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The efficacy of manual techniques in the treatment of carpal tunnel syndrome symptoms: A narrative review

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Abstract
Carpal Tunnel Syndrome (CTS) is a median nerve entrapment syndrome that occurs in the carpal tunnel and causes a variety of motor and sensory impairments in the upper limb including pain and reduced functioning. The application of manual techniques in the context of physiotherapy improves the pain and functional ability of the upper limb. However, their effects require further research. The aim of this review is to investigate the effectiveness of manual techniques in the symptoms of CTS. Method: The Google Scholar and PubMed databases were searched during the period of February – April. The following search terms were used: Carpal Tunnel Syndrome, Manual Therapy, Neurodymamic Therapy, Rehabilitation. Results: 10 studies (clinical studies and crossover studies) were included in this review. Discussion - Conclusions: The application of manual techniques seems to be an effective approach to improving the symptoms of mild to moderate CTS. From the results of the studies included in this review, it seems that out of all the manual techniques, the combination of soft tissue mobilization techniques and neurodynamic therapy provide the best results. More future research should focus on implementing protocols with this therapeutic combination.

Keywords: Carpal tunnel syndrome, manual therapy, neurodymamic therapy, rehabilitation

Introduction
Carpal Tunnel Syndrome (CTS) is the most common syndrome of peripheral nerve entrapment of the upper limb and involves compression of the median nerve as it passes through the carpal tunnel [1, 2]. The carpal tunnel is an anatomical structure formed by the bones of the wrist and the transverse carpal ligament. The median nerve, blood vessels and tendons of the flexor muscles of the fingers pass through it [3, 4]. The median nerve normally provides motor innervation to the thenar muscle group and sensory innervation to the palmar surface of the thumb, index, middle fingers and half of the ring finger [5]. Any inflammatory process that takes place in the area of the carpal tunnel causes compression of the median nerve resulting in pain, sensory disorders and reduced function of the upper limb [6]. The initial stage involves mild sensory disorders such as paresthesia and pain [1]. Symptoms appear more often in the morning after sleep or at night with localization in the extremities of the hand, while in more severe cases the pain extends to the forearm, arm and shoulder [3]. At an advanced stage, the involvement of the motor fibers causes atrophy of the tendon muscles and a reduced ability to abduct and adduct the thumb [1].
The incidence of the syndrome in the general population reaches 99/100.000 people. Global prevalence rates range between 7% and 19% [5]. People over the age of 40 are more vulnerable while women make up 65-75% of cases [6]. Concomitant factors such as rheumatoid arthritis and pregnancy may be found in younger patients [7].
The treatment consists of conservative and surgical with the latter being a last resort. Transient pain relief is achieved by using a splint in the evening and injecting corticosteroids into the carpal tunnel [7]. The application of manual techniques used in the context of physiotherapy seems to contribute positively to the treatment of CTS symptoms [2, 4]. According to the World Confederation for Physical Therapy, manual therapy technique is defined as the set of dexterous movements applied with the hands in order to reduce inflammation, soft tissue swelling and pain, mobilize or manipulate the soft tissue and the joints, improve the elasticity

of the tissues, increase the range of motion of the joints, achieve relaxation, improve muscle function and restore normal movement (https://www.wcpt.org/node/47929). However, the selection of appropriate techniques and the most effective combinations of treatment regimens require further investigation [5]. The purpose of this review is to investigate the efficacy of manual techniques in treating the symptoms of CTS either when applied individually or when combined with other therapies.

Method: Literature was searched on the Google Scholar and PubMed databases with the following keywords: carpal tunnel syndrome, manual therapy, physiotherapy, rehabilitation. The review included both clinical studies applied to patients with CTS and which included in their research design one or more manual techniques alone or in combination with other therapies as well as crossover studies. 10 studies were included in this review. Their main findings are summarized in table 1.

