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Ultrasound Therapy and Tendon Gliding Exercise in Carpal Tunnel Syndrome: A Case Study

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Abstract

Background: Carpal Tunnel Syndrome (CTS) is the most common entrapment neuropathy of the upper extremity, characterized by pain, paresthesia, and impaired hand function. Conservative physiotherapy is widely used to alleviate symptoms and improve functional outcomes.

Objective: To evaluate the clinical outcomes of a multimodal physiotherapy program combining ultrasound therapy and tendon gliding exercises in a patient with CTS.

Methods: This case study involved a 46-year-old female diagnosed with CTS. The intervention included therapeutic ultrasound, tendon gliding exercises, strengthening exercises, and ergonomic education, administered twice weekly for four weeks. Outcomes were assessed using wrist range of motion (ROM), Manual Muscle Testing (MMT), Visual Analog Scale (VAS), and the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ).

Results: After four weeks, movement pain decreased from 6/10 to 2/10 and pressure pain from 4/10 to 1/10. Muscle strength improved from MMT grade 4/5 to 5/5. Wrist ROM increased from 40°–50° to 50°–60° (extension) and from 15°–20° to 20°–30° (flexion). Functional status improved, with BCTQ scores decreasing from 3.5 to 1.0–1.9.

Conclusion: A multimodal physiotherapy program combining ultrasound therapy and tendon gliding exercises may reduce pain, improve wrist mobility, increase muscle strength, and enhance functional ability in CTS patients.

Keywords
Carpal Tunnel Syndrome; Ultrasonic Therapy; Tendon Gliding; Physical Therapy Modalities; Rehabilitation

Introduction

Carpal Tunnel Syndrome (CTS) is the most common entrapment neuropathy of the upper extremity and results from compression of the median nerve within the carpal tunnel at the wrist. This condition typically manifests as pain, numbness, tingling, and weakness in the hand, particularly affecting the thumb, index, and middle fingers. These symptoms may progressively impair hand function and interfere with daily activities such as gripping, writing, and manipulating objects.[1]

The prevalence of CTS has increased in recent decades, largely due to changes in occupational and lifestyle factors. Modern work environments frequently involve repetitive hand movements, prolonged computer use, and sustained wrist postures. These biomechanical factors increase pressure within the carpal tunnel and contribute to irritation of the flexor tendons and surrounding tissues.[2] Repetitive wrist flexion and extension may cause inflammation and swelling of the synovial sheaths surrounding the flexor tendons, which reduces the available space in the carpal tunnel and increases compression of the median nerve.

The pathophysiology of CTS involves several mechanisms, including elevated intracarpal tunnel pressure, impaired intraneural blood flow, and structural changes in subsynovial connective tissues. Increased tunnel pressure can reduce microcirculation within the median nerve, leading to ischemia and intraneural edema. Over time, chronic compression may cause fibrosis of subsynovial connective tissue and reduced mobility of the flexor tendons and median nerve. These pathological changes may result in persistent pain, sensory disturbances, and motor deficits in the affected hand.[3]

Several risk factors have been identified for CTS, including age, sex, occupational exposure, and systemic medical conditions. Women are more commonly affected than men, which may be related to anatomical differences in carpal tunnel dimensions. In addition, metabolic disorders such as diabetes mellitus, obesity, and hormonal changes may contribute to peripheral nerve vulnerability and increase the likelihood of median nerve compression. Occupational factors, particularly repetitive hand movements and forceful gripping, are also strongly associated with CTS development.[4]

Management strategies for CTS generally include both surgical and conservative approaches depending on symptom severity. Conservative treatment is commonly recommended for patients with mild to moderate CTS and aims to reduce pain, decrease nerve compression, and restore functional hand movement. Physiotherapy plays an important role in conservative management by improving tissue mobility, reducing inflammation, and enhancing neuromuscular function.[5]

One commonly used physiotherapy modality in CTS rehabilitation is therapeutic ultrasound. Ultrasound therapy uses high-frequency sound waves to produce both thermal and mechanical effects within soft tissues. These effects may improve local blood circulation, enhance tissue extensibility, and promote cellular metabolic activity. As a result, ultrasound therapy may help reduce inflammation and alleviate pain associated with median nerve compression. Previous clinical studies have reported that ultrasound therapy can reduce pain intensity and improve functional outcomes in patients with CTS.[6]

