

Effect of Tendon and Nerve Gliding In Carpal Tunnel Syndrome: Clinical and Electrophysiological Examination

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Abstract: Carpal tunnel syndrome (CTS) is a common upper extremity entrapment neuropathy and is estimated to occur in 1% to 3% of the general population. The prevalence of CTS in the general population has been estimated to be 5% for women and only 0.6% for men. The higher incidence of CTS in women than in men is due in part to differences in carpal tunnel volume between men and women. The main purpose of this study was to investigate and compare the therapeutic effect of tendon and nerve gliding over the conventional physiotherapy treatment in patients with carpal tunnel syndrome by the mean of clinical and electrophysiological studies.

Methods: 26 patients, both males and females, aged between 30–50 years, of carpal tunnel syndrome were taken. All the patients were assessed for pain, pinch strength, severity and function capacity, level of disability with Michigan hand outcome questionnaire, a standard dynamometer, Boston carpal tunnel questionnaire and Disability of arm, shoulder and hand respectively. After the baseline assessment, all the patients were conveniently divided into two groups, Group A and Group B having 13 patients each. Group A received Tendon – Nerve gliding exercises along with conventional physiotherapy which consists of custom-made neutral volar splint, Ultrasound and Madenci hand massage technique whereas Group B received only Conventional Physiotherapy. Thus, patients in all groups received total interventions of 3 weeks. All the outcome measures were again reassessed after completion of 3 weeks. All the patients received total intervention of 5 sessions per week for 3 weeks.

Results: After statistical analysis, a significant improvement was found in both the groups. However, greater improvement was seen in the group that received tendon and nerve gliding exercises along with conventional physiotherapy.

Conclusion: The present study concluded that tendon and nerve gliding exercises combined with conventional physiotherapy is more effective conservative treatment in carpal tunnel syndrome.

Keywords: Carpal Tunnel Syndrome; Tendon and Nerve Gliding; Nerve Conduction Velocity.

1. INTRODUCTION

Carpal tunnel syndrome (CTS) is one of the most frequent work-related locomotors system disorders and is more frequent in persons whose work or hobby requires repetitive actions, application of significant force and uncomfortable position of the wrist and hand (1). A clinical Diagnosis of CTS defines it as a symptomatic compression neuropathy of the median nerve at the level of the wrist (2). CTS is the most well-known and frequent form of median nerve entrapment (2,3,4,5,6,7) and accounts for 90% of all entrapment neuropathies (8) and occurs most frequently after 40 years of age (9). An entrapment neuropathy is a chronic focal compressive neuropathy caused by a pressure increase inside non-flexible anatomical structures (10). 1 in every 5 subjects who complains of symptoms such as pain, numbness and a tingling sensation in the hands are expected to have CTS based on clinical examination and electrophysiological testing (3).

Primary features of CTS include pain in the hand, unpleasant tingling, pain or numbness in the distal distribution of the median nerve (thumb, index, middle finger and the radial side of the ring finger (11), and a reduction of the grip strength

and function of the affected hand (12). Symptoms tend to be worse at night, and clumsiness is reported during the day with activities requiring wrist flexion (13). Patients often describe a phenomenon termed the “flick sign”, in which shaking or flicking their wrists relieves symptoms (14).

Carpal tunnel syndrome (CTS) is estimated to occur in 1% to 3% of the general population (16, 17). The prevalence of CTS in the general population has been estimated to be 5% for women and only 0.6% for men (15). The higher incidence of CTS in women than in men is due in part to differences in carpal tunnel volume between men and women (18). It has also been suggested that hormonal changes (for example during pregnancy and menopause) influence the onset of CTS in women (46), causing swelling that increases pressure on the median nerve (19). CTS results in considerable discomfort and pain, limitation of activities of daily living, loss of sleep and work disability (20).

Age-related anatomical and physiological changes have strong correlations with decreased functions in the central nervous system as well as the peripheral nervous system. A change in the peripheral nervous system among older adults affects the somatosensory system, physical work performance, and quality of life (21). Blumenthal, Herskovitz & Verghese hypothesized that older adults underreport their CTS symptoms, which results in severe median nerve entrapment compared with young adults, as indicated in muscle wasting and nerve conduction studies (22).

