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COMBINATION TENDON AND NERVE GLIDING EXERCISE WITH NEURODYNAMIC MOBILIZATION TO IMPROVE HAND FUNCTION IN CARPAL TUNNEL SYNDROME PATIENT: A CASE REPORT

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Abstract

Introduction: Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy of the upper extremity caused by compression of the median nerve with an overall prevalence in the general population of 5.3% for women and 2.1% for men. In general, CTS will cause pain, neurological symptoms, and decreased functional ability and can interfere with daily activities. Treatment of carpal tunnel syndrome (CTS) can be done by giving a physiotherapy program, one of which is exercise. The purpose of this study was to determine the effectiveness of the combination of tendon and nerve gliding exercise with neurodynamic mobilization on increasing functional activity in patients with Carpal Tunnel Syndrome (CTS).

Case Presentation: A 19-year-old woman came with a diagnosis of Carpal Tunnel Syndrome Dextra. She had a tingling sensation in his 1,2,3 and 4th half finger with carpal compression and a positive Phalen test. The patient was given a combination of tendon and nerve gliding exercise with neurodynamic mobilization for 6 weeks face-to-face and was evaluated.

Management & Outcome: The patient showed good adherence to the program and achieved the desired goal within 6 weeks of therapy. The patient showed improvement (in pain, range of motion, and hand function. Tendon and nerve gliding exercise combined with neurodynamic mobilization was effective in improving clinical symptoms in patients with CTS.

Discussion: Several recent pieces of literature state nerve and tendon gliding exercise as an alternative intervention in conservative management of CTS. Nerve and tendon gliding exercise is a joint and tendon mobilization exercise program that can be applied by performing several movements of the hands and wrists. This case report combines neurodynamic mobilization. This Exercise Program was carried out for 6 sessions and after 6 weeks of close monitoring and guidance of a combined training program. Overall, the results of this case report for CTS-related disorders and clinical symptoms showed significant results for improving hand function in CTS patients.

Conclusions: A combination of tendon and nerve gliding exercise with neurodynamic mobilization is effective for improving hand function in CTS patients.

Keywords: carpal tunnel syndrome, tendon nerve gliding exercise, neurodynamic mobilization, hand function



Introduction

Carpal tunnel syndrome is the most common case of median nerve entrapment leading to symptoms of peripheral neuropathy. In the general population, the overall prevalence rate is 5.3% for women and 2.1% for men, and the incidence is higher in some occupations (19). In Indonesia, the research of Andrian et al (2017), found that the prevalence of CTS among administrative staff at Hasan Sadikin General Hospital Bandung was 3.3% (4). Although the exact cause of CTS is unknown, it is believed to be caused by a variety of factors, including continuous strain, overuse, repeated or prolonged wrist extension, holding equipment for long periods, and unfamiliar manual work. The occurrence of CTS is caused by increased intracarpal pressure, decreased mobility of the median nerve due to the presence of fibrous tissue, deformation in the form of compression and stretching of the median nerve, increased stiffness of the synovium and the flexor retinaculum or transverse carpal ligament, and hypertrophy of the thenar muscle that puts pressure on the carpal tunnel, the thickness of the flexor tendons overactivity (16) (21).

Typical characteristics of CTS include the presence of complaints including numbness and tingling in the thumb, 2nd finger, 3rd finger, and 4th half finger, weakness of thumb abduction and oppositional movement, pain in the palm and fingers, swelling, temperature changes, and worsens when repeated activities are made and gets worse at night (1)(16). Other symptoms of CTS sufferers usually manifest as decreased mobility of the cervical spine, decreased grip strength, and changes in posture in the form of lateral flexion away from the affected side (18).

Treatment of CTS varies depending on the severity of symptoms, duration of symptoms, and patient preferences. Exercise is one of the recommended physiotherapy options for CTS. Exercise can reduce median nerve pressure in the hand, increase range of motion and improve hand function (2). Physiotherapy also often uses active tendon and nerve gliding exercises, which are mechanically based interventions that can stimulate soft tissue healing and increase the vascularity of the median nerve in the carpal tunnel (14). Active tendon and nerve gliding exercise can reduce edema, increase median nerve activity

by reducing density surrounding connective tissue, and enhances nociception by reducing the concentration of inflammatory substances and increasing the sensitivity of the peripheral nervous system (13). In patients with CTS, tendon and nerve gliding exercise can improve short to medium-term outcomes when combined with other treatments (11).

