STUDY ON THERAPEUTIC MANAGEMENT OF CARPAL TUNNEL SYNDROME

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https://doi.org/10.35189/dpeskj.2024.63.1.4

Abstract. *Carpal tunnel syndrome has long been considered a pathology requiring surgical intervention. Over the years, therapeutic management has become increasingly complex, with improvements observed in patients benefiting from orthopedic, surgical, ergotherapeutic and physiotherapeutic treatments, tailored to individual possibilities. The objective of this case study is to observe whether individualized and adapted kinetic treatment based on specific, non-specific and comprehensive means, succeeds in optimizing the results within the QuickDASH-Score for a 64-year-old patient following surgical intervention for carpal tunnel syndrome. The QuickDASH analyses physical function, pain and other symptoms associated with various types of upper limb musculoskeletal pathologies and disorders. The initial evaluation score was 47 points, with the physiotherapy program carried out over a six-months period. The main objectives included pain, edema, and inflammation control; enhancing joint range of motion within physiological limits in affected areas; preventing muscle-tendon retractions; and fostering independence in daily activities. The final evaluation had 32 points, signifying a 15-point improvement and achievement of the objective, resulting in enhanced quality of life. Physiotherapy in carpal tunnel syndrome is a meticulously applied treatment that alleviates specific symptoms. It's crucial to educate patients on how physiotherapy contributes to full functional recovery, as premature ending can have significant adverse effects on quality of life.*

Keywords: *Carpal tunnel syndrome; QuickDASH Score; physiotherapy program; wrist therapy.*

Received: *16 January 2024 /* **Accepted:** *5 March 2024 /* **Published:** *30 March 2024*

Introduction

Carpal tunnel syndrome (CTS) is a condition that produces paresthesia in the hands and arms due to compression of the median nerve within the carpal tunnel, as a result of nerve and tendon inflammation, causing muscle dysfunction and decreased function (Fraser, 2014). Trigger finger (TF) is a form of stenosing tenosynovitis affecting the flexor tendons of the hand. It is identified by the locking and clicking of one or more fingers when extended from a flexed position (Aziz-Saba, 2021).

According to Patry et al. (2008), this condition has a twofold etiology: ischemia of the median nerve, with amplification of symptoms at night, and hyperpressure inside the carpal tunnel, which

produces symptoms by limiting epineural blood flow. CTS has an incidence of 1 to 3 people in 1000/year and is 10 times more common in females than in males (Farioli et al., 2018).

The primary symptoms of median nerve compression include acroparesthesias affecting the first three fingers and the lateral part of the fourth finger. Other symptoms comprise nocturnal paresthesias, typically alleviated by finger flexion (Flick sign), as well as diminished hand muscle strength, dexterity, and positive results in tests assessing opposition and abductor pollicis brevis muscle function, such as Tinel, Phalen, and Durkan tests (Arab et al., 2018). Diagnosis of trigger finger is typically based on characteristic signs, with individuals experiencing discomfort and edema over the affected flexor sheath in the early stages of symptoms (Matthews et al., 2019).

Electrodiagnostic procedures are a combination of NCS (nerve conduction speed) and EMG (electromyography), which are performed simultaneously (Makkouk et al., 2008). Ultrasound or MRI (magnetic resonance imaging) can help differentiate - de Quervain's tenosynovitis (trigger finger only), ulnar collateral ligament injury of the thumb (gamekeeper's thumb), MCP (metacarpophalangeal) sprain, and MCP osteoarthritis (Vitale et al., 2015).

In the initial stage, patients may wake up from sleep experiencing paresthesias or edema in the wrist and hand, which may not be visible until the later stages of progression. In the final stages, hypotrophy or atrophy of the thenar eminence may occur, along with difficulties in coordinating and performing various movements (Genova et al., 2020). Dala-Ali et al. (2012) describe trigger finger progression in four stages, wherein patients gradually experience pain during prehension until they are unable to achieve extension, as the affected phalanx remains locked in flexion.

Local corticoid injection has been shown to reduce tenosynovial volume, directly impacting the median nerve. Steroids provide immediate relief from pain, paresthesias, and edema in the wrist (Chammas et al., 2014). To alleviate pressure within the canal, wrist and hand braces should be positioned neutrally and tailored to any associated pathologies, such as trigger finger. The efficacy of this therapy appears comparable to corticosteroid injection (Schafer et al., 2022).

Surgical intervention becomes necessary in two circumstances: when there is sensory or motor impairment or in cases of neurogenic pathology involving the abductor pollicis brevis and acute motor axonal neuropathy (Deune, 2020). The endoscopic approach has been shown to yield improved postoperative outcomes, allowing for earlier resumption of hand activities (Atroshi et al., 2003).

CTS is a disorder that requires a complex treatment. Despite the fact that CTS is quite widespread, there is no consensus on the combined use of physical components in its management (Zaralieva et al., 2020). Hot packs, TENS, massage, and exercises were all included in the physiotherapy program. Each session consisted of 15 minutes of heat pack application, 5 minutes of ultrasound therapy, 20 minutes of TENS, 5 minutes of massage, and 15 minutes of exercise before and after treatment. Significant differences in pain levels in both extremities during movement, at night, and after exertion were observed (Tanriverdi et al., 2018).