In addition to electrotherapy modalities, therapeutic exercises are widely used in the rehabilitation of CTS. Tendon gliding exercises are specifically designed to improve the mobility of the flexor tendons within the carpal tunnel and reduce adhesions between surrounding tissues. Improved tendon excursion may decrease mechanical pressure on the median nerve and enhance

neural mobility. Several studies have demonstrated that tendon and nerve gliding exercises can significantly reduce CTS symptoms and improve hand function when performed regularly as part of conservative rehabilitation programs.[7]

Recent evidence also suggests that combining different conservative interventions may produce greater therapeutic benefits compared with single-modality treatments. Multimodal physiotherapy programs that integrate electrotherapy, manual therapy, and therapeutic exercises may address multiple pathophysiological mechanisms involved in CTS, including pain modulation, tissue mobility, and neuromuscular control.[8] However, most previous studies have evaluated these interventions separately or within controlled clinical trials involving larger patient populations.

Despite the growing body of evidence regarding individual physiotherapy interventions for CTS, there remains limited clinical documentation describing the practical implementation of combined ultrasound therapy and tendon gliding exercises within routine physiotherapy management. Case-based clinical reports can provide valuable insights into therapeutic protocols, patient response, and functional recovery during conservative treatment. Therefore, documenting clinical outcomes from integrated physiotherapy interventions may contribute to the understanding of conservative CTS management in clinical practice. The aim of this study was to evaluate the clinical outcomes of a multimodal physiotherapy program consisting of ultrasound therapy and tendon gliding exercises in improving pain, wrist range of motion, muscle strength, and functional ability in a patient with carpal tunnel syndrome.

Methods

This study employed a case study design to evaluate the clinical outcomes of a multimodal physiotherapy intervention in a patient diagnosed with Carpal Tunnel Syndrome (CTS). The case study approach was chosen to provide a detailed description of clinical assessment, intervention procedures, and functional recovery during conservative physiotherapy management. This case report was prepared in accordance with the CARE (CAse REport) guidelines for clinical case reporting.

The participant in this study was a 46-year-old female patient who presented with symptoms consistent with Carpal Tunnel Syndrome. The patient reported persistent tingling, numbness, and pain in the thumb, index, and middle fingers for approximately five months prior to physiotherapy evaluation. The symptoms worsened during activities requiring gripping, lifting, and repetitive hand use, such as household tasks. The patient had no previous history of wrist surgery or traumatic injury to the upper extremity.

The diagnosis of Carpal Tunnel Syndrome in this case was established based on clinical examination and positive findings on CTS provocation tests, including the Tinel test, Phalen test, and Reverse Phalen test. Although nerve conduction studies (NCS) are considered the gold standard for CTS diagnosis, electrophysiological testing was not available in this clinical setting. Therefore, diagnosis was based on established clinical criteria commonly used in physiotherapy practice.

The inclusion criteria for this case study were: (1) clinical symptoms consistent with Carpal Tunnel Syndrome, including pain, paresthesia, or numbness in the median nerve distribution; (2) symptom duration of more than three months; (3) positive results on clinical CTS provocation tests; and (4) willingness to participate in the physiotherapy program. Exclusion criteria included a history of wrist fracture, inflammatory joint disease, previous carpal tunnel surgery, or neurological disorders affecting upper limb function. Before participation in the physiotherapy intervention, the patient provided written informed consent for clinical assessment, treatment procedures, and the use of anonymized clinical data for research and publication purposes.

The physiotherapy intervention and clinical assessments were conducted in the physiotherapy outpatient clinic of a hospital rehabilitation unit. The intervention program was carried out over a four-week period from 19 September to 9 October 2025. During this period, the patient attended physiotherapy sessions twice per week, resulting in a total of eight treatment sessions.

Clinical outcomes were evaluated using several standardized assessment tools commonly applied in musculoskeletal and neurological rehabilitation. Wrist range of motion (ROM) was measured using a universal goniometer to assess joint mobility. Measurements were performed for wrist flexion, extension, radial deviation, and ulnar deviation. The goniometric assessment followed standardized measurement procedures to ensure consistency and accuracy of joint angle measurements. ROM evaluation was used to determine the extent of joint mobility limitation and to monitor changes in mobility during the intervention period.