Recently, several studies have reported the best results when neurodynamic mobilization is used as a conservative treatment, where nerve shifts help to mobilize nerves relative to musculoskeletal tissue (5)(20). The biomechanical effect of this treatment is to restore nerve activity by reducing edema and carpal tunnel adhesions. Due to the chronic nature of CTS, studies have also described the neuromodulatory effects of nerve mobilization techniques, such as reduction of median nerve perception; reduction of pain-causing substances and inflammation, and reversibility of previously enhanced pain pathways. Therefore, peripheral and central sensitization can reduce or reduce the possibility of pain regulation (9)(12). However, the clinical effectiveness of neurodynamics combined with tendon and nerve gliding exercise is unclear because very few studies to date have analyzed this combined approach for the treatment of CTS.

This case study aims to determine the effectiveness of the combination of tendon and nerve gliding exercise with neurodynamic mobilization to improve hand function in CTS patients.

Case Presentation

The case of a 19-year-old woman; BMI 27.1 (height = 1.55 meters, weight = 65 kg); right-handed users; a student (who often spends hours in front of a laptop, typing about 10 hours a day) came to the physiotherapy poly at RSUD Dr. Soeselo Slawi. This case study was conducted for 6 weeks (February 2021 - March 2021) the patient was referred from a neurologist to the physiotherapy outpatient polyclinic Dr. Soeselo Slawi with a diagnosis of carpal tunnel syndrome dextra.

The patient reported a 1-year history of worsening CTS on the right side (from January 2020) and complained of wrist pain, tingling, and discomfort, extending from the



wrist to the upper arm behind the elbow. Intermittent numbness of the first to fourth fingers, especially at night. The patient's complaints will decrease when the patient rests and gently massages the wrist area or shakes the hand. This combination of exercises aims to reduce pain, restore muscle strength, and optimize daily functional activities in the patient's activities as a student.

The basic physical examination includes inspection and palpation. According to the inspection results, there is no edema or deformation of the hands. Palpation revealed right wrist flexor muscle spasm and right wrist tenderness. The physiotherapist then performs special examinations to diagnose carpal tunnel syndrome. This syndrome is diagnosed using the Phalen test and the carpal compression test. In two special tests, a positive tingling sensation was found and extended to the first, second, third, and fourth fingers.

Basic movement examination is carried out through passive, active, and isometric examinations. During passive motion examination, it was found that there was a limited range of motion (ROM) in palmar flexion movements and pain appeared when the movement was forced to exceed the ROM threshold. Isometric movement examination showed pain when performing an isometric examination in palmar flexion movements.

Pain assessment uses the Numeric Pain Rating Scale, a pain measurement tool to determine pain intensity on a numerical scale of 0 to 10. An eleven-point pain scale with scores ranging from 0 “no pain” to 10 “worst pain imaginable” for current pain levels, and worst during the previous 24 hours, Measurement of muscle strength using Manual Muscle Testing (MMT), which is used in physical therapy. MMT uses 5 criteria for assessing muscle strength. Functional activity examination, especially for the upper extremities with Boston Questionnaire Carpal Tunnel Syndrome (BQCTS). The CTS-related disability questionnaire consists of 11 Symptom Severity Scale (SSS) questions and 8 Functional Status Scale (FSS) questions. Score in both scales ranged from 1 to 5 points with a higher score being equivalent to more than 120 severe symptoms or a higher degree of dysfunction and a score of 1 being equal to absence of symptoms or dysfunction. BCTQ has been shown to have good reproducibility, internal consistency, and validity in patients with CTS.