Table 1: Main characteristics of included studies

Author, Year	Number of participants	Intervention duration	Intervention	Conclusions
Ali Talebi al., 2018	n = 30	4w	Group 1 – Neural mobilization Group 2 – Ultrasound therapy and transcutaneous electrical nerve stimulation (TENS).	Median nerve neurodynamic techniques are more beneficial than ultrasound and TENS therapy in reducing pain intensity and functional limitations due to CTS.
Ali Talebi al., 2020	n = 30	4w	Manual Therapy versus neurodynamic technique directed at different anatomical sites of potential entrapment of the median nerve.	Soft tissue and neural mobilization techniques are equally effective interventions in treating the symptoms of CTS.
Bonji *et al*., 2012	n = 22	2w	Transverse massage - pulling on the wrist joints - joint mobilization by gliding on the carpal bones.	The combination of manual techniques improved CTS signs and symptoms with benefits maintained at the follow-up.
Burke *et al*., 2007	n = 28	4w	Each group received soft tissue mobilization techniques either with the Graston method or by hand.	There were no differences between the groups. Both techniques proved to be equally effective in people with CTS.
De-La-Llave-Rincon *et al*., 2012	n = 18	1w	Soft tissue mobilization and neurodynamic technique at different possible median nerve entrapment locations.	Chronic CTS group exhibited reduced pain intensity but unaltered pressure pain sensitivity.
Mohamed, *et al*., 2016	n = 28	16w	Pharmacotherapy for 10 patients and neurodynamic techniques for 18 patients.	Neurodynamic techniques provided better results than pharmacotherapy. Conservative CTS treatment can be based in manual therapy.
Tal-Akabi & Rushton, 2000	n = 21	4w	Neural mobilization versus manual therapy versus control.	Both joint mobilization and neurodynamic therapy are equally effective in treating the symptoms of CTS.
Wolny & Linek, 2018	n = 189	10w	Group 1 – Neurodynamic techniques Group 2 – Placebo therapy	Mild and moderate CTS benefits more from neurodynamic techniques than from placebo therapy.
Wolny & Linek, 2019	n = 103	10w	Group 1 – Neurodynamic techniques Group 2 – No treatment	Conservative mild to moderate CTS treatment benefits from neurodynamic techniques.
Wolny *et al*., 2017	n = 140	10w	Group 1 – Neurodynamic techniques, functional massage, carpal bone mobilization Group 2 – Electrotherapeutical treatment	Both groups improved the same in nerve conduction. Manual therapy group improved further in subjective symptoms, pain reduction and functional status.

Literature review

De-La-Llave-Rincon *et al*. [8] applied to 18 women diagnosed with CTS by electromyogram a combination protocol of manual techniques, which involved soft tissue mobilization (myofascial release, stretching and transverse massage in the wrist area) as well as 10-minute neurodynamic therapy with median nerve gliding. The following were assessed at baseline and one week after: pain with the Numerical Pain Rating Scale (NPRS) and local vulnerability with the Pain Pressure Threshold (PPT). The results of the study showed that pain was effectively reduced one week after combination therapy in contrast to PPT, which did not show statistically significant differences. The authors concluded that soft tissue mobilization techniques in combination with neurodynamic therapy have a strong analgesic effect in individuals with CTS, but their effect on local sensitivity is limited.

In another study, Wolny *et al*. [9] studied the effect of manual techniques in combination with neurodynamic techniques on overall health status in 189 patients with mild to moderate CTS. The participants were divided into two groups (intervention and control). The intervention group followed a 10-week protocol twice a week that included the application of neurodynamic techniques directed at the median nerve (gliding and tension mobilizations of the median nerve), functional massage of the descending part of the trapezius and wrist mobilization techniques. The control group did not receive any treatment. The RAND 36-Item Short Form Health Survey (SF-36) questionnaire was used to assess the overall health status. The results of this study showed statistically significant differences between the groups with the manual therapy group showing improved values in the physical and mental components of the SF-36 questionnaire.