Bongi et al. (2013) discovered that deep transverse massage (Cyriax technique) applied to the thickest tissues on the palmar surface of the hand, wrist, and volar side of the forearm (for 10 minutes) with the hand in traction, along with passive mobilizations of the radio-carpal and radio-

ulnar joints, and opening of the metacarpal-phalangeal joints on the palmar surface (for 15 minutes), improved joint range of motion and increased suppleness of flexor-extensor and pronosupinator muscles.

Bardak et al. (2009) tried tendon gliding exercises, where fingers were positioned in five different postures (straight, hook, fist, tabletop, and straight fist) for 7 seconds. These exercises were performed three times daily over a six-week period, with each repetition done five times. Additionally, splint therapy combined with Madenci massage therapy involved 30 seconds of effleurage, followed by 60 seconds of friction, 30 seconds of petrissage, 30 seconds of shaking, and another 30 seconds of effleurage (totalling 3 minutes). This therapy also included tendon and nerve gliding exercises, resulting in significantly increased grip strength (Madenci et al., 2012).

A home exercise program using the ReHand App, which included pinch exercises, flexion-extension exercises for the index and middle fingers, hand-eye coordination exercises, and controlled wrist flexion-extension movements demonstrated positive effects on functional ability, including grip strength, pain, and dexterity, as measured by the DASH score. Compared to an exercise program prescribed on paper, the ReHand App provided sensorimotor-based real feedback, contributing to its efficacy (Blanquero et al. 2019).

Methodology

Research purpose

The research aims to investigate how physiotherapy contributes to the improvement of fine motor skills and dexterity in patients postoperative for carpal tunnel syndrome. This improvement is measured using specific tests, serving as the foundation for broader studies in the field.

Research objective

- to see the importance of adaptative physiotherapy program which is individualized by the dosage of specific, non-specific and complex means;
- to identify the results after the application of the means on the affected areas included in the carpal tunnel syndrome by specific tests.

Research question

Can we observe an improvement of the QuickDASH-Score results following individualized and adapted kinetic treatment based on tailored specific, non-specific and complex means in postoperative carpal tunnel syndrome?

Case presentation

The 64-year-old female patient received a recommendation to undergo physiotherapy following a surgical procedure performed on January 21, 2022, at Zetta Clinic (Plastic Surgery Clinic) in the Anesthesia and Intensive Care department. She underwent physiotherapy sessions at "Physio Concept by Adriana Șerban" in Bucharest for six months, from January 28, 2022, to July 29, 2022. During the initial three months, physiotherapy sessions were conducted three times a week under supervision at the Physio Concept by Adriana Șerban clinic. Additionally, the patient performed prescribed exercises individually at home. The patient diligently followed the recommended exercises for 30 minutes daily, using household items such as sponges, elastic bands, and plasticine. These exercises included techniques to facilitate lymphatic return, active free exercises at the wrist level, finger grips, phalangeal abduction, and occupational therapy to enhance dexterity. In the last three months, physiotherapy sessions were reduced to twice a week under supervision, while the patient continued to perform exercises independently at home on a daily basis. Initial evaluations were conducted at the onset of treatment, intermediate evaluations after three months, and final evaluations upon completion of the treatment period.

The inclusion criteria were as follows: a diagnosis of carpal tunnel syndrome confirmed by both clinical and paraclinical examinations, recent surgery performed with no more than 20 days having elapsed since the surgical intervention, no local corticosteroid injections administered within the last month, absence of thenar atrophy or weakening of thenar muscles, normal cognitive status enabling the patient to comprehend spoken instructions, and willingness to participate in the current study.

The exclusion criteria were: presence of other associated pathologies (psychiatric, neurological, cognitive, or musculoskeletal), duration of conservative treatment exceeding six months, age exceeding 65 years, history of previous carpal tunnel surgeries with persistent paresthesias, and refusal to participate in the current study.

In January 2022, the patient came to the Neuroaxis clinic with the following issues - Motor conduction: bilateral median nerve with severe elongated distal latency in the right median nerve, while the left median nerve appeared normal. Compound muscle action potential (CMAP) amplitudes were normal, but there was a decrease in motor conduction speed (MCS) in the right carpal tunnel compared to the left, indicating the right hand is more affected than the left hand. The right ulnar nerve exhibited normal limits. Sensory conduction: decreased sensory nerve action potential (SNAP) and sensory conduction speed (SCS) amplitudes in the bilateral median nerve, with greater impairment observed on the right side compared to the left. The right ulnar nerve showed normal results. The conclusion was bilateral carpal tunnel syndrome, with more severe damage observed on the right side, necessitating surgery. The recommendation was to use a right wrist orthosis.

Following the diagnosis of carpal tunnel syndrome in the right hand, surgery was performed at the Zetta Clinic in Bucharest. The surgical procedure involved local application of betadine, followed by incision in italic S parallel to the opposing fold of the phalanx, sectioning of the

transverse carpal ligament, external neurolysis of the median nerve, lavage, hemostasis, suturing, and bandaging. Additionally, an incision was made at the level of the second metacarpal head, followed by dissection, incision with sectioning of the A1 pulley, release of flexor tendons, lavage, hemostasis, suturing, and bandaging. Postoperative treatment included prescription medication, elevation of the operated hand, local cleaning and sterile bandaging every two days, avoidance of local trauma, and removal of suture threads 14 days postoperatively.

After the surgical treatment was performed on the right hand, the doctor recommended that after a year, if there are similar symptoms on the left hand, the surgical procedure should also be performed on this level due to the risk of recurrence and to avoid associated pathologies.

