



The Effect of Ultrasound Therapy and Stretching on Pain Reduction in Carpal Tunnel Syndrome at Indramayu Regional Hospital

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ABSTRACT

Background: Carpal Tunnel Syndrome (CTS) is a nerve disorder that occurs when the median nerve is compressed at the wrist, leading to symptoms such as pain, tingling, numbness, and reduced hand function. These symptoms can interfere with daily activities and work productivity. Physiotherapy interventions play an important role in managing pain and improving functional outcomes in patients with CTS. Ultra Sound Therapy is commonly used to reduce pain and inflammation through deep tissue heating and micro-massage effects, while stretching exercises aim to improve flexibility, reduce muscle tension, and decrease pressure within the carpal tunnel.

Objective: To analyze the effect of Ultra Sound Therapy combined with stretching exercises on pain reduction in patients with Carpal Tunnel Syndrome at RSUD Indramayu.

Methods: The research applied a pre-experimental method using a single-group pretest–posttest design. Participants consisted of individuals diagnosed with Carpal Tunnel Syndrome who fulfilled the established inclusion criteria. Pain levels were assessed with a standardized measurement tool both prior to and following the intervention. The intervention consisted of Ultra Sound Therapy followed by stretching exercises administered according to physiotherapy protocols. Data were analyzed using paired statistical tests to assess differences in pain intensity before and after treatment.

Results: The results explain a significant reduction in pain intensity after the administration of Ultra Sound Therapy and stretching exercises compared to pre-intervention measurements ($p < 0.05$).

Conclusion: The combination of Ultra Sound Therapy and stretching exercises has a significant effect in reducing pain in patients with Carpal Tunnel Syndrome. This intervention can be recommended as an effective physiotherapy modality for pain management in CTS patients at clinical settings.

INTRODUCTION

Carpal Tunnel Syndrome (CTS) is recognized as the most prevalent nerve entrapment condition globally. Its occurrence is influenced by a range of factors, including genetic predisposition, making the etiology multifaceted (Dahlin et al., 2024). The condition arises when the median nerve is subjected to pressure within the carpal tunnel. Affected individuals commonly report pain and abnormal sensations such as tingling, while motor weakness along the median nerve pathway is less frequently observed (Wipperman & Penny, 2024).

The prevalence of Carpal Tunnel Syndrome worldwide varies depending on study method, population, and region. A recent meta-analysis involving over 5 million individuals from 15 countries estimated the global prevalence of Carpal Tunnel Syndrome to be approximately 14.4% (95% confidence interval: 6.7%–28.2%) (Gebrye et al., 2024), and is more often found in women (Nurullita et al., 2023).

The exact prevalence of Carpal Tunnel Syndrome in Indonesia is unknown due to the lack of well-documented national data. However, several studies in high-risk worker groups have shown significant rates. For example, a study of motorcycle taxi drivers reported a Carpal Tunnel Syndrome prevalence of up to 73.3%, with a strong association between employment of more than 4 years and Carpal Tunnel Syndrome incidence ($p=0.029$) (Maharani et al., 2024). Another study of office workers who use computers also showed a prevalence of Carpal Tunnel Syndrome of 36.7% (Repilda et al., 2022). In the garment industry sector in Jakarta, the prevalence of Carpal Tunnel syndrome was reported at 20.3%, more often affecting women aged 30–60 years. (Ramanda, 2024), and the main risk factors include repetitive hand movements, age, length of service, and non-ergonomic work postures (Repilda et al., 2022).

People affected by CTS often experience aching sensations, sensory disturbances, and reduced hand performance, which can limit occupational activities as a result of median nerve compression at the wrist (Rahman, 2020). This pain complaint often worsens at night and interferes with the quality of sleep and the sufferer's daily activities (Aswin & Ibnu, 2025). Apart from pain, sufferers also experience limited range of motion in the joints and decreased muscle strength (C. K. Putri et al., 2024). Pain interferes with normal hand use, leading to impaired performance and potential disability in individuals with CTS when performing everyday tasks (A. K. Putri et al., 2024).

