

# Effect of Neurodynamic Technique on Paraesthesia and Nerve Conduction Velocity in Carpal Tunnel Syndrome: An Interventional Study

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**Abstract:** ***Background:** CTS is a musculoskeletal disorder associated with work activity in the affected individuals, which is caused by strain and repetitive activity, making it a common problem across Globe. Neural mobilization is a manual therapy treatment that alters the physiological properties of nerves, the primary mechanical event in the nervous system is the movement of the neural structures relative to their adjacent tissues. The Semmes Weinstein Monofilament Test, also referred to as the Touch Threshold Test, is one of the clinical tests that measures the response to a touching sensation of the monofilaments using a numerical quantity. Nerve conduction studies (NCS) are objective measures to quantify sensory and motor nerve conduction velocity. **Method:** Total 30 patients were divided into two groups randomly by chit method. Group A (Interventional) received Neurodynamic technique plus conventional treatment while Group B (Conventional) received conventional treatment only. Participants received treatment for 3 days per week for 4 weeks. Both groups were screened at 4 weeks for sensation and nerve conduction studies and analysis was done using spss version 20. **Conclusion:** In present study Group A (Interventional) showed more clinically as well as statistically significant effect than Group B (Conventional) hence the study have accepted the Alternate Hypothesis and Rejected the Null Hypothesis. Thus, It can be concluded that Neurodynamic technique is effective in improving paraesthesia and nerve conduction velocity in individuals with carpal tunnel syndrome.*

**Keywords:** Carpal tunnel syndrome, neurodynamic technique, paraesthesia, nerve conduction velocity

## 1. Introduction

Carpal tunnel syndrome is the common condition that causes numbness, tingling, and pain in the hand and forearm. The condition occurs when one of the major nerves to the hand — the median nerve.<sup>(1)</sup> An estimated 5% of people suffer from CTS worldwide, with the most susceptible population being elderly individuals aged between 40 and 60 years<sup>(2)</sup>. Untreated carpal tunnel syndrome commonly gradually deteriorates with increasing frequency of numbness and tingling and sleep disturbance. The tingling becomes constant and then progresses to numbness. This change (from constant paraesthesia to numbness) may be perceived by the patient to be an improvement on the basis of reduced discomfort<sup>(3)</sup>. Neural mobilization is a manual therapy treatment that alters the physiological properties of nerves, the primary mechanical event in the nervous system is the movement of the neural structures relative to their adjacent tissues. This is also called excursion, or sliding, and occurs in the nerves longitudinally and transversely<sup>(4)</sup>. Many studies revealed that NM reduces intraneural oedema, improves intraneural fluid dispersion, reduces thermal and mechanical hyperalgesia, and reverses the increased immune responses following a nerve injury<sup>(5)</sup>.

Nerve conduction studies focus on defining whether there has been damage to the median nerve inside the carpal tunnel to quantify the severity of this nerve damage using a scale and to define the physiology of this injury as a conduction block, demyelination or axonal degeneration<sup>(6)</sup>.

## 2. Material and Methods

Ethical clearance was taken from committee. All the patients were screened from orthopaedic OPD on the basis of Inclusion criteria. Only the patients who fulfil all the inclusion

criteria were included in this study. Total 32 participants were recruited and were randomly allotted to their respective groups. Group A (n=16) A received Neurodynamic technique (Slider with opener technique) along with Conventional treatment While Group B (n=16). Received Conventional treatment only. Baseline data were taken before starting the intervention. Outcome measures taken were Semmes Weinstein Monofilament test to measure sensation and Nerve Conduction study to measure median nerve distal latency and conduction velocity. Both the groups received intervention for 4 weeks. After 4 weeks of Interventions, both the Outcomes SWMT and NCS were measured again.

### Declaration:

- No conflict of interest.
- No financial burden on subject.
- If financial burden will be there, seen by researcher.
- Approval of Ethics committee was taken. [Registration No. GSIIESC/57/22]

**Study Design:** Interventional Study

**Study Setting:** Orthopaedic OPD and Physiotherapy college, Ahmedabad.

**Study Duration:** One year

**Sampling Technique:** Convenient Sampling Method (Chit method) SAMPLE SIZE = Effective sample size / (1-non-Response rate anticipated)

**Sample Size:** 32 The sample size was calculated with the formula given:

$$n = (Z\alpha/2 + Z\beta)^2 \times 2 \times \sigma^2 / d^2$$

**Inclusion Criteria:**

- Willingness to participate
- Greater than 20 years of age
- Unilateral CTS
- Positive Phalen's maneuver
- Positive NCV study (DML >4.4 ms)
- Conservatively treated patients
- Mild - Moderate CTS.