Management and Outcome

Patients are given verbal and written instructions along with printed illustrations to perform the following exercises for the wrist/hand: tendon and nerve gliding exercises (Fig. 1a & 1b); and the therapist performed neurodynamic mobilization (Fig. 2). The therapist administered this exercise combination until the patient's 6-week follow-up visit and was provided with an exercise journal for record compliance. The prescribed exercises were:

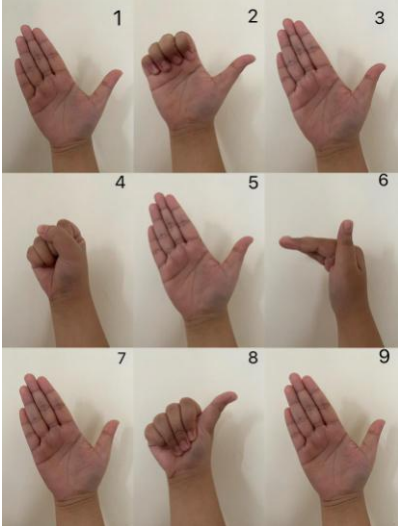
	<p>Tendon Gliding Exercise</p> <ul style="list-style-type: none"> • Palmar and all fingers in a straight position • Bend your fingers down until each knuckle and fingertips touch the top of your palm • Make a fist and squeeze slowly • Bend the patient's fingers straight ahead to form the letter "L" • Bend your fingers only at the MCP joints and PIP joints and then return to the starting position <p>Dose F: 3-5x a week; I - T: 1 set, hold 7 seconds.</p>
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Figure 1a. Tendon Gliding Exercise

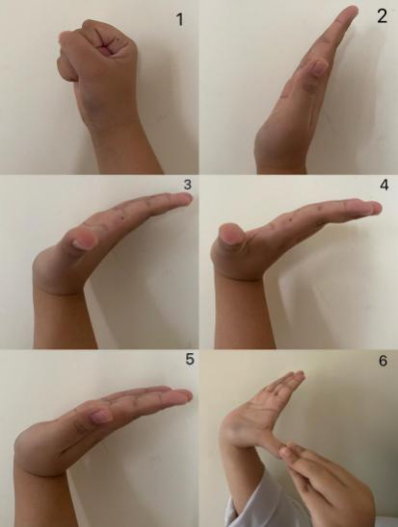
	<p>Nerve Gliding Exercise</p> <ul style="list-style-type: none"> • The wrist is in a neutral position and the fingers and thumb are in a flexed (grasped) position. • Then, with finger extension. • With wrist and finger extended and thumb in neutral. • With wrist, finger, thumb extension. • Like the fourth position, with the forearm supinated. • Like the fifth position, and the other hand gently stretching the thumb. <p>Dose F: 3-5 times a week I - T: 1 set, hold 7 seconds.</p>
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Figure 1b. Nerve Gliding Exercise