The treatment of CTS falls under two categories; conservative and surgical. Conservative treatment is generally offered to patients suffering from mild to moderate symptoms of CTS (23). Options of such treatment include oral and transvenous steroids, vitamins B6 and B12 (24), nonsteroidal anti-inflammatory drug (NSAIDs), diuretics, pyridoxine, and local injection of corticosteroids. In addition, activity modification, ultrasound, yoga, chiropractics, laser treatment, carpal bone mobilization and the use of hand splints have been advocated (25, 26,27).

Splinting is the most popular method among the conservative treatments of CTS (25, 26,27). Immobilization of the wrist in a neutral position with a splint maximizes carpal tunnel volume and minimizes pressure on the median nerve (28).

There are conflicting results on the efficacy of therapeutic ultrasound in the treatment of CTS, and only a few studies reported the benefit of ultrasound in CTS treatment (28, 29, 30, 31,32). Field et al, 2004 studied on efficacy of massage on CTS, they have suggested that significant improvement was observed in the massage group in terms of pain, anxiety, depression, hand grip strength, and median nerve peak latency scores(41). Of the many studies of conservative treatment of CTS, only a few has used exercise treatment. Tendon- and nerve gliding exercises have been used particularly for the management of postoperative CTS (33), while only two studies in the literature have used tendon- and nerve-gliding exercises in conservative management of CTS.

The aim of this study was to investigate and compare the therapeutic effect of tendon and nerve gliding over the conventional physiotherapy treatment in patients with carpal tunnel syndrome by the mean of clinical and electrophysiological studies.

2. METHODS

Design:

The research design of present study is quasi-experimental in nature. The study was performed at the Out Patients Department (OPD) of University College of Physiotherapy, Faridkot, and In Patients Department (IPD) of Department of Orthopedics, Guru Gobind Singh Medical College and Hospital, Faridkot between April, 2015 to March, 2016. The study was approved by the Research and Ethical committee of University College of Physiotherapy, Baba Farid University of Health Sciences, Faridkot. Total 30 patients, both male and female, age between 30-50 years were included in the study. Subjects were selected on the basis of convenient sampling. All the patients had Unilateral or bilateral involvement with mild carpal tunnel syndrome duration according to Disease classification in CTS (47). Patients were included in study according to subjective symptoms, physical examination, and electrophysiological findings. Subjective symptoms were history of Pain in the median nerve distribution, Nocturnal Pain and Dysaesthesia. Physical examination included Tinel sign test, Phalen test, pain measurement, pinch strength measurement, severity and function capacity measurement, level of disability measurement. Patients were excluded if they were taking regular analgesic or anti-inflammatory drugs, steroid injection within the previous 3 months, upper limb fracture, malunion and non-union of the effective upper limb, metal implants in the affected upper limb, neurological disorders other than CTS like radiculopathy or polyneuropathy, known case of tendon transplant supplied by median nerve, presently following any stretching or strengthening maneuver for upper extremities, predisposing etiological factors in CTS such as diabetes, hypo and hyper thyroidism, acute trauma, pregnancy, rheumatic disease, present receiving physical therapy treatment for the management of CTS.

Patients were randomly assigned to one of the two groups: Group A (n=15) and Group B (n=15). Group A received Tendon and nerve gliding exercises, ultrasound, and splinting and madenci hand massage technique, Group B received ultrasound, and splinting and madenci hand massage technique. Twenty six patients completed the study. The four dropouts are described as follows: two patients (group A) were lost to follow up; two patients (group B) refused electrophysiological study due to improvement of symptoms.

3. INTERVENTION

Tendon – Nerve gliding - Tendon and Nerve gliding were given according to standard protocol given by Totten PA, Hunter JM, 1991. During tendon-gliding exercises, the fingers were placed in five discrete positions. Those were (1) Straight- neutral wrist, fingers extended, (2) Hook-hand in neutral position with distal digits fully flexed, (3) Fist-fully closed position, all interphalangeal joints fully flexed, (4) Table top-wrist straight with fingers flexed only at the metacarpophalangeal joints, and (5) Straight fist-wrist neutral with flexed metacarpal phalangeal, proximal and distal interphalangeal joints.

