

# Effectiveness of Ultrasound Modality In Carpal Tunnel Syndrome (CTS) Patients: Literature Review

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## Abstract

Carpal Tunnel Syndrome (CTS) is a common condition affecting individuals across various age groups, with a prevalence of 20.3% in Indonesia. This syndrome occurs due to the compression of the median nerve, leading to pain, numbness, and weakness in the affected hand. One of the non-invasive treatments used for CTS is ultrasound therapy, which offers a warming effect to stimulate tissue repair and reduce inflammation without causing adverse side effects. The objective of this study is to evaluate the effectiveness of ultrasound therapy in treating CTS. A systematic literature review was conducted using the PICO search strategy on the Google Scholar database, resulting in five relevant journals that met the inclusion criteria. The findings indicate that applying ultrasound therapy for 15 minutes per session with an intensity of 1.0 W/cm<sup>2</sup>, frequency of 1 MHz, five sessions per week for six weeks, significantly improves pain relief and functional activity in CTS patients. The therapy shows a high level of effectiveness, with statistical significance ( $p < 0.001$ ) in reducing pain, decreasing inflammation of the median nerve, and promoting nerve regeneration, making it an effective treatment option for CTS sufferers.

**Keywords:** carpal tunnel syndrome, ultrasound, pain

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## INTRODUCTION

Carpal Tunnel Syndrome (CTS) is the most common upper extremity compressive neuropathy, with an estimated lifetime incidence of 3.1% (Pourmemari et al., 2018), although its prevalence depends on the definition used in each study (Thiese et al., 2014).

Carpal tunnel syndrome is a health disorder characterized by pain, numbness, and tingling in the hands. This sensation can be felt on the thumb, index finger, middle finger, and 1/2 ring finger on the radial side. This occurs when the median nerve that passes through the carpal tunnel in the wrist is pinched or compressed. (Genova et al., 2020).

The wrist and fingers are made up of muscles, tendons, joints, and nerves. The wrist and fingers have a more complex function than other parts of the body. Among its functions, the most common is carpal tunnel syndrome (CTS).

Carpal tunnel syndrome is more common in women and mainly affects middle-aged workers. Therefore, this syndrome is associated with significant medical costs and economic burdens, especially related to lost productivity (Foley & Silverstein, 2015).

According to (Alhusain et al., 2019), people who perform repetitive activities and use their hands with sufficient force have a higher incidence of carpal tunnel syndrome. People who work with repetitive hand movements and use extra hand strength are at higher risk.

The prevalence of carpal tunnel syndrome in the general population ranges from 3 to 6%, with the working population having a higher risk of developing carpal tunnel syndrome than the unemployed population.

Carpal tunnel syndrome (CTS) is the most common type of peripheral trap syndrome that occurs in the wrist in a space called carpal tunnel. This syndrome is a debilitating hand disease that, if left untreated, can cause damage to the median nerve and result in loss of hand function.

Carpal Tunnel Syndrome consists of the wrist bone and the transverse ligament (retinal flexor) in the anterior part of the carpal nerve and the medianas nerve pass through this compartment through 9 tendons.

Due to its special location in the tunnel, the median nerve is susceptible to compression and in some cases this syndrome occurs due to repetitive wrist movements. During repeated flexion and extension of the wrist, the pressure on the tunnels increases and the nerves become more and more compressed. The pressure in this chamber varies from 18 to 47 mm Hg depending on the position of the different wrists.

Research shows that the rate of disease in women is four times higher than in men; It seems that occupational factors play an important role in the development of this syndrome. The incidence of carpal tunnel syndrome worldwide reaches 12,267 people per 100,000 population with a prevalence of 9.2% in women and 6% in men (Sekarsari & Farzan, 2017). According to the National Health Survey (NHIS), the prevalence of carpal tunnel syndrome in adults is 1.55% or equivalent to 2.6 million people (Basuki et al., 2015).

Ultrasound therapy is chosen because it can accelerate the healing of damaged tissue with a penetrating warming effect so that it can cause vasodilation which then increases the supply of oxygen to repair damaged tissue to treat wrist pain. decreased (Ono et al., 2020).

Research on the effectiveness of ultrasound therapy in improving the symptoms of carpal tunnel syndrome and the functional status of patients with carpal tunnel syndrome is still limited and provides mixed results. Ultrasound therapy is expected to accelerate the improvement of carpal tunnel syndrome symptoms so as to improve functional status. Therefore, this study aims to find out whether ultrasound can reduce pain in patients with carpal tunnel syndrome.

The novelty of this research lies in its focus on the application of ultrasound therapy as a non-invasive treatment method for Carpal Tunnel Syndrome. While existing studies on CTS treatments are limited and provide varying outcomes, this study explores the specific effects of ultrasound therapy on pain relief and functional improvement in CTS patients. Additionally, the study will analyze the optimal parameters for ultrasound therapy, such as frequency, intensity, and duration, which have not been comprehensively explored in previous research.