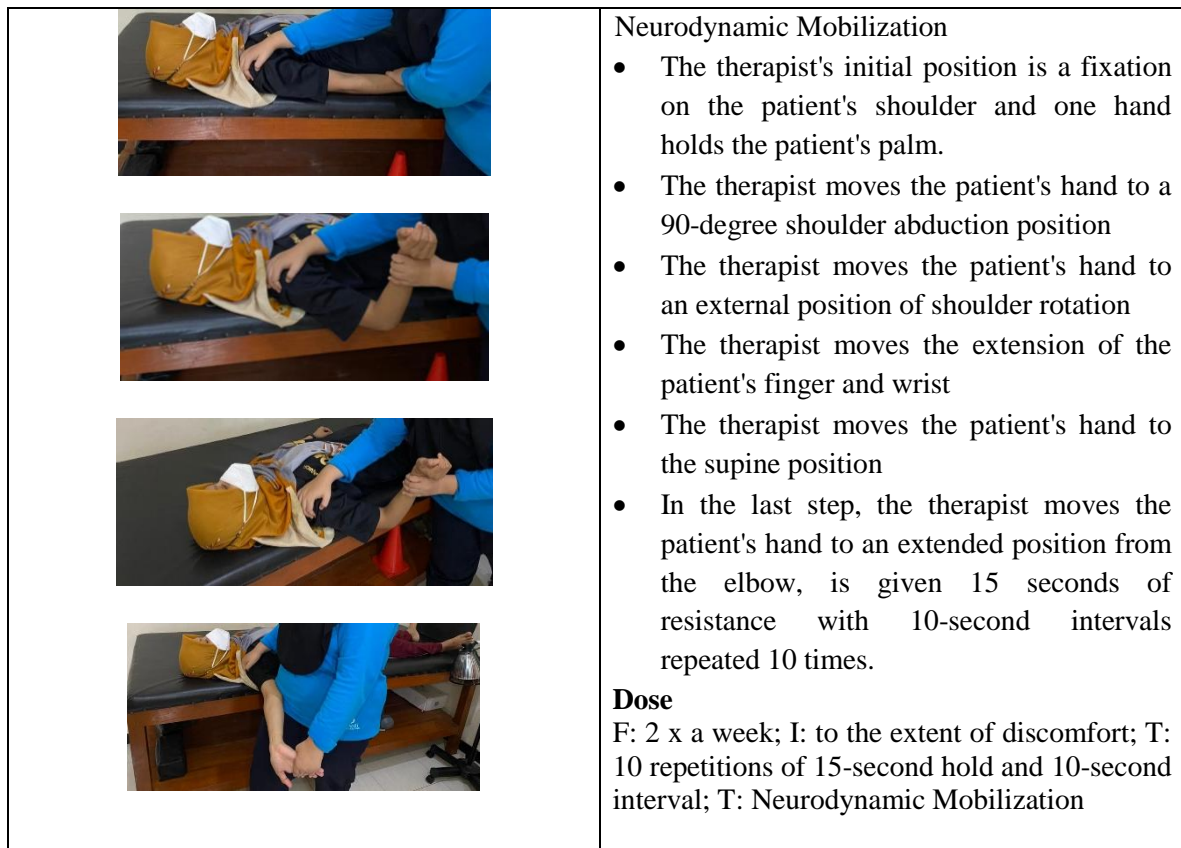


Figure 2. Neurodynamic Mobilization of the Median Nerve

Result

Total meetings and giving exercise combinations were 6 sessions. After 6 weeks of close monitoring and a guided combination exercise program, the patient showed improvement in symptoms. Based on the evaluation records, clinical outcomes had greatly improved outcomes with the implementation of a combination exercise program. Pain decreases, ROM increases, and hand function improves. Improved functional status according to BCTQ.

At the end of the follow-up period, the patient was able to write for 2 hours, type, and do daily household chores without pain (Table 1). The patient still hopes that the minor residual pain he feels in both hands will subside and he can be pain-free and continue to do his hand activities more efficiently.

Table 1. Case Study Evaluation Results

	T1	T2	T3	T4	T5	T6
ROM (ISOM)	S : 55° - 0° - 55°	S : 55° - 0° - 55°	S : 60° - 0° - 60°	S : 60° - 0° - 65°	S : 60° - 0° - 70°	S : 60° - 0° - 70°
PAINFUL (NPRS)	5	4	4	3	2	2
MUSCLE STRENGTH (MMT)	4	4	4	5	5	5
FUNCTIONAL (BCTQ)	20 (moderate)	16 (mild)	16 (mild)	10 (mild)	8 (asymptomatic)	7 (asymptomatic)

Discussion

Patients in this case report are encouraged to keep records of the designated rehabilitation programs to support patient compliance with the programs carried out in this report. Patients showed significant improvement in clinical signs and symptoms (reduced pain, increased hand ROM and forceps function, and improved functional ADL indicators). Therefore, close collaboration and communication with patients and patient adherence to the combination exercise program in this case report had a significant impact on patient outcomes and changes.

Mobilization exercises are commonly used for CTS symptoms by increasing axonal transport and nerve conduction. The most common mobilization exercises are tendon gliding and nerve gliding exercises. Tendon gliding and nerve gliding exercises can maximize the relative excursion of the median nerve in the carpal tunnel and excursion of the flexor tendons relative to each other (22). The exercise is a sequence of finger movements, for gliding the tendon, and movements of the wrist and fingers, for gliding the median nerve. The patient should practice 3 to 5 times a week, every 10 repetitions. Each position is held for seven seconds (9).

Some recent literature mentions nerve and tendon gliding exercise as an alternative intervention in the conservative management of CTS (7). Nerve and tendon gliding exercise

is a joint and tendon mobilization exercise program that can be applied by performing several movements of the hands and wrists.



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This exercise program was followed by improvement in clinical symptoms in patients, measured for 6 weeks. This exercise also helps the tendons shift to their original position which can increase the range of motion of the joints and optimize the patient's hand function. This program can be included with other non-medical interventions such as splinting and lifestyle changes (22). According to the American Academy of Orthopedic Surgeons, this exercise is divided into 4 main parts, namely: wrist extension stretch, wrist flexion stretch, median nerve glides, and tendon glides (2).