During the median nerve gliding exercise, the median nerve was mobilized by putting the hand and wrist in six different positions. Those were (1) Neutral clenched fist, (2) Neutral extended fingers and wrist, (3) Extended fingers and wrist with thumb in neutral position, (4) Wrist fingers and thumb in extended position, (5) Wrist, fingers, and thumb extended with wrist in fully supinated position, (6) Wrist, fingers in neutral position with thumb passively stretched in abduction using opposite hand.

During these exercises, the neck and the shoulder were in a neutral position, and the elbow in supination and 90 degrees of flexion. Each position was maintained for 5 seconds. The exercises were performed as five sessions of 10 repetitions each. Exercise treatment was continued for 3 weeks (34).

Madenci hand massage technique was applied by the patient himself /herself. This massage technique begins with 30 second effleurage, continues with 60 second friction, 30 second petrissage, 30 second shaking and end with 30 second effleurage. Total duration of application of this technique was 3 minute (35).

Therapeutic Ultrasound treatment was administered for 15 minute per session to the palmar carpal tunnel area at a frequency of 1 MHz and intensity of 1.0 W/cm^2 , pulsed mode 1; 4 and with aqua sonic gel as the couplant. A total of 15 ultrasound treatments session were performed, five times a week, for 3 weeks (34).

A custom-made neutral volar splint was given to patients in the both groups. The patients were instructed to wear the splints whole night and during the day for 3 weeks (34).

Parameters used in the study:

1. Electrophysiological examination: Motor nerve conduction velocity test (MNCV)
2. Evaluation of pain: Michigan hand outcome questionnaire (MHQ)
3. Evaluation of pinch strength: Standard dynamometer
4. Evaluation of symptom severity and function capacity: Boston carpal tunnel questionnaire
5. Evaluation of level of disability: Disability of arm, shoulder and hand (DASH).

Assessment of all patients in both the groups was taken at 0th week and 3rd week of the treatment through following scale:

Pain was measured by the Michigan Hand Outcomes Questionnaire (MHQ), high scores indicate greater pain (48).

Electrophysiological examination (MNCV) It is used for an electrophysiological procedure which measures the nerve conduction velocity of the nerves. Scoring: Normal conduction velocity for median nerve is $>50 \text{ m/s}$.

Pinch strength The Jamar dynamometer was used to measure pinch strength. It is calibrated in kilograms of force.

Boston carpal tunnel questionnaire The SSS (Symptom Severity Scale) consists of 11 items related to six domains said to be critical for the evaluation of CTS. The FSS (Function Severity Scale) consists of eight-items related to a variety of activities commonly performed by a broad spectrum of patients (i.e. young and elderly, workers inside and outside the home). Each item is rated by the patient on a 1 to 5 point (most severe) liker scale, with higher ratings indicating more pain and disability.

Disability of arm, shoulder and hand (DASH) The questionnaire has 30 items with each item rated on a five-point scale (1 to 5). Raw scores range from 30 to 150. These scores are converted to a score of 0 to 100. A score of zero reflects no disability. A higher score indicates increasing disability (49).

Statistical analysis:

The statistical analysis of the data was performed by Statistical Package for Social Sciences (SPSS) 20.0 for Windows. Student’s t test was used for the intergroup comparison of independent variables, whereas paired t test was used for the time-dependent changes of intragroup variables. The results were presented as mean, and a P value < 0.05 was considered statistically significant.

4. RESULTS

There was no statistically significant difference between the two groups in terms of age, gender P > 0.05 (Table 1).

Table.1: Demographic profile of selected patients

| Variables | | Group A (Tendon nerve gliding) | Group B (Conventional therapy) |
|--------------------|--------|-----------------------------------|-----------------------------------|
| Gender | Male | 4 | 5 |
| | Female | 9 | 8 |
| Age Year (Mean) | Male | 38.25 | 40.8 |
| | Female | 39.11 | 39.125 |

There was no statistically significant difference between the groups in terms of initial symptoms such as pain, disability, and loss of strength, as well as severity and function capacity and physical examination findings including Tinel, Phalen (P < 0.05). There was no statistically significant difference between the groups in electrophysiological parameter (MNCV).