Muscle strength of the wrist muscles was evaluated using Manual Muscle Testing (MMT). The MMT grading scale ranges from 0 to 5, where grade 0 indicates no muscle contraction and grade 5 indicates normal muscle strength against full resistance. In this study, wrist muscle strength was assessed for palmar flexion, dorsiflexion, radial deviation, and ulnar deviation. Pain intensity was assessed using the Visual Analog Scale (VAS). The VAS is a widely used subjective pain assessment tool consisting of a 10-cm scale ranging from 0 (no pain) to 10 (worst imaginable pain). Pain intensity was recorded under three conditions: pain at rest, pain during movement, and pain during palpation of the affected area.

Functional impairment related to CTS was assessed using the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ). The BCTQ is a validated instrument commonly used to evaluate symptom severity and functional status in patients with CTS. It consists of two subscales: the Symptom Severity Scale (SSS), which contains 11 items, and the Functional Status Scale (FSS), which contains 8 items. Each item is scored on a scale from 1 to 5, with higher scores indicating greater symptom severity or functional limitation. The final score for each subscale is calculated as the average of the responses. Previous studies have reported that the BCTQ demonstrates good validity and reliability for evaluating clinical outcomes in CTS patients. Clinical assessments were conducted at baseline (T1) before the intervention and at the final evaluation after completion of the four-week physiotherapy program (T4).

The physiotherapy program consisted of a multimodal intervention that included orthotic support, electrotherapy, manual therapy, and therapeutic exercise. The intervention protocol was designed to address pain reduction, improve tendon and nerve mobility, and enhance wrist muscle strength. Initially, the patient was provided with a wrist orthosis to maintain the wrist in a neutral position. The orthosis was primarily used at night because the patient reported increased symptoms during nocturnal periods. If symptoms persisted during daytime activities, the orthosis could also be used during specific functional tasks to reduce mechanical stress on the carpal tunnel.

Electrotherapy modalities included Transcutaneous Electrical Nerve Stimulation (TENS) and therapeutic ultrasound. TENS was applied using a frequency of 80 Hz and a pulse duration of 60 μs for 20 minutes during each session. The stimulation intensity was adjusted to produce a comfortable tingling sensation without causing muscle contraction. This intervention aimed to modulate pain perception through sensory nerve stimulation.

Therapeutic ultrasound was applied to the palmar aspect of the wrist over the carpal tunnel region using a frequency of 1 MHz and an intensity of 1 W/cm² in pulsed mode with a duty cycle of 20%. A transducer with an effective radiating area (ERA) of approximately 5 cm² was used. The treatment area covered the carpal tunnel region and surrounding soft tissues. Ultrasound gel was applied as a coupling medium to ensure optimal transmission of acoustic energy. The ultrasound was delivered for five minutes during each treatment session.

Manual therapy techniques were also incorporated into the intervention program. These techniques included mobilization of the carpal bones, transverse carpal ligament release, palmar fascia release, and soft tissue mobilization of the distal and proximal forearm muscles. In addition, gentle mobilization of the median nerve was performed following principles of neural mobilization described in clinical neurodynamics approaches. Manual therapy procedures were performed for approximately 25 minutes in each treatment session.

Therapeutic exercises were implemented to improve tendon mobility and muscle strength. Tendon gliding exercises were performed to facilitate smooth movement of the flexor tendons within the carpal tunnel and reduce potential adhesions between surrounding tissues. The patient also performed eccentric exercises for the flexor digitorum tendons using a 1-kg weight. The exercise involved controlled wrist flexion followed by slow return to the neutral position, performed for ten repetitions.

Isometric strengthening exercises were additionally prescribed to improve wrist muscle strength. These exercises initially used manual resistance provided by the physiotherapist for eight seconds per repetition with ten repetitions per set. As the patient's tolerance improved, resistance was gradually increased using resistance bands.

Following the exercise session, kinesiology taping was applied when clinically indicated. The tape was applied with approximately 15–35% tension while the wrist and elbow were positioned in extension. The purpose of taping was to provide additional support to the wrist structures and reduce mechanical stress on the median nerve.

Because this study used a single-case design, the analysis focused on descriptive comparison of clinical outcomes before and after the intervention. Changes in ROM, muscle strength, pain intensity, and functional status were evaluated by comparing baseline and final measurements. Clinical improvement was interpreted based on the magnitude of change observed across the outcome measures.