Non-invasive treatment for CTS involves various physiotherapy modalities, including ultrasound therapy and stretching. Ultrasound therapy uses sound waves to stimulate tissue, reduce inflammation, and accelerate healing. Research shows that ultrasound therapy is Proven to alleviate pain and enhance hand performance in individuals with CTS.

Meanwhile, stretching, specifically self-myofascial stretching techniques on the carpal ligament, Shown to help decrease pain and restore hand capability in individuals experiencing initial to moderate severity of CTS. The integration of ultrasound therapy with stretching exercises may produce a combined effect that enhances pain relief and hand function in individuals with CTS.

Based on the background described above and the absence of studies specifically evaluating the combination of ultrasound therapy and stretching in patients with Carpal Tunnel Syndrome at Indramayu Regional Hospital, the objective of this study was to determine the effect of ultrasound therapy and stretching on pain reduction in patients with Carpal Tunnel Syndrome at Indramayu Regional Hospital.

METHOD

This research applied a pre-experimental method using a single-group pretest–posttest design, and it was carried out at the Physiotherapy Unit of RSUD Indramayu from October to November 2025. This study employed a pre-experimental design using a one-group pretest–posttest approach. The research was conducted at the Physiotherapy Unit of Indramayu Regional Hospital from October to November 2025. This study has obtained ethical approval based on an ethical clearance letter No. KEPK.EC/466/I/2026 and was conducted in accordance with the seven WHO (2011) ethical standards, including social value, scientific validity, fair subject selection, favorable risk–benefit ratio, independent ethical review, informed consent, and respect for participants. All respondents provided informed consent prior to participation in the study

In this design, all study participants underwent pain intensity measurement before the intervention (pre-test), followed by treatment in the form of US and stretching exercises, and subsequently a reassessment of pain intensity after the intervention (post-test).

The study utilized primary data obtained directly from CTS patients presenting with pain and undergoing therapeutic intervention at the Physiotherapy Unit of RSUD Indramayu. The study population included

all Carpal Tunnel Syndrome patients who visited the physiotherapy unit during the study period, totaling 27 patients. The research sample comprised 25 patients. Subjects were recruited via purposive sampling based on specific inclusion and exclusion requirements.

The inclusion criteria were patients diagnosed with unilateral Carpal Tunnel Syndrome (CTS), aged 30–59 years, both male and female, who complained of mild to moderate wrist pain, and who had not previously undergone wrist surgery. In addition, all participants were willing to take part in the study and to complete the entire intervention protocol.

The exclusion criteria included patients with severe Carpal Tunnel syndrome requiring immediate surgical intervention, those with a history of wrist trauma or fracture within the previous six months, patients with other neurological disorders such as diabetic peripheral neuropathy or cervical radiculopathy, and patients with a pacemaker or other contraindications to ultrasound therapy.

Participants were considered dropouts if they failed to complete all scheduled Ultrasound Therapy and stretching sessions (e.g., absence from more than two sessions), withdrew voluntarily despite prior consent, or experienced adverse effects or medical complications necessitating discontinuation of the intervention, such as skin irritation caused by ultrasound or injury during stretching exercises.

The intervention consisted of Ultrasound Therapy applied to the painful wrist area, followed by stretching exercises targeting the wrist flexor and extensor muscles, administered according to predetermined dosage and duration. Pain severity was measured both before and after the intervention through the VAS. VAS has been proven valid with a significance value of $p < 0.001$ and demonstrates excellent reliability with a coefficient > 0.9 , making it appropriate for use in this study (Syintia *et al.*, 2024).

Data analysis was performed using univariate and bivariate analysis. Univariate analysis was used to describe respondent characteristics and data distribution. Normality was tested using the Shapiro-Wilk test. Since the data were not normally distributed ($p < 0.05$), the Wilcoxon Signed Rank Test was used to analyze differences in pain levels before and after the intervention. The level of significance was set at $\alpha = 0.05$.