When the pretreatment and post treatment parameters were compared via repetitive measurement analysis, there was statistically significant difference between both the group A and group B. There was not statistically significant difference was found between the groups regarding pretreatment values (P > 0.05), the post treatment pain, level of disability, pinch strength, symptom severity and function capacity scores and also in electrophysiological parameters (MNCV) were significantly improved in group A compared to the group B (P < 0.05) (Table 2)(Fig 1).

Table.2: Compare of pretreatment and post treatment parameters of group A and group B

| Parameters | Group A | | t-value | p-value (P < 0.05) | Group B | | t-value | p-value (P < 0.05) |
|--|------------------|------------------|---------|-----------------------|------------------|------------------|---------|-----------------------|
| | 0 week (mean) | 3 week (mean) | | | 0 week (mean) | 3 week (mean) | | |
| Pinch Strength(Kgf) | 2.731 | 3.776 | -17.58 | .000 | 2.038 | 2.761 | -9.50 | .000 |
| DASH | 80.08 | 53.00 | 17.51 | .000 | 85.54 | 67.77 | 11.29 | .000 |
| MNCV | 21.04 | 25.56 | -12.43 | .000 | 19.38 | 21.73 | -10.34 | .000 |
| Boston carpal tunnel questionnaire | | | | | | | | |
| Symptom severity scale(SSS) | 1.89 | 0.98 | 8.53 | .000 | 1.94 | 1.57 | 8.67 | .000 |
| Function capacity scale(FSS) | 2.93 | 1.85 | 6.57 | .000 | 3.18 | 2.77 | 5.45 | .000 |
| Michigan hand outcome questionnaire(MHQ) | | | | | | | | |
| Pain | 66.53 | 68.46 | 3.38 | .02 | 42.69 | 52.69 | 2.67 | .01 |

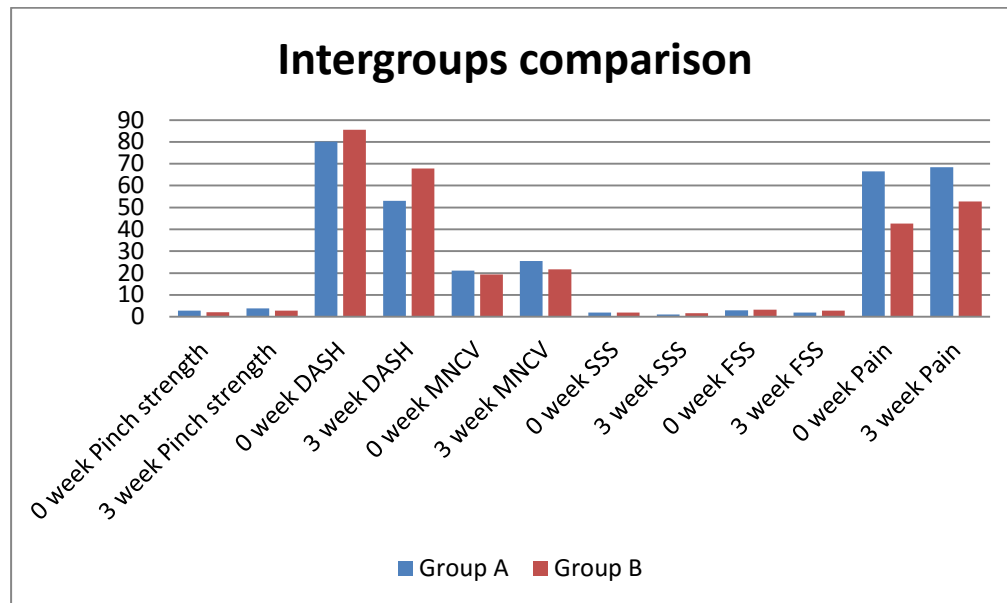


Fig.1: comparison of pretreatment and post treatment pinch strength, DASH, MNCV, Boston carpal tunnel questionnaire, pain (MHQ) in group A and group B.

5. DISCUSSION

The aim of present study was to find the effect of tendon and nerve gliding over the conventional physiotherapy treatment which includes splint, ultrasound and madenci hand massage technique in patients with carpal tunnel syndrome. The effect has been studied by the means of clinical and electrophysiological evaluation. As there were limited studies in the literature which showed the combined effect of tendon and nerve gliding combined with splint, Ultrasound and Madenci hand massage technique, therefore, present study was focused on it.