This research contributes to the medical field by providing evidence-based insights into the use of ultrasound therapy for treating CTS. It offers a potential alternative or complementary treatment to more invasive options like surgery. The study's findings will guide healthcare professionals in optimizing ultrasound treatment protocols for CTS patients, helping to reduce medical costs and economic burdens associated with this condition, especially for individuals who rely on their hand functions for daily activities and work.

## **METHODS**

This research uses a literature review approach. A literature review is an integrated analysis (not just a summary) of scientific writing that is directly related to the research question. This means that the literature shows the correspondence between the written text and the research question formulated.

Literature reviews can be stand-alone works or introductions to papers research that more large, depends at kind needs. (University of West Florida, 2020).

The research question followed the PICO format: (P=Population) patients with carpal tunnel syndrome, (I=Intervention) Ultrasound, (C=Comparison) no comparator, (O=Outcome)Ultrasound can effectively reduce pain in patients with CTS. The research journal articles reviewed are limited by inclusion and exclusion criteria, with journal collection having a span of time for the last 10 years, namely 2013-2023

The article will be reviewed if it has met the following inclusion criteria: (i) the study subjects are women who have wrist pain due to conditions related to Carpal Tunnel Syndrome with an age range of 18 – >85 years.

Research articles will be rejected if authors meet the following exclusion criteria (i) the research uses a systematic review method, (ii) research journals under 2013, (iii) the subject refuses to participate. Authors Get information based on a database of journals such as Google Scholar Coping in the study will be accepted by the authors of any effect of the intervention of each article impact or not the research sample. To summarize the data, the author summarizes the article based on study subjects, age and gender of participants, type of intervention given (both in terms of frequency, duration and tools to measure the effectiveness of the intervention), conclusions

The research instrument uses Symptom Severity Scale (SSS): a self-administered questionnaire developed to assess the severity of symptoms in patients with Carpal Tunnel Syndrome. The questionnaire contains eleven questions with multiple-choice answers, with scores ranging from 1 point (lightest) to 5 points (severest)

Functional Status Scale (FSS) is an objective, fast, quantitative, and reliable tool to assess the functional status of all children from full-term newborns to adolescents. Conceptually, this scale is based on the activity scale of daily living, which is used in adult research to evaluate function, disability, and dependence. Based on a standard neurological examination, 7 functional systems (plus "other") were assessed. This rating is then used in conjunction with observations and information regarding gait and the use of aids to assess EDSS. Each FSS is an ordinal clinical assessment scale that ranges from 0 to 5 or 6. EDSS is an ordinal clinical assessment scale that ranges from 0 (normal neurological examination) to 10 (death due to MS) with an increase of half a point.

Visual analogue scales (VAS): psychometric measurement instruments designed to document the severity characteristics of disease-related symptoms in individual patients and use them to achieve rapid (statistically measurable and reproducible) symptom severity classification and disease control Visual Analogue Pain Scale (VAS), tests for monofilament sensitivity, hand grip strength, lateral pinching, pulp-to-pulp pinching, and tripod pinching. All evaluations are carried out by a physiotherapist who specializes in single hand therapy. A visual analogue pain scale (VAS) is used to measure patient-reported pain, ranging from zero (no pain) to ten (maximum pain).

Ultrasound (US): Ultrasound is used to create stimuli with an oscillation frequency of 95 Hz. Most ultrasound devices provide continuous or intermittent power. Intermittent ultrasound administration has advantages because it is able to prevent thermal effects. Whereas continuous ultrasonic transmission has the most thermal effect big (Kevin et al. 2015). (US) is a form of mechanical energy from the group of electrophysical agents in which this device can increase the frequency in the form of sound waves that can be heard by humans, from about 15 to 20,000 Hz, This is common in children and adults. . Frequencies of 10 and 3.0 MHz or IMHz one million cycles per second are commonly used for ultrasound therapy (Watson & van Wijk, 2015).

American therapy has both thermal and non-thermal effects. Thermal effects have advantages in increasing collagen tissue extensibility, blood circulation, sensory and motor nerve speed, and enzyme activity. In addition, it can also reduce seizures, stiffness, inflammation and pain. Meanwhile, non-thermal effects have advantages in reducing edema by increasing the permeability of cell membranes and blood vessel walls, increasing blood circulation, protein synthesis and tissue regeneration so as to lead to wound healing.

For US doses using MHz frequencies, an intensity of 1.0 W/cm<sup>2</sup> within 5 minutes twice a week of therapy can improve functional ability and reduce complaints suffered in Carpal Tunnel Syndrome.

