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REVIEW ARTICLE

CARPAL TUNNEL SYNDROME-A NARRATIVE REVIEW

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ABSTRACT

Introduction: Carpal tunnel syndrome is the most common musculoskeletal disorder resulting from ischemic response to the median nerve in the carpal tunnel. The thumb, index finger and middle finger are particularly affected by the compression of the median nerve through the carpal tunnel at the wrist. Methodology: There are several methods for diagnosing CTS, including history taking, physical examinations, diagnostic questionnaires, electrodiagnostic testing, and ultrasound. Provocative tests can be a part of the CTS diagnostic tools and are crucial components of the physical examination. **Result:** Physiotherapy intervention is widely applied as a conservative treatment and a non-invasive method in clinical settings. Conclusion: For patients with mild to moderate CTS symptoms, conservative treatment is beneficial and recommended by numerous studies.

Keywords: Carpal Tunnel Syndrome, Shock Wave Therapy, Physiotherapy intervention, symptom and hand function, Idiopathic

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INTRODUCTION

Carpal Tunnel Syndrome: Carpal tunnel syndrome (CTS) is a mononeuropathy caused by squeezed or compression of the median nerves in the wrist. The symptoms can vary and might only affect the wrist or the whole hand, or they could spread to the forearm or, in exceptional cases to the shoulder¹. Hand discomfort, numbness, and tingling along the median nerve are the characteristics of the Patients may syndrome. experience paresthesias in the affected hands, either with or without numbness or pain, particularly in the median nerve distribution, which includes the thumb, index, and middle fingers.

The CTS symptoms depending on the severity of the disease and it classified as mild, moderate, or severe. In mild CTS, the patient symptoms of experiences intermittent paresthesia or nocturnal hand pain, but there is no change in fine motor skills ¹. According to reports, almost 80% of carpal tunnel syndrome patients wake up throughout the night due to numbness of the hands². The wrist position during sleep significantly worsens by increasing the pressure inside the carpal canal. In moderate CTS, studies have reported that the patients have persistent paresthesia and interference with activities of daily living, functional limitations and continuous nightly awakening.

Most patients at this stage which have nocturnal symptoms, hand dysfunction, sensory loss and hand weakness were impetus to seek medical intervention. In this stage , the choice of conservative treatment is beneficial especially in idiopathic CTS. In severe CTS, the symptoms worsens and become more constant as they experience numbness or ongoing pain at hand and may radiate to the elbow and shoulder . Prolong median nerve compression may affect motor function and cause the thenar muscles to visibly atrophy. At this stage, these symptoms are frequently made worse when sleeping and brought on throughout the day by a static or repetitive motion of the hand.

Pathophysiology and Mechanism of the Carpal Tunnel Syndrome: The precise cause of CTS is still unknown, the compression and enlargement of the median nerve in the carpal tunnel are incompatible, which leads to increased pressure inside the carpal tunnel and is the main cause of CTS. The size of the median nerve and the elements of the tunnel were out of proportion as a result of the blood flow becoming obstructed when the pressure increased. The pressure in the carpal tunnel is known to range between 2 mmHg and 10 mmHg normally, therefore repeated and prolonged wrist movements (flexion and extension) cause a rise in pressure. The fluid pressure in the carpal tunnel may fluctuate as a result of the prolonged wrist position adjustments. As a result, the pressure is increased by more than ten times during extension, compared to eight times during flexion of the wrist. Repeated wrist movements that induced an extended rise in interstitial pressure thickened the synovial membrane, which worsened the functioning of the median nerve³.

Investigation of the Carpal Tunnel Syndrome: Carpal tunnel syndrome (CTS) is an important cause of pain and functional impairment of the hand. The justification of the clinical diagnosis is an important issue given the prevalence, potential resulting disabilities, and the predictable response to treatment . Several methods have been applied in clinical diagnosis of CTS. It focuses on nature and provocation of symptom by provocative test, sensorimotor

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nerve evaluation by Nerve Conduction Study (NCS) or Electromyography (EMG) and questionnaire⁴. It can be established by history and physical examination, with or without aid of diagnostic questionnaires, electrodiagnostic studies, magnetic resonance imaging (MRI) and ultrasonography 5 .