Instruments and types of evaluation

Joints range of motion were measured using the goniometer specially designed for the distal segment of the upper limb, the assessments starting with the right hand and then with the left hand (Meals et al., 2018) from the sitting position: flexion-extension, radial and ulnar tilt at the radiocarpal level, metacarpophalangeal flexion-extension, proximal and distal interphalangeal flexion-extension for the 5 phalanges.

To evaluate muscle strength, we used the 6-step scale from different positions depending on the muscles responsible for performing a certain movement. In the unloaded position, the movement is made in the range 0-2 (no gravity) and 3-5 against gravity (Cordun, 1999): flexion, extension, abduction, abduction of the hand, flexion and extension, abduction and adduction of the fingers, thumb-index, thumb-forefinger, thumb-middle finger, thumb-ring finger, thumb-pinky finger grip strength and amplitudes (Min Cha et al., 2014).

The QuickDASH-Score Test (Disabilities of the Arm, Shoulder and Hand) was also applied, assessing disability and associated symptoms related to the upper limb. This questionnaire includes 11 items that analyse the patients' capacity to perform certain activities with the help of the upper limbs, evaluating the difficulty and interaction in daily life. Responses are rated on a 5-point Likert scale ranging from "No difficulty/Not at all/None" (1p), "Slightly/Mild difficulty" (2p), "Moderate difficulty/Moderately" (3p), "Severe difficulty/Quite a bit/Very limited" (4p), "Unable/Extremely/So much difficulty that I can’t sleep" (5p) (Budtz et al., 2018).

Procedure and objectives of the kinetic treatment

Considering the results obtained during the initial evaluation, the objectives of the kinetic treatment were categorized as follows:

- control of pain, edema and inflammation;
- improving joint range of motion at the wrist, metacarpophalangeal, proximal and distal interphalangeal levels within physiological limits;
- preventing muscle-tendinous retractions;
- prevention the formation of cicatricial adhesions;

- gradual increase in muscle strength;
- improvement of neuro-muscular control;
- promoting independence in the constitution of daily acts and activities.

The objective of the intermediate evaluation is to assess the outcomes achieved through the kinetic treatment methods, quantify motor evolution within the 0 to 3-month treatment period, and evaluate the patient's adherence to the provided instructions in the functional recovery process. Furthermore, based on the results obtained from this evaluation, exercises will aim to reinforce initial objectives and establish new ones to be accomplished by the final evaluation.

The aim will be to improve fine motor skills and dexterity, follow the evolution of the QuickDASH score during the 6 months of kinetic treatment and, as far as possible, improve the performance of the 4 types of grip. Because the patient uses the computer between 5 and 8 hours/day, it will be taken into account that the workspace has efficient ergonomics so that carpal tunnel syndrome does not also occur in the distal segment of the contralateral upper limb.

Specific kinetotherapeutic methods

Patients undergo close monitoring to evaluate advancements in range of motion, strength, pain alleviation, and aspects of occupational therapy. In this case study, following the approach outlined by Jimenez-del-Barrio (2022), the treatment includes physical exercises, massage therapy, lymphatic drainage, postural therapy, and occupational therapy.

In the initial phase, light exercises (Soyuer et al., 2021), were implemented, with progression tailored to the patient's capabilities. Following the first physiotherapy session, the patient underwent evaluations every 2–4 days throughout the initial postoperative month to monitor functional recovery progress. Seven days post-surgery, the patient started a physiotherapy program comprising light active-free, active-passive, and purely assisted passive exercises, along with stretching and static isometric exercises targeting the hand, wrist, and forearm. Additionally, specific exercises aimed to facilitate the sliding of the median nerve in the area of surgical intervention were incorporated. Mobilizations were conducted multiple times daily to improve perineural gliding across the full range of motion at the wrist and elbow joints.

Longitudinal massages are administered twice daily for 5-6 minutes each session, continuing until a change in perception and sensitivity is noted. Ice application to the incision area follows all other exercises, lasting for 20 minutes, depending on the presence of pain and edema, (Koo et al., 2012). The patient received instructions to perform lymphatic drainage, beginning from the axilla and continuing until a reduction in lymphedema is observed, followed by massage starting from each phalanx and moving in a distal to proximal direction to redirect edema. Lymphatic drainage and massage were alternated in a 1:1 ratio, with massage utilized for its beneficial effects on muscle contractility, elasticity, and excitability, aiding in the prevention of atrophy and disruption of fibrous adhesions, (Cordun, 1999).

In addressing posture concerns, we used MAPS Therapy, aiming to optimize functional recovery of affected structures through precise and individually tailored techniques adapted to the patient's current condition. MAPS Therapy helps in safeguarding damaged structures, facilitating joint movement without risk, treating post-traumatic sequelae by modelling new tissue to enhance joint mobility, and improving motor control (Tveter, 2022).

The objective of the occupational therapy plan is to maximize participation in daily activities, with a focus on assisting patients with carpal tunnel syndrome in various specific tasks until they are ready for reintegration into socio-professional and family life (Roll & Hardison, 2017). To achieve this, ergotherapy was employed, with tasks adapted to the individual capacities of each patient at the time, thereby supporting progress towards independence in their respective roles.