Wolny & Linek [10] performed a clinical study in 103 patients with mild to moderate CTS. The participants were divided into two groups (intervention and control). The intervention group followed a combination protocol of manual techniques and neurodynamic therapy for 10 weeks twice a week. The protocol of the intervention group included joint mobilization in the wrist area, functional massage in the trapezius muscle as well as gliding and tension mobilizations of the median nerve while the control group did not follow any treatment. Pain, symptoms severity and functional status were assessed before and after intervention with the Boston Carpal Tunnel Questionnaire (BCTQ) while the grip strength with a hand dynamometer was also examined. The results of this study showed statistically significant differences between the groups in all the examined variables with the intervention group showing significantly improved values after 10 weeks

in both pain, functional ability and grip strength of people with CTS. The researchers concluded that the combination of manual techniques and neurodynamic therapy is an effective treatment regimen for treating the symptoms of CTS.

Bongi *et al*. [11] investigated the effects of a combination protocol of manual techniques which was applied progressively to 22 patients with CTS. The study participants attended six sessions over a period of two weeks. In the 1st session, a 10-minute transverse massage was applied; in the 2nd session, traction was added to the wrist joints, while in the 4th-6th sessions, joint mobilization was added by gliding on the carpal bones. Symptom Severity Scale and Functional Status were evaluated with the BCTQ, while conduction velocity and distal motor latency of the median nerve were evaluated with an electromyographic evaluation. The evaluation was initially done in two stages, in the 1st session and after 12 and 24 weeks. Based on their results, the researchers reached the conclusion that a combination protocol of manual techniques holds merit as a conservative CTS treatment regimen, as it improved the symptoms of the condition.

Tal- Akabi and Rushton [12] conducted a clinical study in 21 patients with CTS who were about to be treated surgically. The participants were divided into three groups: two intervention groups and one control group. The 1st group followed a neurodynamic therapy protocol. The 2nd intervention group followed a program of joint mobilization of the carpal bones while the third group did not follow any treatment. The active range of wrist movement (flexion and extension), upper limb tension test and pain though three different pain scales were evaluated before and after treatment. The results of the research showed statistically significant differences in all the examined variables between the two intervention groups in relation to the control group. Meanwhile, no statistically significant differences were observed between the two intervention groups. The researchers concluded that both joint mobilization and neurodynamic therapy are equally effective in treating the symptoms of CTS.

Ali Talebi *et al*. [13] applied a randomized controlled trial to 30 patients with CTS to compare the effect of median nerve mobilization with that of surrounding structures. Participants were randomly divided into two groups and treated for four weeks, three times per week. In the 1st group, the median nerve was mobilized with neurodynamic gliding techniques for 15 minutes in each session. In the 2nd group, the following were applied: pulling on the wrist, stretching on the transverse palmar ligament, palmar fascia release, friction on the tendons of the flexor muscles and myofascial release in the forearm area. Pain with the Visual Analogue Scale and Symptom Severity Scale, functioning with the hand Functional Status Scale and motor and sensory distal latencies of median nerve were evaluated before and after treatment. The results of the study showed that after the 4th week all the examined variables improved equally in both groups without detecting differences between the groups. The researchers concluded that both neurodynamic techniques and manual therapy are equally effective in treating the symptoms of CTS.

Ali Talebi *et al*. [14] applied a study to 30 diabetic patients with CTS randomly dividing them into two groups. Each group followed 12 treatments, with a frequency of three times a week. The first group received 20 minutes of transcutaneous electrical nerve stimulation (TENS) and five minutes of therapeutic ultrasound. The 2nd group followed a protocol of manual techniques on the median nerve and surrounding structures for 25 minutes. The program of manual techniques included mobilizations of the carpal bones, release of the transverse ligament and neurodynamic techniques. The Visual Analogue Scale, Symptom Severity Scale, Functional Status Scale and median neurodynamic test were evaluated before and after the interventions in both groups. The results showed that there were statistically significant differences in all the examined variables with the manual therapy group showing a significant improvement compared to the natural means group. The researchers concluded that the application of manual therapy is more effective than that of natural treatments in people with CTS.