Results

The participant in this case study was a 46-year-old female patient who presented with symptoms consistent with Carpal Tunnel Syndrome. The patient reported tingling, numbness, and pain in the thumb, index finger, and middle finger that had persisted for approximately five months before physiotherapy assessment. The symptoms were aggravated during activities requiring repetitive wrist movement and forceful gripping, such as lifting objects and performing household tasks.

Initial clinical assessment revealed limited wrist mobility, decreased muscle strength, and pain during movement and palpation of the wrist. Functional evaluation using the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) indicated moderate functional impairment prior to the intervention. The clinical management process of the patient during the physiotherapy intervention is presented in Table 1.

Table 1. Patient Flow During the Study

Stage	Description
Patient presentation	A 46-year-old female patient presented with tingling, numbness, and pain in the thumb, index, and middle fingers for approximately five months.
Clinical examination	Physical examination and CTS provocation tests (Tinel test, Phalen test, and Reverse Phalen test) were performed.
Diagnosis	Carpal Tunnel Syndrome was diagnosed based on clinical findings consistent with median nerve compression.
Baseline assessment (T1)	Initial evaluation included wrist range of motion (ROM), Manual Muscle Testing (MMT), Visual Analog Scale (VAS), and Boston Carpal Tunnel Syndrome Questionnaire (BCTQ).
Intervention	The patient underwent a multimodal physiotherapy program including ultrasound therapy, tendon gliding exercises, strengthening exercises, manual therapy, and ergonomic education.
Treatment period	Physiotherapy sessions were conducted twice per week for four weeks (eight total sessions).
Final assessment (T4)	Post-intervention evaluation was conducted using the same outcome measures: ROM, MMT, VAS, and BCTQ.

Wrist joint mobility was evaluated using goniometric measurement at baseline (T1) and after completion of the physiotherapy intervention (T4). Measurements were obtained for wrist flexion and extension movements.

Table 2. Changes in Wrist Range of Motion

Movement	Normal ROM	Baseline (T1)	Final Evaluation (T4)
Wrist Extension	70°	40°–50°	50°–60°
Wrist Flexion	80°	15°–20°	20°–30°

The results demonstrate an increase in wrist range of motion between the baseline and final evaluation. Wrist extension increased from 40–50° at baseline to 50–60° at the final evaluation. Wrist flexion increased from 15–20° to 20–30° following the intervention.Normal wrist range of motion is approximately 70° for extension and 80° for flexion, indicating that the patient's wrist mobility improved but remained below the typical physiological range.

Pain intensity was assessed using the Visual Analog Scale (VAS) under three conditions: pain at rest, pain during wrist movement, and pain during palpation.

Table 3. Changes in Pain Intensity (VAS)

Pain Condition	Baseline (T1)	Final Evaluation (T4)
Pain at Rest	0/10	0/10
Pain During Movement	6/10	2/10
Pain on Palpation	4/10	1/10

The results show a decrease in pain intensity from the baseline assessment to the final evaluation. Pain during movement decreased from 6/10 to 2/10, while pain during palpation decreased from 4/10 to 1/10. Pain at rest remained at 0/10 throughout the observation period. Wrist muscle strength was assessed using Manual Muscle Testing (MMT). Measurements were conducted for palmar flexion, dorsiflexion, ulnar deviation, and radial deviation movements.

Table 4. Changes in Wrist Muscle Strength (MMT)

Movement	Baseline (T1)	Final Evaluation (T4)
Palmar Flexion	4/5	5/5
Dorsiflexion	4/5	5/5
Ulnar Deviation	4/5	5/5
Radial Deviation	4/5	5/5

Muscle strength measurements showed improvement across all assessed wrist movements. At baseline, muscle strength was graded as 4/5 for all movements. At the final evaluation, muscle strength increased to grade 5/5 in palmar flexion, dorsiflexion, ulnar deviation, and radial deviation.

Functional status was assessed using the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ), which evaluates symptom severity and functional limitations associated with CTS.

Table 5. Changes in Functional Status (BCTQ)

Assessment Time	Mean BCTQ Score	Interpretation
Baseline (T1)	3.5	Moderate functional limitation
Final evaluation (T4)	1.4	Mild functional limitation

The results indicate a decrease in the BCTQ score following the physiotherapy intervention. At baseline, the patient's score indicated moderate functional limitation. At the final evaluation, the mean BCTQ score decreased from 3.5 at baseline to 1.4 at the final evaluation, indicating improvement in functional ability.