Non-specific and complex kinetotherapeutic methods

The wrist was immobilized in a neutral position using a dorsal orthosis immediately postoperatively. For the initial two weeks following surgery, flexion and extension movements of the wrist were avoided to prevent overloading. The new standard protocol (Mesplie, 2015), recommends immobilizing the joint in a dorsal orthosis with a slight extension of 5-10°.

During the first three months of rehabilitation, long-lasting and low-frequency TENS impulses were used to reduce pain perception. This method has been proven effective as it targets the subcortical level and is well-tolerated by patients with a low pain threshold. Subsequently, over the following three months, neuromuscular electrical stimulation was applied to strengthen the quadriceps. This technique involves sending impulses that induce repeated muscle contractions, aiding in the re-education of muscle functionality in terms of strength and, consequently, promoting joint range of motion (Marshall, 2008).

Thermotherapy has been shown in studies to improve blood flow to the median nerve, resulting in decreased pain in the carpal tunnel. It also has a muscle relaxant effect on the hand and wrist areas and promotes the body's natural healing process. Cupping therapy is another method that stimulates the skin and subcutaneous areas, increasing blood flow through the release of adenosine, noradrenaline, and histamine, (Farhat & Mughal, 2021).

Soft tissue mobilization (STM) techniques have demonstrated various improvements in the signs and symptoms associated with carpal tunnel syndrome. These techniques work by breaking fibrous adhesions of scar tissue and fascial restrictions without applying direct pressure to the pathway of the median nerve, (Burke et al., 2007).

Hydrothermokinetic therapy uses warm water, typically between 33-36°C, to perform exercises that have a muscle-relaxing effect. This therapy aids in decreasing pain in the affected area and facilitates healing, allowing exercises to be performed for longer durations without overstraining the muscles (Laymon et al., 2015).

The hydrokinetotherapy program was conducted three times a week, with exercises aimed at improving joint range of motion and gradually increasing muscle strength. Each series lasted approximately 20 minutes. The exercises involved two sets of five repetitions from a standing

position. In one exercise, the hand of the left upper limb rested on a support bar, while the arm of the right upper limb remained next to the body, with the forearm flexed on the arm and the hand in supination. The head and neck were tilted to the left side, and simultaneous movements included elbow extension and abduction of the right arm along with the right lateral tilt of the head and neck.

In another exercise, the right upper limb was abducted to 90° from the shoulder joint, with the hand in supination. The head and neck were tilted to the left side, and simultaneous movements included neck extension of the right hand along with the right lateral tilt of the head and neck. Additional exercises involved flexion and extension of the phalanges (gripping and releasing a bar) and flexion and extension of the wrist, all performed simultaneously with both upper limbs.

Physiotherapy program

Considering the patient's symptoms, the surgical procedure, the associated hand pathology, and her occupation, we tailored the treatment modalities to her functional level, ensuring that the objectives were met. To our knowledge, there is no scientific study that has addressed the primary pathology of carpal tunnel syndrome and the secondary pathology of trigger finger from a physiotherapeutic perspective, especially when incorporating MAPS Therapy posture in the rehabilitation program along with other specific and nonspecific modalities.

The physiotherapy program was developed based on information from existing scientific articles (Shafaee-Khanghah et al., 2020; Lunsford et al., 2019). However, the unique nature of the case provided us with the opportunity to explore various methods and modalities while adhering to the principle of individualized care, ultimately aiming for optimal results for the patient.

„Research has demonstrated the importance of a global rehabilitation program after median nerve decompression in the carpal tunnel in order for a patient to return to their prior work: recovery of finger range of motion and differential gliding exercises for the finger flexor tendons, retrograde massage and increasing venous return, shoulder exercises, scar treatment; remodelling, and desensibilization (when necessary), wrist range of motion exercises, Transcutaneous Electric Stimulation (T.E.N.S.) or microcurrent stimulation, median nerve gliding exercises, strengthening exercises, sensory evaluation and re-education, ergonomic therapy” (Luchetti & Amadio 2007, p. 256-264).

Due to the presence of dual pathologies that were addressed through surgical intervention on the same day, our approach aimed to safeguard all affected structures while also incorporating physical exercises to enhance joint mobility and muscular strength, thereby facilitating the performance of daily activities. This approach was particularly tailored to accommodate the unique MAPS Hand Therapy. The exercises within the kinetic program commenced with the patient seated, with the right upper limb flexed at the shoulder joint and extended at the elbow joint, while resting the hand on the table. (TENS) currents were applied for 20 minutes, accompanied by the simultaneous application of hot gel packs for thermotherapy.

The physical therapy program included 14 exercises that were performed in 120 minutes, the most important of them are: from the position seated on the chair, the right upper limb flexed from the shoulder joint, the forearm flexed on the arm, the hand in a neutral position, the patient perform free active exercises from the wrist - flexion and extension; same position the forearm flexed on the arm, the hand in a neutral position, the grip I-II, I-III, I-IV and I-V are performed (free active and after with a sponge ball at every grip); the elbow extended, the roll of the hand on the Theraputty is executed simultaneously with the flexion of the forearm on the arm and pressure on the Theraputty and later with the elbow flexed and the hand in pronation/supination, pressure is executed on the Theraputty simultaneously with the abduction of the phalanges, hold for 3 seconds and return; massage with oil, effleurage and friction techniques for 5 minutes and then cupping therapy for the flexor, extensor, lumbrical, interosseous muscles and the scar on the wrist for 10 minutes (Figure 1); at MAPS, posture is performed on wrist extension movements (a) – 7 minutes, phalanx extension (b) – 7 minutes and active wrist extension (c) – 30-40 repetitions (Figure 2); scar mobilization techniques with the Rockblade IASTM for 10 minutes caudo-cranially and laterally (Figure 3); dexterity, fine motor skills and neuro-muscular coordination exercises for 10 minutes using different types of grip (Figure 4).