Wolny and Linek [9] in their clinical study, attempted to investigate the efficacy of manual and neurodynamic therapy on mild and moderate CTS patients and compare it with electro physical treatment methods. 140 patients with CTS were divided into two treatment groups. The 1st group followed a protocol that included manual therapy with neurodynamic techniques, functional massage and carpal bone mobilization techniques while the 2nd group followed a protocol with laser and ultrasound therapy. Both groups received 20 treatments (two per week for 10 weeks). Nerve conduction, pain severity, symptom severity, and functional status were measured with the BCTQ before and after treatment. The results showed that, despite both groups exhibiting positive effects, the manual therapy group scored better in terms of functional status, pain reduction and subjective symptoms. There was no statistically significant difference between groups in nerve conduction.

Mohamed *et al*. [15] compared the effect of conservative medication with median nerve neurodynamic therapy to treat CTS symptoms in 28 patients. Participants were randomly divided into two groups (pharmacotherapy group and manual techniques group). The range of motion of the wrist, sensory disorders, pain, grip strength, atrophy of the thenar muscles, severity of the symptoms and functional state were evaluated with the relevant scales. The medication received by the pharmacotherapy group consisted of non-steroidal anti-inflammatory drugs: 150g of diclofenac per day for two weeks and 1500g of vitamin B12 for six weeks. The other group received neurodynamic gliding techniques for the median nerve. The evaluation was done before and after the treatment period. The results showed that the participants in the manual therapy group showed improved values in all the examined variables in relation to the pharmacotherapy group after six weeks. The researchers concluded that the application of manual techniques is more effective than that of pharmacotherapy in people with CTS.

Burke *et al*. [16] divided 28 patients with CTS into two groups, one of which received soft tissue mobilization with the Graston technique involving the use of scar tissue dissection tools and the other soft tissue mobilization by hand. The first treatment protocol included a short 12-minute warm-up by bike or treadmill, the Graston technique for the forearm, wrist and hand, stretching, resistance training and ice therapy. The 2nd group followed the same protocol with the difference that the mobilization of the soft tissue was done by hand (use of pressure with the fingers of the therapist instead of the tool). The treatments for the first four weeks were twice per week and were reduced to once per week for the next two weeks. Assessment of pain, severity of symptoms, functional ability, range of motion of the wrist and strength of the hand was performed before and after the intervention with a 3-month follow-up. The results of the study revealed that there were no statistically significant differences between the two treatment

protocols. Both groups exhibited improvements in terms of wrist motion and strength as well as nerve conduction. However, these improvements were comparable, which led to the conclusion that both the Gaston technique and by hand soft tissue mobilization are equally suitable to treat CTS.

Discussion and Results

From the results of the above studies, it seems that the application of manual techniques offers significant benefits to the general health of patients with CTS as it reduces pain and sensory disorders, improves the range of motion of the wrist and improves functioning and quality of life of patients with CTS [10, 12, 13, 16, 17]. The application of these techniques both when applied individually and when applied in combination to other treatment regimens seems to be more effective than the absence of treatment [12], as well as than conventional pharmacotherapy in the management of CTS symptoms [15]. They also seem to benefit more than the application of electrotherapeutical treatments such as laser and therapeutic ultrasound [14].

Of all the manual techniques applied in the above research, soft tissue mobilization techniques, joint mobilization and massage techniques had the highest frequency, while most protocols combined manual techniques with median nerve gliding based on neurodynamic therapy [8–10] The results of this review show that the combination of soft tissue mobilization techniques and neurodynamic therapy may ultimately be the most effective combination for treating CTS symptoms as it was the first choice in most of the studies included in our review.

In summary, the application of manual techniques is recommended for the conservative treatment of CTS. Further research should be done to evaluate its effects after treatment on parameters that do not seem to agree with the results of previously published research, such as the speed of impulses in the median nerve, the strength of the fist, etc. Moreover, more studies that combine soft tissue mobilization techniques with neurodynamic therapy are suggested to be implemented in the future as this combination seems to have the best results. Further investigation of natural treatment methods can reduce the choice of surgical treatment in mild to moderate conditions.

Conclusions

Applying manual techniques appears to be an effective approach to improving the symptoms of mild to moderate CTS. From the applied protocols, the combination of soft tissue mobilization techniques and neurodynamic therapy seems to provide the best results. More future research should focus on implementing protocols with this therapeutic combination.

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