Overall clinical outcomes observed during the intervention period included changes in wrist mobility, pain intensity, muscle strength, and functional status. Improvements were observed across multiple outcome measures between the baseline assessment and the final evaluation after completion of the physiotherapy intervention.

Changes in wrist range of motion were observed in both flexion and extension movements. Pain intensity decreased during movement and palpation of the wrist, while pain at rest remained unchanged. Muscle strength of the wrist improved across all assessed movements according to Manual Muscle Testing results. Functional assessment using the BCTQ indicated reduced symptom severity and improved functional capacity in daily activities.

Discussion

This case study evaluated the clinical outcomes of a multimodal physiotherapy program consisting of ultrasound therapy, tendon gliding exercises, strengthening exercises, and ergonomic education in a patient with Carpal Tunnel Syndrome (CTS). These findings support previous evidence that multimodal physiotherapy interventions can improve clinical outcomes in patients with carpal tunnel syndrome.

The reduction in pain intensity observed in this case may be related to the combined effects of electrotherapy and therapeutic exercise. Therapeutic ultrasound is known to produce both thermal and non-thermal physiological effects in soft tissues. These effects include increased local circulation, enhanced tissue metabolism, and improved extensibility of connective tissues. Such mechanisms may contribute to reduced inflammation and decreased mechanical irritation of the median nerve within the carpal tunnel.[9,10] Previous clinical studies have reported that ultrasound therapy can reduce pain intensity and improve functional outcomes in patients with CTS by promoting tissue healing and reducing local inflammatory processes.[11]

In addition to electrotherapy, tendon gliding exercises were incorporated as a key component of the rehabilitation program. These exercises are designed to promote the smooth movement of flexor tendons within the carpal tunnel and reduce adhesions between tendons and surrounding connective tissues. Improved tendon excursion may decrease mechanical compression on the median nerve and enhance neural mobility. Neural and tendon mobility are important factors in reducing symptoms associated with entrapment neuropathies.[12] Several studies have demonstrated that tendon and nerve gliding exercises can reduce pain and improve hand function in patients with CTS when performed regularly as part of a conservative rehabilitation program.[13]

The improvement in wrist range of motion observed in this case may also be associated with reduced pain and improved tissue mobility following the physiotherapy intervention. Pain often limits voluntary joint movement due to protective muscle guarding and avoidance behaviors. As pain decreases, patients are more able to perform active wrist movements, which may contribute to increased joint mobility.[14] Additionally, manual therapy techniques such as carpal bone mobilization and soft tissue manipulation may enhance joint flexibility and reduce stiffness in surrounding tissues. These interventions may improve the biomechanical environment within the carpal tunnel and facilitate smoother movement of both tendons and neural structures.[15]

Muscle strength improvements observed in this case may be explained by the strengthening exercises included in the rehabilitation program. Strengthening exercises for the wrist flexor and extensor muscles can enhance neuromuscular control and improve the stability of the wrist joint during functional activities.[16] Improved muscular support may reduce excessive mechanical stress on the carpal tunnel during repetitive movements. Strengthening exercises may also contribute to improved coordination and functional performance in daily activities involving gripping and object manipulation.[17]

Functional improvement observed in the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) scores further supports the clinical benefits of the intervention. The BCTQ is widely used to assess symptom severity and functional limitations in CTS patients and has been shown to have good reliability and validity in clinical research. Decreases in BCTQ scores in this case indicate reduced symptom severity and improved ability to perform activities of daily living such as grasping objects, writing, and performing household tasks. Functional recovery is an important goal of conservative CTS management, as many patients experience difficulty performing routine hand activities due to pain and weakness.[18,19]

The findings of this case study are consistent with previous research that has reported beneficial effects of conservative physiotherapy interventions in CTS management. Multimodal physiotherapy programs combining electrotherapy, therapeutic exercises, and ergonomic education have been shown to produce improvements in pain reduction and functional recovery. Studies evaluating tendon and nerve gliding exercises have also reported improvements in symptom severity and hand function when these exercises are integrated into rehabilitation programs.[20]