The exercises were conducted in 2 sets of 5 repetitions each, which were later increased to 6 repetitions following the intermediate evaluation. They were initially performed with the right hand and then repeated with the left hand as necessary. A 10-minute break was taken after every 60 minutes of the kinetic program. Additionally, slight elongations and frontal mobilizations were performed for the involved joints at the conclusion of the session to increase joint space and relax the targeted muscles. To gradually restore muscle strength in the wrist and hand over a 3-month period, light manipulation and low-resistance exercises with Theraputty were initially employed. Subsequently, after the interim assessment, isometric exercises with the assistance of the forearm flexor were introduced, with the number of repetitions progressively increasing.

The patient initially engaged in elevation of the upper limb above the level of the heart while holding a small sponge ball in the hand. This was performed three times a day for 10 minutes each session immediately postoperatively to facilitate venous and lymphatic return. After 4-5 months post-op, this routine was reduced to once a day, three times a week. Additionally, TENS electrodes were applied once a day for three days a week during the first 3 months. They were placed on the distal level of the first three phalanges (palmar part) and at the origin of the flexor tendons to achieve an analgesic effect.

After the intermediate assessment, coordination, fine motor skills, and dexterity exercises were introduced as part of occupational therapy. This included the caterpillar and elephant exercises. At MAPS Therapy, the intensities of elastic bands and joint amplitudes were increased for all types of exercises, and the intensity of the strengthen quads current was raised from 18 to 21 throughout the program. PNF techniques such as slow reversal, slow reversal with opposition, and active relaxation-opposition movement were incorporated into the functional recovery program. Following the exercises at MAPS Therapy, the patient performed active stretching at the wrist,

MTF, PIF, and DIF up to maximum amplitude. Passive intervention was then applied to further improve joint amplitudes, taking into account the patient's current abilities and pain management.

Figure 1. Massage and cupping therapy for flexor, extensor, lumbar, interosseous and scar muscles

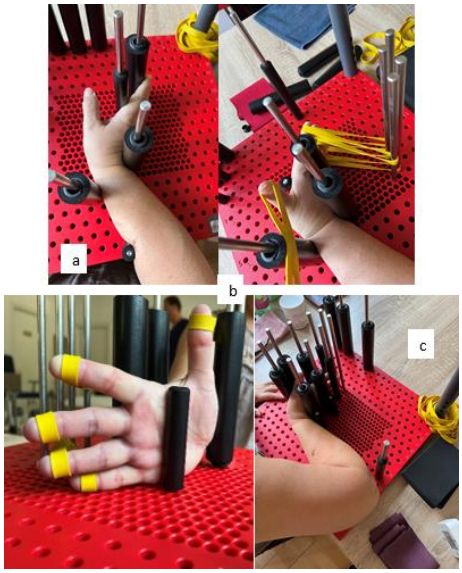

Figure 2. Posture at MAPS wrist extension, phalanx extension, active wrist extension

Figure 3. Caudocranial and lateral scar mobilization with the IASTM Rockblade

Figure 4. Coordination, fine motor skills and dexterity exercises through different types of grip

Results

The final evaluation involved the quantification of joint range of motion and the possibility of performing different types of grip where the following results were recorded for both upper limbs.

For the wrist joint, flexion recorded an increase of 6° for the right, and 2° for the left, extension recorded increases of 4° for the right and 2° for the left, radial inclination was seen with an increase of 3° for the right and 2° for the left and ulnar inclination was quantified with an increment of 3° for the right and 2° for the left (Figure 5).

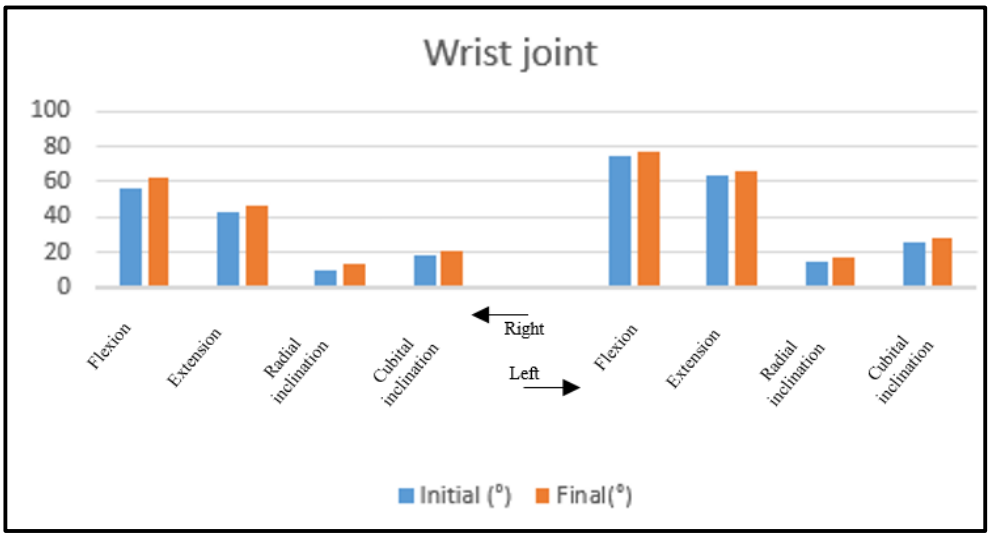

Figure 5. Graphical interpretation of movements at the level of the wrist joint

The metacarpophalangeal joint demonstrated a bilateral increase of 2° in flexion and extension, as well as 2° in abduction and adduction (Figure 6).