Provocative Tests: Provocative tests are frequently used to assess the incidence of CTS since they can be easily carried out on the patient. The sensitivity and specificity of provocative tests as the physical examination were the key elements to integrate as diagnostic tools in CTS. Numerous provocative tests have been applied in clinical settings. However, the most often used tests in clinical settings were the Tinel's Sign and the Phalen Test. The patient places their elbows on a flat surface, 90 degrees flexed, and their wrists in unforced flexion as a component of Phalen's test. If the patient's symptoms appeared within 1 minute, this was considered a positive sign. The Phalen's test had a sensitivity of 88 percent, a predictive value of 87 percent, and a specificity of 100 percent. The average time it took for a positive result to appear was 26 seconds ⁶. Otherwise, Tinel's sign is performed by tapping on the volar surface of the wrist. The Tinel sign had a sensitivity of 67 percent, a positive predictive value of 50 percent, and a specificity of 100 percent⁷. Both tests revealed a positive response if the affected hand's thumb, second, and middle fingers, as well as the radial side of the ring finger, reproduced symptoms (pain and paraesthesia).

Sensorimotor Nerve Evaluation: The Nerve Conduction Study (NCS) is used as a standard diagnostic method to diagnose the CTS, which has a high degree of sensitivity and specificity. NCS can be used to determine focal demyelination, which is the main pathological change of CTS . Based on NCS, the normal value of nerve conduction ; \geq 50 m/s, motor latency; ≤4.0 m/s. The person who has diminished nerve conduction value (<50 m/s), increased motor latency (>4 m/s) commonly suffers with CTS symptoms. There are few considerations and relatively contraindications to the routine of NCS. The NCS is not recommended for patients who have external cardiac pacing wires and surface nerve stimulation since there is a substantial risk of electrical damage to the heart. Additionally, due to the potential risk of causing or worsening arrhythmia⁸, clinical judgement is advised in patients who have just suffered an acute myocardial infarction. The NCS procedure is expensive, takes more time (30-60 minutes), and required some expertise.

Self-Administered Questionnaire: Selfadministered questionnaires are preferred because it simple to administer and clinically in establishing the beneficial patient's assessment of their severity, function, and limitations in daily living activities. The application of disease-specific instruments for CTS has expanded in clinical settings. In CTS, several self-administered questionnaire have been used including Disabilities of Arm, Shoulder, Hand Questionnaire (DASH), Michigan Outcomes Hand Questionnaire (MHQ) Boston Carpal and Tunnel Questionnaire (BCTQ). The Boston Carpal Tunnel Questionnaire (BCTQ) commonly used as a disease-specific patient-oriented tool in CTS to determine the symptoms severity and functional status for clients. It also referred as the Levine scale, developed in 1993. It is recommended to be used in any type of CTS research due to its quick and easy to administer . It suitable to be used individually and in large populations ^{10,11}.

Prevalence and Associated Factors of Carpal Tunnel Syndrome: Previous studies showing that the CTS is considered a common compression disease and debilitating disorder showed one in five ambulatory clinic visits in primary care. The prevalence of CTS in general population showed ranging between 0.6% and 14.4%¹². The prevalence rate of CTS is higher in all countries including Malaysia¹³. In Malaysia highes rate found especially among dentists, nurses and counter workers. Studies in other Asian countries revealed the prevalence rates were 4.7 % in Japan 14 , 6.5 % to 21.4 % in Korea ¹⁵, and 14.5 % among fishnet manufacturing workers in Thailand, which is much higher than in the general population ¹⁶. Differences in incidence rates between countries might be related to a variety of factors, including behaviours, aetiology (such as occupations and environments that promote general health), and weather ¹⁷.

Previous studies revealed that the women are much more susceptible than men to develop CTS as showed 9.2% and men 6 % ⁶. Generally the factor that influenced the high prevalence in women may be due to anatomy of the carpal tunnel itself. The significant differences in anatomy of carpal tunnel size in women showed smaller than men considered as a major factor to develop CTS among women. It commonly affected to elderly women age between 40 to 60 years old and usually affected bilateral hand. The age-specific incidence of women increased gradually, peaking between the ages of 50 and 59, and then declined. The aggravated factor may be due to abnormal body structure as their body composition gradually changes. It including the reduction of the secretion of growth hormone and the use of hormone replacement therapy (oestrogen)

among the menopause women causes changes in body structure⁻ The hormone replacement therapy may increases the fluid retention in soft tissues of the carpal tunnel is related to the cause by increasing pressure on the median nerve¹⁸.

Obesity is one of the factors reported in CTS especially in women who recently gained weight. Body mass index (BMI) more than 30 showed two-fold higher risk of CTS ^{19.} The risk may due to increase in fatty tissue or increased hydrostatic pressure in the carpal tunnel among an obese person. When the pressure increases in the carpal tunnel, the median nerve is affected by ischemia leading to paresthesia and pain at the median nerve distribution usually in the three radial fingers .