It was reported that tendon and nerve gliding exercise resulted in significant improvement in CTS-related symptoms, including the severity of clinical symptoms in terms of pain and general functional status of patients in all study groups based on a meta-analysis by Kim, which identified 4 randomized controlled trials. A systematic review of nerve and tendon gliding exercise as an intervention in CTS reported that after performing this exercise routinely at the clinician's dose, participants experienced faster clinical symptoms, shorter pain recurrence intervals, and return to optimal hand and wrist function. . As many as 2 of the 3 studies reviewed that compared nerve and tendon gliding exercise with other conservative interventions such as splinting showed that all participants in the treatment group experienced significant improvement in CTS symptoms in the form of pain compared to the comparison group.

Nerve and tendon gliding exercise can maximize symptom improvement caused by median nerve compression in the carpal tunnel and flexor tendon-related symptoms that occur in CTS patients. When the exercise is performed, remodeling and stretching of the tenosynovium around the carpal tunnel structures occur, this reduces adhesion and compression of the structures within the carpal tunnel. In other words, this exercise can return the anatomical structure to its original position and so that the compression adhesion in the tunnel is reduced and the symptoms also gradually disappear. This effect is also thought to increase the venous return from the median nerve so that the pressure in the canal is reduced (6) (17).

Neurodynamic mobilization has the effect of reducing nociceptive pain in nerves by increasing intraneural nerves (10). Another effect of neurodynamic mobilization has a potential effect on nerves that can reduce swelling of nerves, increase blood supply to nerves and improve median nerve neurodynamics (8). The principle of Neurodynamic mobilization adopts tension utilizing elongation of the nerves which can increase the transmission of nerve impulses to the distal, slide nerves where nerve excursions occur which make the transmission of nerve impulses from proximal to distal and compression, in the case of CTS there is pressure due to muscles and fascia, on Its execution involves an elbow extension maneuver, extension of the wrist, Lateral ipsilateral flexion of the neck closes the spinal canal and intravertebral foramen around the nerves, so that in this position there is an increase in nerve pressure which will pump impulses from proximal to distal. The provision of Neural Mobilization was evaluated after 10 weeks using the Boston Carpal Tunnel Questionnaire (BCTQ) measurement, which increased functional status by 47%, for a 67% reduction in subjective symptoms of CTS (15).

This is in line with the original study, Elgendy, Ali, and Labib (2018), which investigated the effectiveness of neurodynamic mobilization in CTS patients, and the intervention was applied three times per week for two weeks. Significant improvements were seen in pain levels, along with improvements in upper limb function, as measured using the upper limb functional scale (UEFS). Neurodynamics plays an important role in pain management and improves nerve root mobility. When nerve roots are under pressure and microcirculation is impaired, pressure on the nerve roots can cause edema and demyelination. Neurodynamic techniques involving short oscillations have been shown to reduce edema and thereby reduce hypoxia and hiss (3).

Therefore, the literature on training combination purchasing programs should be improved. Further research should be carried out with more participants and the incorporation of more complicated technologies with suitable conventional therapies in physiotherapy services in Indonesia to propose a more robust approach to patient functional

improvement. This exercise program was carried out for 6 sessions and after 6 weeks of close monitoring and guidance of a combined exercise program Overall, the results of this case report for



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disorders and clinical symptoms related to CTS showed significant results for improving hand function in patients with CTS in this case the patients were able to write for 2 hours, type, and do daily household chores without pain. In particular, the persistence of the results of this report for 6 weeks can be attributed to the combined administration of nerve and tendon gliding exercise with neurodynamic mobilization.

Conclusion

The combination of giving tendon and nerve gliding exercise with neurodynamic mobilization can be an effective alternative mediating intervention for patients with CTS. The biomechanical effect of this exercise can reduce adhesion to carpal tunnel edema and restore nerve portability. Given the high incidence of CTS, it is necessary to have an effective and efficient alternative therapy applied to CTS patients, one of which is nerve gliding exercise and neurodynamic mobilization. This case report can conclude that tendon and nerve gliding exercise combined with neurodynamic mobilization is effective in improving hand function in CTS patients.

Acknowledgments

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