ORIGINAL ARTICLE

Effect of median nerve neuromobilization on functional status in patients with carpal tunnel syndrome: A double blinded randomized control trial

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Abstract

Objective: To measure additional benefits of neuromobilisation along with conventional treatment in improving the functional status in patients having carpal tunnel syndrome.

Method: The prospective, double-blind randomised controlled trial was conducted from August 2018 to June 2019 at the Physiotherapy outdoor clinic of Mayo Hospital, Lahore, Pakistan, and comprised patients of either gender aged 20-45 years with <3-month history of carpal tunnel syndrome. The patients were randomised into control group 1 and experimental group 2. Group 1 received conservative treatment including ultrasound therapy, wrist splinting, and tendon-gliding exercises, while Group 2 additionally received neuromobilisation. Functional limitation was measured using the Functional Status Scale and the Symptom Severity Scale of the Boston Carpal Tunnel Syndrome Questionnaire. Patients had 2 sessions per week for 6 weeks. Clinical data was noted at baseline, after 3 weeks of treatment and finally at the end of the 6-week intervention. Data was analysed using SPSS 21.

Results: Of the 66 patients, there were 33(50%) in Group 1; 3(9.1%) males, 30(90.9%) females, overall mean age 37.79 ±5.91 years. The remaining 33(50%) were in Group 2; 2(6.1%) males, 31(93.9%) females, overall mean age 35.58 ±7.15 years. Both the groups showed significant improvement ($p < 0.05$), but the addition of neuromobilisation in Group 2 showed better results compared to Group 1($p<0.05$).

Conclusion: The addition of neuromobilisation to routine physical therapy was found to have significantly decreased the symptoms of carpal tunnel syndrome and improved the functional status of the patients.

Keywords: Functional status, Carpal tunnel syndrome, Neuromobilisation.

Trial No: This study registered in Chinese Clinical Trial Registry with Registration No: ChiCTR2000029377(http://www.chictr.org.cn/showproj.aspx?proj=48704).

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Introduction

Carpal tunnel syndrome (CTS) is attributed to increased pressure in the carpal tunnel leading to compression on the median nerve at the level of the wrist. Pain in the wrist and hand which may radiate to the arm with paraesthesia in the latter and half digits are the most common CTS symptoms. In cases of advanced CTS, atrophy of muscle of thenar eminence is also seen.[1] Individuals performing repetitive activities of hand have a high prevalence of CTS.[1] Additionally, prolonged activities of flexor muscles of the wrist and digits lead to the appearance of sensory symptoms. Actual weakness of the affected hand muscle is a rare complaint in CTS patients. Primarily diagnosis of CTS is based on clinical evaluation of findings by physical examination and nerve conduction studies.[2]

About 3.8% people may be diagnosed with CTS on a clinical basis and 2.7% population is diagnosed electrophysiologically.[1] Recent data shows that the incidence of CTS has increased from 258 per 100,000 persons per year in 1981-85 to 424 per 100,000 persons per year in the United States. However, it is not clear if this increase was due to better diagnostic facilities and increased awareness of CTS or something else.[3] The course of CTS is random. Sometimes it may occur as continuously deteriorating hand function in patients, while in other patients it may occur as periods of complete painlessness with intermittent exacerbations.[4] There is a huge number of studies describing interventions for CTS, but they have failed to give proper evidence regarding the efficacy of mobilisation and exercise therapy for CTS treatment in improving the hand function.[1]

In patients with mild to moderate CTS, the recommended non-invasive treatments include non-steroidal anti-inflammatory drugs (NSAIDS), modifications in occupational habits, neutral splints, and physical therapy (PT).[5] Pathophysiology of CTS shows a reduction in the gliding motion of the median nerve through the carpal tunnel, excessive stress on the median nerve during upper-limb motions, and possibly fibrosis nerve connective tissue or peripheral median nerve adhesions.[4]

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Pathophysiology has given new insights regarding CTS treatment.[4] During movements of the upper limb, longitudinal gliding of the median nerve takes place. Conversely, it has been observed that in entrapment neuropathy, like CTS, this longitudinal gliding of the median nerve is found to be somewhat limited.[4] Furthermore, scar tissue, adhesions and fibrosis of connective tissue may hinder the gliding of the nerve and adaptation of the nerve in certain movements and postures. This leads to motion limitation of proximal nerve areas near roots relative to the surrounding compartment along with decreased intra-nerve fibre and intra-fascicle sliding.[4]

Different important and commonly used non-invasive treatments of CTS include wrist immobilisation using a splint, and different PT interventions to reduce inflammation, ache and oedema. But all of these interventions fail to restore normal hand functions.[1,4,6] For the treatment of entrapment neuropathies, a new technique, neuromobilisation, has recently been increasingly used. It is performed using a combination of passive and voluntary movements that aim at recovering normal physiological and mechanical functions of the nerve during limb motions and commonly used postures.[1,4,6] Different studies have investigated non-invasive treatments of CTS, including a few which used neuromobilisation technique as a treatment intervention which have provided conflicting results. A recent systematic review concluded that the use of nerve gliding, when used alone or combined with other therapies, resulted in more improved pain intensity, pain threshold, and recovery in hand function in CTS patients compared to other therapies.[7] On the other hand, no appreciable variation was seen by Akalin et al.[8]

An unusual tension in the subsequent nerve is produced by any disease or pathology which results in the reduction of nerve motion and routine strain during general postures and extremity movements. The key point in the management of CTS is that the treatment protocol should consider all relevant structures surrounding the nerve.[1,9] Consequently, a successful neuromobilisation plan for treating CTS would comprise particular neuromobilisation techniques, widening of the carpal tunnel, and flexor tendon gliding exercises. Additional interventions might have been ignored by previous studies.[10]

The current study was planned to assess additional benefits of neuromobilisation along with conventional treatment in improving the functional status in CTS patients.