Impact of Carpal Tunnel Syndrome: Numerous studies showed the associated correlation between the severity and hand function among the CTS patients. When the symptom severity scale was high, there was an increase in functional limitation of hand function. The symptoms of CTS may lead to reduction in hand power and visible atrophy in the thenar eminence muscle. It may affect the grip and pinch strength of the affected hand . Previous study found that 70% of CTS patients decrease in the sensory surface in the medial innervation zone²⁰. It may reduce the ability to precisely regulate force production of the hand and permanent disability due to end-stage carpal tunnel syndrome. Some of them will preserve their affected hand from any work that takes weeks or months as part of recovery that will eventually contribute to muscle atrophy of thenar muscles.

Patients with CTS may also impact on their function, productivity, quality of life and

financial status. Absenteeism and disability were more common among CTS patients as the employees with CTS take between 25 and 27 days of sick leave each year, which is longer than any other work-related illness except in bone fractures ²¹. It is one of the most common causes of reduced productivity and generates millions in losses²².

Management of the Carpal Tunnel Syndrome:

The aims of the CTS management is to relieve the symptoms as well as relieve carpal tunnel pressure by conservative or surgery. Conservative treatment preferred to patients with mild to moderate CTS while the patients with moderate to severe symptoms, surgical intervention is recomended. Several conservative treatment commonly used in clinical setting include ultrasound therapy, LASER therapy, hand activities, paraffin wax and flexible wrist splints or therapy kinesiotaping, local injection of corticosteroids (CSI), night splints (NS), oral steroids, electromagnetic field therapy , workplace adaptation and cupping therapy. Physiotherapy intervention is one of the common conservative treatment in treathing CTS.

Physiotherapy and Carpal Tunnel Syndrome: The main objective of physiotherapy for CTS patients is to relieve symptoms and improve functional abilities as well as improve quality of life. An appropriate physiotherapy intervention will restore symptomatic relief and function of the affected hand. Physiotherapy is a reasonably cost-effective, non-invasive, easy-to-apply, and frequently used therapeutic approach for CTS patients.

Therapeutic intervention has clearly benefited both patients and society. However, there does not appear to be a standard physiotherapy protocol for treating CTS patients. A systematic review by Huisstede et al. ²³ found that the effectiveness of physiotherapy interventions with electrophysical modality provides evidence for CTS. Several study revealed strong evidence that the conservative intervention is beneficial for short-term period, but there is little evidence of the medium and long-term effectiveness especially in idiopathic CTS ^{24,25}.

Ultrasound Therapy and Carpal Tunnel Syndrome: The ultrasound therapy (UST) widely used as physiotherapy modality worldwide. It successful for patients with idiopathic CTS by produces thermal and nonthermal effects. The results of UST may include pain relief, improvement of sensory loss, reduce symptom severity, recovering the grip strength, and increased patient satisfaction.

However, the effectiveness of ultrasound therapy in CTS remains uncertain. Previous studies have shown that the UST is effective in reducing the symptoms and increasing the hand function by using various parameters . The common used intensity is shown to be 0.8 to 1.0 W/cm^2 , frequency 1 to 3 MHz and duration 5 minutes to 15 minutes. The increase of frequency of ultrasound cause decrease in depth in penetration and concentration of the energy. The low-frequency of the transducer is used for deeper effect, otherwise the high-frequency is used for superficial effect ^{26, 27}.

Extracorporeal Shock Wave Therapy and Carpal Tunnel Syndrome: Recently, few studies have used Extracorporeal Shock Wave Therapy (ESWT) as a non-invasive treatment and evidence-based physiotherapy approach in the treatment of CTS. ESWT have received increased attention as being a safe and novel therapy for CTS. However, there is very scarce literature on the usage of ESWT in CTS especially in Malaysia. The mechanism of ESWT in improving the symptom is not fully understood. It may related by mechanotransduction factor as biological response to shock wave impulse lead to induce biochemical changes within the targeted tissues. This effect improved vascularization, the local release of growth factors, and local anti-inflammatory^{28, 29}.

Nerve And Tendon Gliding Exercise: Numerous study found that neurodynamic mobilisation used as a conservative treatment. It have been used particularly for the management of postoperative as well as conservative management. This clinical approach reported greater and faster pain relief, decreased sensitive distal latency, time summation, and improvement of functions such as pinch grip, which avoided surgical intervention in the majority of cases ^{30.}

In physiotherapy intervention, nerve and tendon gliding exercise is a common exercise administered together for CTS patients. In order to improve the efficacy of non-surgical treatment for CTS, nerve and tendon gliding exercises were developed as a supplemental approach to standard conservative treatment in a clinical setting.

CONCLUSION

Patients with carpal tunnel syndrome found benefit from conservative treatment. Physiotherapy technique uses in clinical setting that have an impact on the body's basic functions. Physiotherapy treatment for CTS patients is not administered according to any established protocol. ESWT is a recently developed physiotherapy technique that is widely used, non-invasive, and simple to use.

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