RESULTS

Table 1 summarizes the characteristics of the 25 CTS patients participating in this research. Female respon-

dents dominated the sample (72%), while males represented 28%. The highest proportion was in the 40–49 age group (64%), followed by 30–39 (24%) and 50–59 (12%). In terms of occupation, most respondents were housewives (52%), while the remainder worked in the informal and formal sectors involving repetitive hand activities. This distribution of characteristics indicates that Carpal Tunnel syndrome is more common in individuals of productive age who engage in repetitive manual activities, which physiologically and ergonomically pose a risk of causing repeated pressure on the median nerve.

Table 1. Subject Characteristics

Subject Characteristics	n	%
Gender		
Male	7	28.0
Female	18	72.0
Total	25	100.0
Age Group		
30-39 years	6	24.0
40-49 years	16	64.0
50-59 years	3	12.0
Total	25	100.0
Work		
Housewives	13	52.0
Laborers	4	16.0
Civil Servants	3	12.0
Office Administrators	1	4.0
Motorcycle Taxi Drivers	1	4.0
Traveling Tailors	1	4.0
Gado-Gado Sellers	1	4.0
Massage Therapists	1	4.0
Total	25	100.0

Table 2. Data Normality Test

Test of Normality	N	α
Pain Score before Intervention	25	0,000
Pain Score after Intervention	25	0,000

Description: Shapiro-Wilk test

According to Table 2, the Shapiro–Wilk test results show p-values less than 0.05 for pain measurements before and after the intervention, reflecting non-normal data distribution. Hence, the Wilcoxon test was employed to assess pain differences.

As illustrated in Table 3, the mean pain level prior to treatment was 5.88 ± 0.332 and declined to 3.44 ± 0.583 following the application of US combined with stretching. This reflects a mean decrease of 2.44. The Wilcoxon test result ($p = 0.000$; $p < 0.05$) confirms a significant difference between the two measurements.

These findings suggest that the combined use of US and stretching led to a significant reduction in pain

among individuals with CTS, proving effective in reducing pain in the study respondents.

Table 3. Effect of Ultrasound Therapy and Stretching on Pain

Pre-test and Post-test Pain Scores	n	Mean	SD	p-value
Pain before intervention	25	5,88	0,332	0,000*
Pain after intervention	25	3,44	0,583	
Difference between pre-test and post-test scores	25	2,44	0,507	

Description: * Wilcoxon test

DISCUSSION

Based on the demographic characteristics, the majority of participants in this study were female (72%), with the largest age group being 40–49 years (64%), and predominantly housewives (52%). These findings are consistent with previous studies indicating that Carpal Tunnel Syndrome (CTS) is more commonly found in females than males (Nurullita et al., 2023). In addition, the age distribution in this study is in line with previous findings, which show that CTS occurs more frequently in the 30–60 year age range, particularly among individuals in their productive years (Ticoalu et al., 2025). The predominance of housewives in this study is also consistent with previous findings stating that occupations involving repetitive hand movements are a major risk factor for CTS (Baraja et al., 2025). These results indicate that the characteristics of respondents in this study are consistent with prior research. According to the researchers, the combination of gender, age, and repetitive occupational activities plays an important role in increasing pressure on the median nerve, thereby contributing to the occurrence of pain in CTS patients.

The outcomes of this research showed a statistically significant reduction in pain after the combination of ultrasound therapy and stretching. The decrease in the VAS score from 5.88 to 3.44 suggests that the intervention effectively reduced pain from moderate to mild.

Clinically, a reduction of ≥ 2 points on the VAS scale is considered a significant change, so these results are not only statistically significant but also relevant for CTS patients. In CTS, increased intracarpal canal pressure causes compressive and tensile forces of the median nerve, impaired intraneural blood circulation, the formation of endoneural edema, and consequently, pain and sensory-motor dysfunction (Joshi et al., 2022).