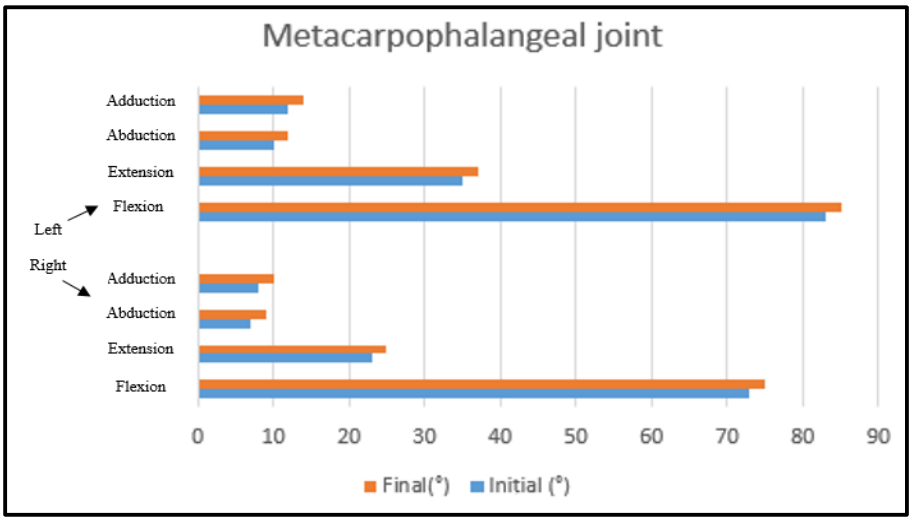

Figure 6. Graphical interpretation of movements at the level of the metacarpophalangeal joint

The interphalangeal proximal joints exhibited increases of 8° in flexion for the right hand and 2° for the left hand, while the extension movement showed preservation of the joint amplitudes. (Figure 7).

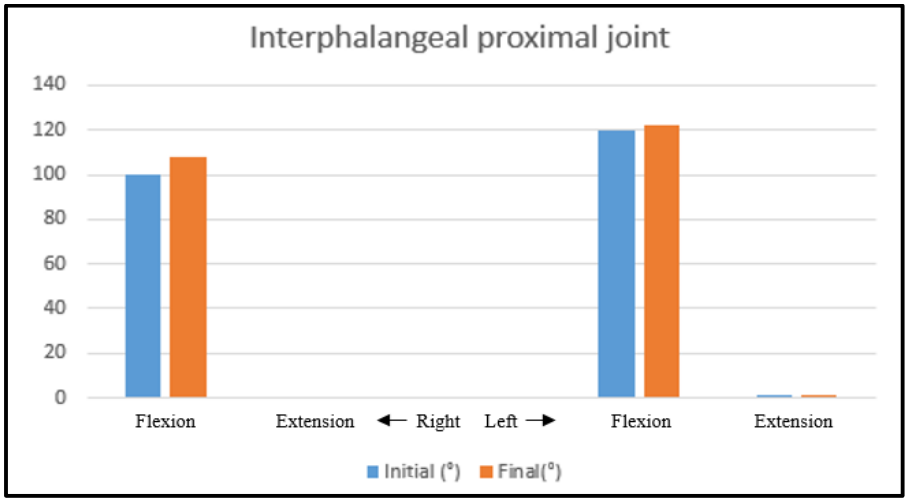

Figure 7. Graphical interpretation of movements at the level of the interphalangeal proximal joint

For the interphalangeal distal joints, there were increases of 4° for the right hand and 3° for the left hand in flexion movement, while extension movement showed an increase of 1° bilaterally. (Figure 8).

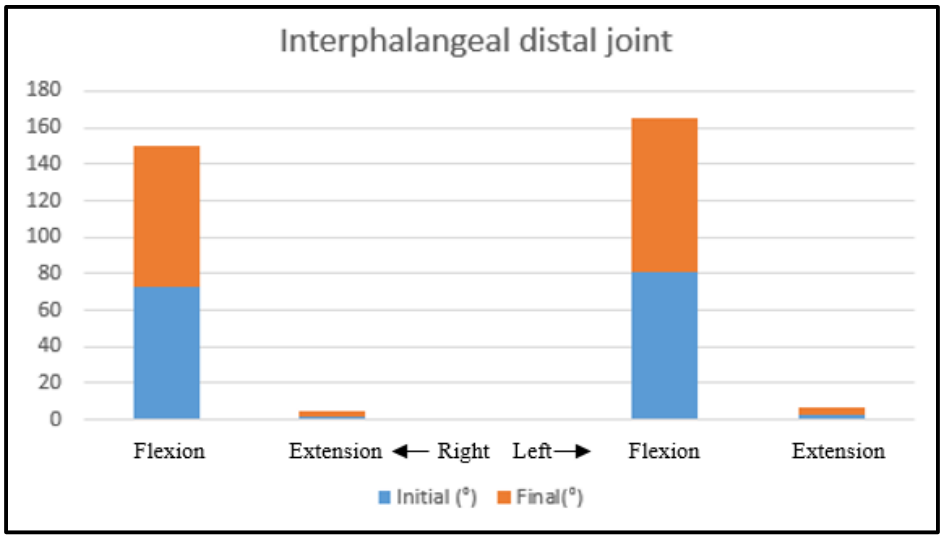

Figure 8. Graphical interpretation of movements at the level of the interphalangeal distal joint