Many studies stressed on the effectiveness of neutral angle wrist splinting in CTS. The pressure in the carpal tunnel is the lowest in neutral position and significantly increases when the wrist is in flexion or extension (36). Among the conservative treatment, splinting the wrist in a neutral position will help reduce and may even completely relieve CTS symptoms (37).

Nobuta S et al, 2008 studied the Effects of wrist splinting for carpal tunnel syndrome and motor nerve conduction measurements. This study showed that wrist splinting is most effective in mild to moderate carpal tunnel syndrome (38).

Moraska A et al, 2008 found that massage plays a role in the reduction of the pain severity by decreasing the muscular tonus and increasing the local sympathetic activity (39).

Field et al, 2004 studied on efficacy of massage on CTS, they have suggested that significant improvement was observed in the massage group in terms of pain, anxiety, depression, hand grip strength, and median nerve peak latency scores(40).

Baysal, 2006 studied on Comparison of three conservative treatment protocols in carpal tunnel syndrome. The end results of this study was long-term patient satisfaction questionnaire revealed that symptomatic improvement is more prominent in the group treated with splinting, exercise and ultrasound therapy combination. Our results suggested that a combination of splinting, exercise and ultrasound therapy is a preferable and an efficacious conservative type of treatment in CTS (34).

Akalin E et al, 2002 studied the comparison of wrist splint alone to the group with wrist splint in combination with nerve- and tendon-gliding exercises for the efficacy of the treatment. They reported significant improvement in clinical parameters, functional status scale and symptom severity scale in both groups. Greater improvement in pinch strength was observed in the group treated with exercises (41).

Rozmaryn et al. (42) have used nerve- and tendon-gliding exercises in conservative treatment models to decrease adhesions developed in the carpal tunnel and regulate venous return in the nerve bundle. It confirmed that tendon and nerve gliding exercises promote more rapid pain reduction and greater functional improvement.

Szabo et al. (48) showed that the relationship between median nerve and flexor tendon excursion was consistently linear. They suggested active finger motion of the median nerve and flexor tendons in the vicinity of the wrist to prevent adhesion formation even if the wrist is immobilized.(43)Seradge et al, 1995 demonstrated that intermittent active wrist and finger flexion-extension exercises reduce the pressure in the carpal tunnel. Tendon- and nerve-gliding exercises may maximize the relative excursion of the median nerve in the carpal tunnel and the excursion of flexor tendons relative to one another (44).

Boston Scale is used for the patient-based evaluation of the symptom severity and functional capacity [45]. In the present study, we also used the Boston Questionnaire to observe the efficacy of splint and massage therapy. The symptom severity was decreased and the functional capacity was increased in both groups.

Regarding electrophysiological study results, there was statistical significant improvement in MNCV in groups A and B, but there was a highly significant improvement in MNCV in group A as compared to the B.

The major limitation of our study is the design, having a small number of patients. We think it is better to make clinical and electrophysiological studies in the long-term follow-up. The reason why we made satisfaction questionnaire is the patient refusal due to disturbing effect of electrophysiological studies. However, there are methodological strengths of our study. These include the prospective, randomized design, the use of valid, standard measures, the evaluation of the functional status of patients, and we also could evaluate the electrophysiological efficacy of our treatment methods.

The results of the present study indicated that the tendon and nerve gliding exercises combined with splint, Ultrasound and Madenci hand massage technique were effective in improving the pain intensity, pinch strength, severity and function capacity of the hand and level of disability of arm and hand. Overall, our results suggest that a combination of splinting, exercise, madenci hand massage technique and ultrasound therapy is a preferable and an efficacious conservative type of treatment in CTS.

Abbreviations: CTS: Carpal Tunnel Syndrome, US: Ultrasound, MHQ: Michigan hand outcome questionnaire, DASH: Disability of Arm, Shoulder and Hand.

Consent: All authors declare that written informed consent was obtained from the patient before starting the study for publication of this study report.

Ethical approval: This study was approved by Research and Ethical committee of University College of Physiotherapy, BFUHS University, Faridkot, Punjab.

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Competing interests: Authors declare that no competing interests exist.

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