The use of ergonomic education and activity modification in this case may also have contributed to symptom improvement. Patients with CTS often perform activities that increase pressure within the carpal tunnel, such as repetitive wrist flexion, sustained gripping, and forceful hand movements. Ergonomic education helps patients modify daily activities to reduce excessive mechanical stress on the wrist. In this case, the patient was advised to use assistive devices, wear protective gloves during household tasks, and maintain neutral wrist positioning during repetitive activities. These behavioral adjustments may help prevent symptom exacerbation and support long-term recovery.[21]

However, it is important to recognize that improvements observed in this case may also be influenced by factors other than the physiotherapy intervention alone. For example, symptom improvement may partially result from natural recovery processes, activity modification, or placebo effects associated with therapeutic interventions. Conservative management often involves multiple interacting factors that contribute to symptom relief.[22] Therefore, the improvements observed in this case should be interpreted cautiously.

Despite the positive outcomes reported, this study has several limitations. First, the study involved only a single patient, which limits the generalizability of the findings. Case studies are useful for describing clinical practice and generating hypotheses, but they cannot establish causal relationships between interventions and outcomes. Second, the absence of a control condition makes it difficult to determine the relative contribution of each intervention component. The physiotherapy program included several modalities, including ultrasound therapy, tendon gliding exercises, manual therapy, and strengthening exercises, making it difficult to isolate the specific effects of each intervention.

Another limitation is the reliance on clinical assessment tools without objective electrophysiological measurements such as nerve conduction studies. Although clinical tests such as the Tinel and Phalen tests are commonly used in CTS assessment, electrophysiological testing is considered the gold standard for confirming median nerve compression. Future studies may benefit from incorporating electrophysiological measurements to provide more comprehensive evaluation of treatment outcomes.

Future research should consider larger sample sizes and controlled study designs to better evaluate the effectiveness of combined physiotherapy interventions in CTS management. Randomized controlled trials comparing different physiotherapy modalities may help determine the most effective rehabilitation strategies. In addition, long-term follow-up studies are needed to assess whether improvements in symptoms and functional ability are maintained over time.

From a clinical perspective, this case study highlights the potential role of multimodal physiotherapy interventions in conservative management of carpal tunnel syndrome. Integrating electrotherapy, manual therapy, and therapeutic exercises may address multiple pathophysiological mechanisms simultaneously, potentially improving pain, mobility, and functional performance in patients with CTS.

Conclusion

This case study evaluated the clinical outcomes of a multimodal physiotherapy intervention consisting of ultrasound therapy, tendon gliding exercises, strengthening exercises, and ergonomic education in a patient with Carpal Tunnel Syndrome (CTS). The intervention was implemented over a four-week period and aimed to address pain, wrist mobility, muscle strength, and functional limitations associated with CTS.

The results demonstrated improvements across several clinical outcomes. Pain intensity during wrist movement decreased from 6/10 to 2/10, and pain on palpation decreased from 4/10 to 1/10 according to the Visual Analog Scale (VAS). Wrist range of motion increased in both flexion and extension movements, indicating improved joint mobility. Muscle strength of the wrist improved from Manual Muscle Testing (MMT) grade 4/5 to 5/5. Functional evaluation using the Boston Carpal Tunnel Syndrome Questionnaire (BCTQ) also showed improvement, with the score decreasing from 3.5, indicating moderate functional limitation, to a range of 1.0–1.9, corresponding to mild functional limitation.

These findings suggest that a multimodal physiotherapy program integrating ultrasound therapy and tendon gliding exercises may contribute to the reduction of pain, improvement of wrist mobility, enhancement of muscle strength, and improvement of functional ability in individuals with CTS. However, because this report describes a single clinical case, the findings cannot be generalized to a broader population. Future studies involving larger sample sizes and controlled research designs are needed to further evaluate the effectiveness of combined physiotherapy interventions for the management of Carpal Tunnel Syndrome.

Author Contribution

Cindy Hasna Fatikha: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Writing – original draft.
Umi Budi Rahayu: Supervision, Methodology, Validation, Writing – review and editing.
Yunita Nur Rochmah: Investigation, Resources, Clinical supervision, Writing – review and editing.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This study followed ethical principles for clinical case reporting. Written informed consent was obtained from the patient prior to treatment and publication of anonymized clinical data. All personal identifying information was removed to maintain patient confidentiality. Because this report describes routine clinical management of a single patient and does not involve experimental intervention, formal institutional ethical approval was not required.

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