Following the results observed in the joints affected by this condition, it is noted that in the final assessment, there were increases ranging from 1 to 8° compared to the initial assessment. It is important to note that due to the trigger finger surgery, the index finger showed reductions in joint amplitudes at the metacarpophalangeal and interphalangeal proximal and distal levels of 0.5° compared to the other fingers. This difference persisted throughout the physiotherapy program.

Regarding the thumb-pinky finger grip, during the initial evaluation, the patient was unable to achieve it, with a distance of 4 cm between the two phalanges. In the first 3 months, this grip was practiced actively with assistance. After the interim assessment, a low-intensity sponge ball was introduced to minimize the distance between the phalanges during the grip and to enhance muscle strength. By the end of the treatment, the distance between the two phalanges decreased from 4 cm to 2.5 cm, with muscle strength reaching F3 levels (Figure 9).

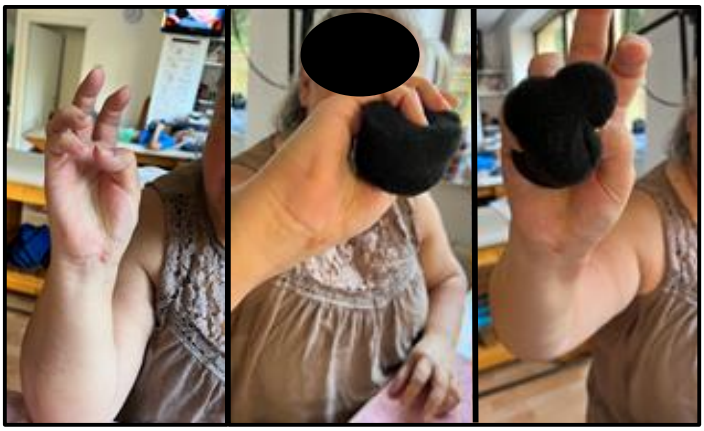

Figure 9. Free active and active resistive thumb-pinky finger grip

Following the initial and final evaluations, out of a total of 55 points for a low functional level and 11 for an optimal functional level, the patient obtained a score of 47 in the initial evaluation and a score of 32 in the final one, the difference of 15 points recording the achievement of the objective present research and implicitly an improvement and increase in the quality of life (Figure 10). Thus, the specific, non-specific and complex means that were used in the recovery treatment of postoperative carpal tunnel syndrome were able to improve neuro-muscular control, joint amplitudes, prevent the occurrence of muscle-tendinous retractions and promote independence in carrying out acts and activities daily.

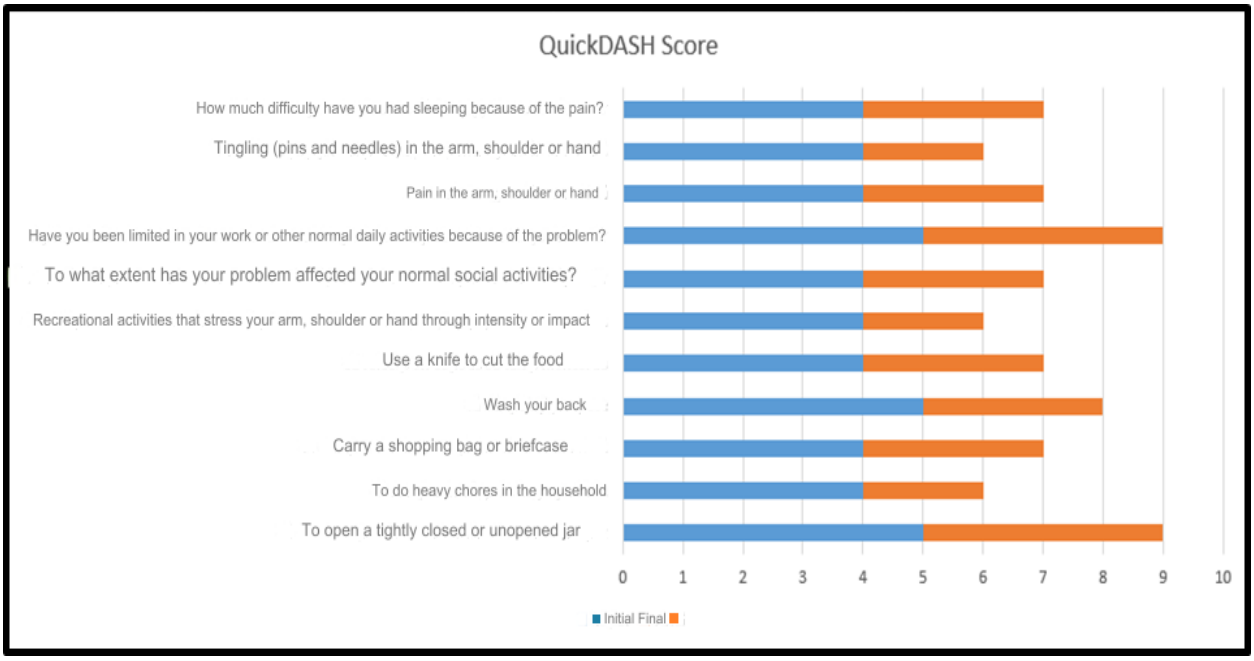

Figure 10. Graphical representation of initial and final QuickDASH Score

Discussion

The aim of this study was to underscore the efficacy of the rehabilitation program and the role of physiotherapy in enhancing fine motor skills and dexterity following surgical intervention for carpal tunnel syndrome. These improvements were evaluated through specific tests, serving as a foundation for subsequent scientific inquiries.