**RESULTS AND DISCUSSION**

Of the 5 journals that were obtained, they were researched through *screening, eligibility and inclusion*. *Ultrasound* is one of the physiotherapy therapy modalities that uses sound waves with mechanical vibrations so as to produce longitudinal waves that propagate through a certain medium with varying or varying frequencies. From this understanding, ultrasound is a treatment using vibrations from sound waves that have a frequency of more than 20,000 Hz (Purnomo et al., 2017). *Ultrasound* is a conservative treatment, which shows improvements in pain relief and functional activity.

**Table 1. Comparison of Experimental Group and Control Group**

Reviewer	Participant		Intervention		Measure ment	Results	Design Study
	Intervention group	Control group	Experimental group	Control group			
(Bhavani Prathap et al., 2023)	n= 30 65 - >80 years old	-	Ultrasound	No intervention	VASE	P<0.0001	Intervention Study
(Fernández-de-las-Peñas et al., 2023)	n= 70 >65 years	-	Ultrasound	No intervention	FSS	P<0,001	RCT
(Afifah et al., 2019)	n= 30 18 -85 years old	-	Ultrasound	No intervention	VASE	P<0,001	RCT
(Rayegani et al., 2019)	n= 403 36-51 years old	-	Ultrasound	No intervention	SSS	P<0.00001	System atic

						review and Meta-Analysis Study
(Thanaya et al., 2023)	n= 12 >18 years old	n= 12 >18 years old	Ultrasound	Splinting and exercise therapy	FSS	RCT
					P<0.05	

Based on a literature review study, the authors found that of the 545 sample results, the average sample was dominated by women aged  $\geq 85$  years. Of the many literatures found, most of the literature uses RCT research designs and VAS, FSS and SSS measurements with  $p < 0.001$ . The experimental group used an ultrasound intervention while the control group was not given an intervention.

**Table 2. Ultrasound Intervention Therapy Dosage**

Reviewer	Type of Intervention	Therapeutic Dosage				Duration Therapy
		F	I	T	T	
(Bhavani Prathap et al., 2023)	Were administered to the wrist crease to the palmar region, along with wrist mobility exercise.	1 MHz	1.0 W/5cm <sup>2</sup>	Ultrasound	15 min	5 times/week, for 6 weeks
(Fernández-de-las-Peñas et al., 2023)	Ultrasound imaging of the arm points to the for application of ultrasound-guided percutaneous electrical stimulation in the median nerve.	2 Hz	1.0 W/cm <sup>2</sup>	Ultrasound	15 min	3 times/week
(Afifah et al., 2019)	Exercise therapy consisted of wrist flexion stretches, wrist extension stretches, tendon glides, and medial nerve glides.	20,000 Hz	1.0 W/cm <sup>2</sup>	Ultrasound	15 min	5 times/week, for 6 weeks
(Rayegani et al., 2019)	Of wrist bones and transverse ligament (flexor retinaculum) in anterior part of the wrist and the median nerve.	1 MHz	1.0 W/cm <sup>2</sup>	Ultrasound	15 min	5 times/week, for 3 weeks
(Thanaya et al., 2023)	Various types of wrist splints and different angles of immobilizing the wrist are effective in treating.	1 MHz	1.0 W/cm <sup>2</sup>	Ultrasound	15 min	3 times/week, for 4 weeks

Based on the research that has been conducted, researchers have found that *the Ultrasound* modality can be applied to patients with *Carpal Tunnel Syndrome* with a frequency of 5 times/week, an intensity of 1.0 W/ 5 cm<sup>2</sup>, with a duration of 15 minutes for 6 weeks and carried out 5 times/week.

**Table 3. Mean of Study Characteristics**

Reviewer	Measurement	Group experiment		Control group		Significant
		Pre	Post	Pre	Post	
(Bhavani Prathap et al., 2023)	VASE	5.13 ± 0.92	2.00 ± 0.53	-	-	P < 0.0001
(Fernández-de-las-Peñas et al., 2023)	FSS	2.3 ± 0.6	2.4 ± 0.7	-	-	P < 0.001
(Afifah et al., 2019)	VASE	2.1 ± 2.3	2.2 ± 2	-	-	P < 0.001
(Rayegani et al., 2019)	SSS	2.2 ± 0.7	2.3 ± 0.6	-	-	P < 0.00001
(Thanaya et al., 2023)	FSS	2.4 ± 0.18	1.91 ± 0.14	2.42 ± 0.14	2.16 ± 0.19	P < 0.05

Based on the table above, when compared to the control group, the intervention group showed a good and significant improvement.