Patients and Methods

The prospective, double-blind randomised controlled trial (RCT) was conducted from August 2018 to June 2019 at the PT outdoor clinic of Mayo Hospital, Lahore, Pakistan. After approval from the institutional ethics review committee, the sample size was calculated in light of the findings of an earlier study.[11] Since that study had not reported standard deviation (SD) and there was no other study available, the current study assumed SD = 1. The sample size was calculated for testing two independent means (two-tailed test) using the following formula:[12]

$$n_1 = \frac{(z_{1-\alpha/2} + z_{1-\beta})^2\,[\sigma_1^2 + \sigma_2^2/r]}{\Delta^2}$$

$$r = n_2/n_1,\ \Delta = \mu_1 - \mu_2$$

Where mean in Group 1 (μ_1) = 2.20, assumed SD (σ_1) = 1.00; mean in Group 2 (μ_2) = 2.90, assumed SD (σ_2) = 1.00; ratio (r) = 1.00; alpha (α) = 0.05, Z (0.975) = 1.959964; and beta (β) = 0.200, Z (0.800) = 0.841621.

The sample was raised using convenience sampling technique. Those included were patients of either gender aged 20-45 years with <3-month CTS history. The participants were excluded if they suffered from any systemic or musculoskeletal pathology of the involved extremity; if they had been suffering from CTS for >3 months; if they had severe to extreme CTS symptoms; if they had history of any surgery or corticosteroid injection treatment for CTS; if they had any sensory or motor deficit in the ulnar or radial nerve, recurrent CTS, and median nerve involvement above the wrist.

The patients were screened by an independent assessor and were randomised control Group 1 and experimental Group 2 using the envelope method. The randomisation was stratified by another person who was contacted after the initial allocation so that the randomisation may be secured and concealed. The participants and the treatment-giving therapists were not blinded, while the assessor and the biostatistician were blinded.

Diagnosis of mild to moderate severity of CTS was confirmed using physical tests and electroneuromyography. Functional limitation was measured using the Boston Carpal Tunnel Syndrome Questionnaire (BCTSQ) which has two subscales: symptoms severity scale (SSS) and the functional status scale (FSS).[13]

Group 1 received conservative treatment comprising ultrasound therapy, using pulsed mode 0.8W/cm^2 and frequency 1MHz[14], as well as wrist-splinting and tendon-gliding exercises, while Group 2 received the same treatment with the addition of neuromobilisation, which included passive neuromobilisation of the median nerve and functional self-exercises. The procedure started with the patient in the supine position. The following steps were taken in sequence: shoulder girdle depression; slight abduction of the elbow extension with arm lateral rotation and forearm supination; wrist, finger and thumb extensions were added; and the shoulder was taken into further extension. To apply maximum stretch opposite cervical side flexion was done, and, in the end, the wrist was repeatedly moved into and out of stretch by performing a few degrees of flexion and extension at the wrist.[15]

Both the groups were treated by a physical therapist for 2 sessions a week for 6 weeks. Clinical data was noted at baseline, after 3 weeks of treatment, and finally at the end of the 6-week intervention.

Data was analysed using SPSS 21. Mean ± standard deviation were used for quantitative data, and frequencies and percentages for qualitative data. Also, pp-plot and qq-plot were used along with the one-sample Kolmogrov Smirrnove test to check data normality. As the data was normally distributed for comparison of quantitative variables in the groups, independent sample t.test was applied at each follow-up separately. Multivariate repeated-measure analysis of variance (ANOVA) was applied to compare quantitative data within and between the groups. $P<0.05$ was taken as significant.

Results

Of the 66 patients, there were 33(50%) in Group 1; 3(9.1%)

Table-1: Baseline inter-group categorical variables.

