic movements of the wrist or fingers, constitute basic risk factors for this pathology.<sup>2,20</sup> Consequently, the results show that the total number of cases corresponded to the female sex, this being, together with occupational factors (related to repetitive movements), the most important risk factors.

In previous research, the highest percentage of these cases was found in people aged 45 to 64 years.<sup>13</sup> Some studies indicate that CTS is bilateral in 65 % to 84 % of the cases.<sup>2,7</sup>

It is suggested that further studies continue to evaluate the results obtained in the management of CTS with methods such as infiltration with corticosteroids and the use of therapeutic ultrasound, either

separately or in comparison with other treatment methods.<sup>2,9,17,20,27</sup>

## Conclusion

A reduction in the presence of symptomatology and clinical signs is achieved with both treatment methods. However, in terms of pain intensity and degree of severity of CTS, more asymptomatic cases were observed, and a greater reduction in the number of symptoms in the management with infiltration than in the management with ultrasound. However, a reduction in functional symptoms was observed.

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