**CONCLUSION**

Carpal Tunnel Syndrome is a health disorder that can cause pain, numbness, and tingling in a person's hands. The results of the study showed that Ultrasound modality therapy provided a significant effectiveness of p<0.001 in reducing pain, reducing inflammation of the median nerve and aiding nerve recovery by stimulating regeneration. Ultrasound can also be performed by adding a combination with wrist mobility exercises as a conservative treatment, which shows improvements in pain relief and functional activity.

**BIBLIOGRAPHY**

- Afifah, A. N., Ilmiyati, N., & Toto, T. (2019). Model project based learning (PjBL) berbasis STEM untuk meningkatkan penguasaan konsep dan keterampilan berpikir kritis siswa. *Quagga: Jurnal Pendidikan dan Biologi*, 11(2), 73–78.
- Alhusain, F. A., Almohrij, M., Althukeir, F., Alshater, A., Alghamdi, B., Masuadi, E., & Basudan, A. (2019). Prevalence of carpal tunnel syndrome symptoms among dentists working in Riyadh. *Annals of Saudi medicine*, 39(2), 104–111.
- Basuki, R., Jenie, M. N., & Fikri, Z. (2015). Faktor prediktor carpal tunnel syndrome (CTS) pada pengrajin alat tenun bukan mesin (ATBM). *Jurnal Kedokteran Muhammadiyah*, 4.
- Bhavani Prathap, S., Vinodhkumar, R., Vignesh, S., Kumaresan, A., & Jagatheesan, A. (2023). Effect of Ultrasound Versus Transcutaneous Electrical Nerve Stimulation in Management of Carpal Tunnel Syndrome. *INTI JOURNAL*, 2023(14), 1–7.
- Fernández-de-las-Peñas, C., Ortega-Santiago, R., De-la-Llave-Rincón, A. I., Cleland, J. A., Pareja, J. A., Fahandezh-Saddi-Díaz, H., & Arias-Buría, J. L. (2023). Ultrasound-guided percutaneous electrical nerve stimulation versus surgery for women with unilateral carpal tunnel syndrome: A randomized parallel-group trial. *European Journal of Pain*, 27(7), 860–870.
- Foley, M., & Silverstein, B. (2015). The long-term burden of work-related carpal tunnel syndrome relative to upper-extremity fractures and dermatitis in Washington State. *American Journal of Industrial Medicine*, 58(12), 1255–1269.
- Genova, A., Dix, O., Saefan, A., Thakur, M., & Hassan, A. (2020). Carpal tunnel syndrome: a review of literature. *Cureus*, 12(3).
- Ono, K., Akimoto, K., Kameda, S., & Suematsu, N. (2020). Dual-CTS: Novel high-efficiency spatial reuse method in heterogeneous wireless IoT systems. *2020 IEEE 31st Annual International Symposium on Personal, Indoor and Mobile Radio Communications*, 1–6.
- Pourmemari, M., Heliövaara, M., Viikari-Juntura, E., & Shiri, R. (2018). Carpal tunnel release: Lifetime prevalence, annual incidence, and risk factors. *Muscle & nerve*, 58(4), 497–502.
- Purnomo, D., Amin, A. A., & Ardiningsih, R. C. (2017). Pengaruh Ultrasound dan Terapi Latihan Pada Carpal Tunnel Syndrome. *Jurnal Fisioterapi Dan Rehabilitasi*, 1(2), 34–42.
- Rayegani, S. M., Moradi-Joo, M., Raeissadat, S. A., Bahrami, M. H., Seyed-Nezhad, M., & Heidari, S. (2019). Effectiveness of low-level laser therapy compared to ultrasound in patients with carpal tunnel syndrome: A systematic review and meta-analysis. *Journal of lasers in medical sciences*, 10(Suppl 1), S82.
- Sekarsari, D., & Farzan, A. (2017). *Hubungan lama kerja, gerakan repetitif dan postur janggal pada tangan dengan keluhan carpal tunnel syndrome (cts) pada pekerja pemecah batu di kecamatan moramo utara kabupaten konawe selatan tahun 2016*. Haluoleo University.
- Thanaya, S. A. P., Saraswati, P. A. S., & Barani, M. D. S. P. (2023). The effectiveness of combining ultrasound therapy with splinting and exercise therapy for patients with carpal tunnel syndrome. *Physical Therapy Journal of Indonesia*, 4(2), 155–159.
- Thiese, M. S., Hegmann, K. T., Wood, E. M., Garg, A., Moore, J. S., Kapellusch, J., Foster, J., & Ott, U. (2014). Prevalence of low back pain by anatomic location and intensity in an occupational population. *BMC musculoskeletal disorders*, 15, 1–11.
- Watson, L., & van Wijk, K. (2015). Resonant ultrasound spectroscopy of horizontal transversely isotropic samples. *Journal of Geophysical Research: Solid Earth*, 120(7), 4887–4897.

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