Study group of participants		Frequency	Percent
Gender of the Participant			
Routine Physical therapy group	Male	3	9.1
	Female	30	90.9
Neuromobilisation group	Male	2	6.1
	Female	31	93.9
Marital Status of participant			
Routine Physical therapy group	Married	29	87.9
	Single	4	12.1
Neuromobilisation group	Married	24	72.7
	Single	9	27.3
Socioeconomic status of participants			
Routine Physical therapy group	Upper class income above 50000	8	24.2
	middle class incomes between 20000 to 50000	20	60.6
	lower income class income below 20000	5	15.2
Neuromobilisation group	Upper class income above 50000	10	30.3
	middle class incomes between 20000 to 50000	20	60.6
	lower income class income below 20000	3	9.1
Occupation of participants			
Routine Physical therapy group	sedentary worker	12	36.4
	labourer	2	6.1
	House wife	16	48.5
	Any other	3	9.1
Neuromobilisation group	sedentary worker	5	15.2
	labourer	3	9.1
	House wife	20	60.6
	Any other	5	15.2
Affected side			
Routine Physical therapy group	Right	16	48.5
	Left	17	51.5
Neuromobilisation group	Right	21	63.6
	Left	12	36.4
Does the person perform any vigorous activity			
Routine Physical therapy group	Yes	10	30.3
	No	23	69.7
Neuromobilisation group	Yes	8	24.2
	No	25	75.8

Table-2: Baseline inter-group comparison.

Study group		Mean ± Std. Deviation
Routine Physical Therapy Group	Age of the participant	37.79±5.91
	Weight of the Patient	69.22±8.62
	Height(m)	1.5837±0.063
	BMI	27.74±4.18
	Pre-treatment Median Nerve Latency	4.56±0.893
	Pre-treatment SSS Index	2.70±0.585
	Pre-treatment FSS Index	2.83±0.640
Neuromobilisation group	Age of the participant	35.58±7.15
	Weight of the Patient	68.54±9.63
	Height (m)	1.62±0.062
	BMI	26.20±4.53
	Pre-treatment Median Nerve Latency	4.32±0.740
	SSS pre Index	2.55±0.412
	FSS pre Index	2.59±0.643

BMI: Body mass index, SSSL Symptoms severity score, FSS: Functional status score.

Table-3: Mean values of study variables along with intra- and inter-group comparisons across the study period.

	Routine Physical Therapy Group				Neuromobilization Group				P-value for between the Group Difference
	Pre-treatment Mean±Std. Dev.	After 3rd Week Mean±Std. Dev.	After 6 weeks Mean±Std. Dev.	P value	Pre-treatment Mean±Std. Dev.	After 3rd Week Mean±Std. Dev.	After 6 weeks Mean±Std. Dev.	P value	
SSS Index	2.70±0.58	1.72±0.60	0.99±0.66	.000	2.55±0.41	1.56±0.40	0.73±0.33	.000	.048
FSS Index	2.83±0.64	2.18±1.96	1.04±0.58	.000	2.59±0.64	1.49±0.42	0.75±0.35	.000	.017

males, 30(90.9%) females, overall mean age 37.79 ±5.91 years. The remaining 33(50%) were in Group 2; 2(6.1%) males, 31(93.9%) females, overall mean age 35.58 ±7.15 years (Table-1). At the end of the 3rd week, there were 9(13.63%) dropouts; 5(55.5%) from Group 1 and 4(44.4%) from Group 2. They were replaced with new participants.

There was no significant difference between the groups at baseline (Table-2).

Both the groups showed significant improvement ($p<0.05$), but the addition of neuromobilisation in Group 2 showed better results compared to Group 1 ($p<0.05$) (Table-3).

Discussion

Although routine PT did improve signs and symptoms of CTS significantly, the addition of median nerve mobilisation significantly enhanced the results in the current study. Earlier studies have shown that neuromobilisation improves pain symptoms and hand function[6,9], but contrasting findings are also available.[16] The current findings negate the notion as it found significantly better results with neuromobilisation, which is in line with a study that reported better long-term effects of neuromobilisation compared to other techniques.[17] A CTS case study concluded that there were significant improvements in median nerve distal sensory and motor latencies in patients having symptom duration of 8 months by treating with ultrasound in 20 sessions.[18] On the other hand, any underlying pathology that causes physiological and structural damages, such as demyelination and axonic damage, is indicated by abnormal electrophysiological findings.[19] In the current study, though pre-treatment electrophysiological parameters were measured, no post-treatment electrophysiological data was collected due to which post-treatment changes in electrophysiological properties of the median nerve could not be measured.

A similar study that measured the effect of neuromobilisation on CTS in a 4-week treatment protocol found that conventional treatment more significantly improved sensory symptoms compared to neuromobilisation along with conventional treatment which more significantly improved functional status and median nerve latencies.[4] However, the current study found that neuromobilisation improved both sensory and functional outcomes more significantly compared to the routine treatment. This difference is maybe due to the difference in treatment length as the treatment in this study was given for 6 weeks.

The current study has limitations. The sample was raised using convenience sampling technique which is not a very preferable option due to the risk of biases. The sample size was small and simple replacement of those who dropped out could have resulted in a change in findings. The study used manual muscle testing for muscle strength which resulted in similar results in both groups. The use of an electronic muscle strength meter could have given better results. The current RCT was registered retrospectively. The study was done at a single centre, and it was not possible to completely blind the therapists. Finally, owing to lack of funds post-treatment electromyography and nerve conduction studies could not be done.

Future studies should explore the matter in an organised manner.

Conclusion

Routine PT improved the symptom severity and functional status in CTS patients, but the addition of neuromobilisation improved the parameters significantly more compared to routine PT.

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Conflict of Interest: None.

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