Ultrasound therapy works through both thermal and non-thermal mechanisms. The thermal effect increases local tissue temperature, causing vasodilation, increased blood flow, and decreased muscle spasm around the carpal tunnel. This helps reduce intracanal pressure and raise the median nerve's pain threshold (Morales-Hernandez et al., 2023). Ultrasound waves generate heat in deep tissues such as muscles, tendons, ligaments, and the median nerve in the wrist. This increase in temperature increases peripheral arterial blood flow, tissue metabolism, and cell membrane permeability. As a result, the pain threshold increases while a reduction occurs in the sensitivity of type C nerves, which play a role in pain perception, resulting in reduced pain (Lina et al., 2022).

Additionally, non-thermal effects such as acoustic streaming and microcavitation increase cell membrane permeability, accelerate tissue metabolism, and support nerve tissue regeneration. These mechanisms contribute to reducing local inflammation and peripheral nociceptor excitability, thereby reducing pain perception (da Silva et al., 2022). Ultrasound waves cause vibrations in tissue molecules, generating mechanical energy that can alter pain signal transmission and stimulate thermal receptors in the skin. These effects help alter pain perception and reduce local inflammation (Lina et al., 2022).

These results are in agreement with studies conducted by ElMeligie et al. (2024) and Ahmad et al. (2024), highlighting that ultrasound therapy contributes to pain reduction and functional improvement of the hand in CTS patients. Carpal Tunnel Syndrome occurs due to compression of the median nerve in the carpal tunnel of the wrist. Stretches, such as wrist extension stretches and nerve gliding, help loosen the tissues around the carpal tunnel, thereby reducing pressure on the median nerve, which directly reduces pain and tingling symptoms (Suherdin et al., 2024).

Stretching exercises play a role in reducing pain by increasing the flexibility of the soft tissues surrounding the carpal tunnel. Stretching the wrist flexor muscles and mobilizing the median nerve helps reduce tissue adhesions, increase tendon mobility, and widen the carpal tunnel space. Furthermore, stretching remodels and stretching the tenosynovium surrounding the carpal tunnel structures, reducing adhesions and compression within the carpal tunnel. In other words, these exercises can restore these anatomical structures to their proper position, reducing adhesions and compression within the tunnel and relieving symptoms (Anggraini & Windhy Astari, 2021).

Additionally, stretching improves blood circulation and tissue oxygenation, which contributes to a decrease in pain-causing inflammatory mediators. Stretching exercises can also activate the gate control mechanism, thereby suppressing the transmission of pain impulses at the spinal cord level. CTS occurs when the median nerve experiences pressure within the carpal tunnel region of the wrist. Stretching, such as wrist extension stretches and nerve gliding, helps loosen the tissues around the carpal tunnel, reducing pressure on the median nerve, which directly reduces pain and tingling symptoms (Suherdin et al., 2024). These findings align with research by Anggraini & Windhy Astari (2021) and Shem et al. (2020), which reported that stretching and nerve gliding exercises were effective in reducing pain and improving Carpal Tunnel Syndrome symptoms.

According to the researchers, the combination of ultrasound therapy and stretching provides complementary therapeutic effects. Ultrasound therapy functions as a passive modality that prepares the tissue through anti-inflammatory and muscle-relaxing effects, while stretching utilizes the more pliable tissue conditions to improve wrist mechanics and reduce pressure on the median nerve. This multimodal approach aligns with the principles of evidence-based physiotherapy, where Carpal Tunnel Syndrome treatment focuses not only on pain reduction but also on restoring function and preventing recurrence.

CONCLUSION

The application of both ultrasound therapy and stretching led to a significant pain decrease among CTS patients at Indramayu Regional General Hospital. The findings demonstrated that prior to the intervention, the average pain score was 5.88 ± 0.332 , which is considered moderate pain. Post-intervention, the mean pain score was reduced to 3.44 ± 0.583 , indicating a significant reduction in pain. The results show that applying both US and stretching can significantly reduce pain intensity in patients suffering from Carpal Tunnel Syndrome.

SUGGESTION

Based on the research results, physiotherapists are advised to use a combination of ultrasound therapy and stretching as a physiotherapy intervention option for patients with carpal tunnel syndrome to help reduce pain intensity. Furthermore, future researchers are advised to conduct studies with a larger sample size and a more robust research design to ensure more accurate, representative, and more widely generalizable results.

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