The present case, involving the simultaneous surgical resolution of carpal tunnel syndrome (CTS) and trigger finger (TF), prompted us to explore the efficacy of the specific, non-specific, and complex interventions utilized in previous studies. At this moment, we have not found any scientific article (to our knowledge) on the postoperative physiotherapy outcomes for TF and CTS. This rarity underscores the uniqueness of our case, particularly due to the incorporation of MAPS Therapy, which lends originality to the functional recovery program.

Gil et al. (2020) randomly divided 66 postoperative (10 days) mini-open technique carpal tunnel syndrome patients in 3 groups. Standard therapy included scar management, gelflex brace, wound care and edema management, tendon and nerve gliding exercises, thumb and wrist range of motion, orthosis at night and after at 2-6 weeks post-op were included light resistive grip, patient education to prepare for return to work (2 sessions/day, 2-3 sessions/week, approx. 60 min). Expedited therapy had the same type but without the 2-6 weeks post-op management. The researchers applied QuickDASH Test pre-op, 2 weeks post-op and monthly until 6 months. The results for pre-op were the same for the all 3 groups, at first post-op visit expedited therapy had a good result comparative to the other groups, at one month the standard and no therapy groups had lower results in QuickDASH and at 6 months post-op the researchers found no significant results between the groups. We can say that more studies should be done to know the type of means and dosage of them used in the rehabilitation program after CTS and TF.

Lu et al. (2015) study found that the intervention group exhibited notable enhancements compared to the control group in terms of range of motion of the DIP and PIP joints following surgical treatment for TF. The rehabilitation program for the intervention group consisted of two sessions per day, twice a week, each lasting 40 minutes, over a span of three weeks. The program prioritized edema control, scar management, and prevention of joint contractures during the first week post-operation. In the second week, efforts focused on restoring tendon excursion and mitigating scar adhesions and intrinsic muscle tightness, while the third week emphasized strengthening exercises and activities aimed at achieving complete functional recovery.

The methodology employed in this study sets a precedent that could serve as a benchmark for future research, as it underscores the importance of ongoing adaptation to patient needs and continued treatment until full recovery, as evidenced by improvements in QuickDASH scores. Further investigations involving similar cases of primary and secondary pathologies are warranted to determine the specific types of therapies, dosages, and repetitions necessary to achieve complete functional recovery comparable to pre-surgery levels.

The limits of the study are given by the singularity of the case where the present pathologies allowed the realization of a kinetic program adapted to the patient's needs. The success of the kinetic program and associated therapies may not yield identical results in different contexts or with different patient populations, emphasizing the need for further research and exploration in varied clinical settings.

Conclusions

Carpal tunnel syndrome is a neuropathy in which compression of the median nerve within the carpal tunnel contributes significantly to the patient's physical and mental ability to perform daily activities. The therapeutic management, which includes pharmaceutical, orthopedic, surgical and physiotherapeutic treatments, used synergistically, succeed in reducing the specific symptoms and improving the quality of life.

In order to meet the specific objectives, the patient's capabilities and the activities that she performs at home or at work will be taken into account, as these influence the prognosis in terms of post-surgical functional recovery of the joints of the hand and wrist.

Following joint and muscle evaluations and the possibility of performing the four types of grip, the objectives of the physiotherapeutic treatment were summarized in: control of pain, edema and inflammation, improvement of the joint range of motion, preventing the occurrence of muscle-tendinous retractions, prevention of cicatricial adhesions, gradual increase in muscle strength, improvement of neuro-muscular control, promotion of independence in daily acts and activities.

During the six months of treatment, the functional recovery program combined static and dynamic free active, active-passive, concentric active resistive, purely assisted passive, static isometric exercises, PNF techniques and stretching.

During the final evaluation, positive results could be recorded at the level of the wrist, metacarpophalangeal, proximal and distal interphalangeal joints, muscle strength and the performance of doing the types of grip. In QuickDASH Score, the difference of 15 points between the two evaluations contributed to the reduction of the specific symptomatology and the improvement of the quality of life. These things were due to physical exercise, massage, postural and occupational therapy, electrotherapy, immobilization and hydrothermokinetherapy which contributed to the treatment goals.

Physiotherapy is a carefully considered treatment approach for addressing specific symptoms associated with carpal tunnel syndrome. However, it's essential to communicate to patients how movement therapy contributes to complete functional recovery. Premature cessation of physiotherapy before achieving full restoration of function can lead to adverse consequences and negatively impact quality of life.

Author Contribution: Both authors have equally contributed to the study.

Funding: This study did not receive any external funding.

Informed Consent Statement: The participant provided her written informed consent to take part in this study.

Data Availability Statement: Data can be made available upon request to the contact author.

Conflicts of Interest: The authors declare no conflicts of interest.

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