**Exclusion Criteria:**

- History of any surgery in affected hand
- History of orthopaedic or neurovascular condition.

**Withdrawal Criteria:**

- If patient wants to withdraw himself/herself from this study.
- If patient has worsening of neurological symptoms.

**Materials And Equipments:**

- Consent form
- Assessment form
- Pen and paper
- Plinth
- Chair
- Cushion
- Ultrasound Machine
- Monofilament test kit (Semmes Weinstein Monofilament)
- NCV set-up
- Certificate of Clinical Neurodynamics

**Slider Technique** <sup>(4)(7)</sup>

**Frequency:** 12 sessions in 4 weeks (3 session in a week)

**Intensity:** 3 to 4 set for 5 to 30 repetitions

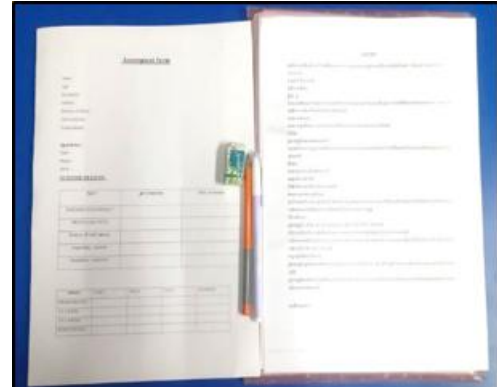
**Type:** Neurodynamic technique

**Time:** 15 to 20 minutes per session

**Opener Technique** <sup>(4)</sup>

It is interface opening techniques that produce an opening action around nervous system and consist of movement of joint, muscles and fascia. Static opener remains in open position for certain period of time. This enables blood flow to

return to neural tissue so that oxygenation is improved. Treatment of this condition through the mechanical interface are directed at normalizing pressure dysfunction on the nervous system. Static Opener is maintained for approximately **30-60 seconds for 3 repetitions** for every session and then progression will be according to patient's tolerance.

**Figures**

**Photograph 1:** Assessment form



**Photograph 2:** NCV SET-UP (RMS EMG EPK MK II MACHINE)



**Photograph 3:** Monofilament



**Photograph 4:** Ultrasound machine



**Photograph 6:** Neurodynamic Technique: Ppener

**Conventional treatment:**



**Figure 1:** Elbow extension with wrist flexion



**Photograph 7:** Patient receiving



**Figure 2:** Elbow flexion with wrist extension



**Photograph 8:** Patient performing active exercise  
ultrasound machine

**Photograph 5:** Neurodynamic technique: Slider



**Photograph 9:** Assessing motor nerve study for median  
nerve

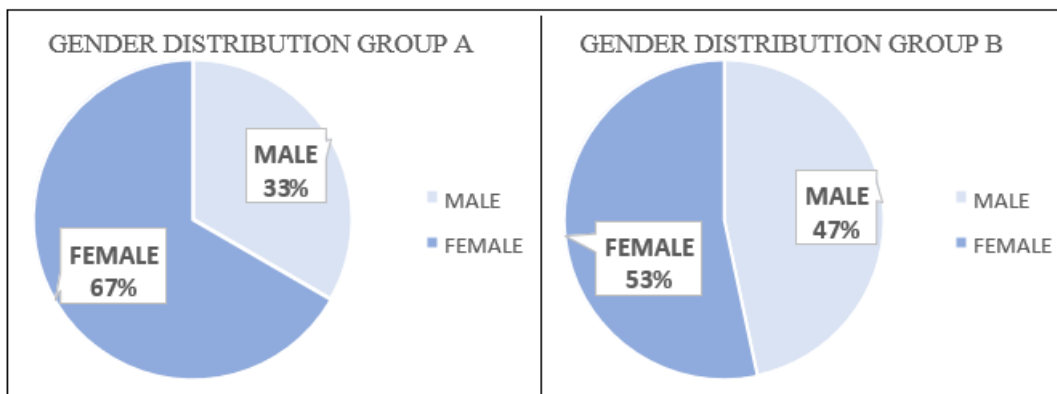


**Photograph 10:** Assessing using 0.18g force monofilament (3.22-blue)

## Tables

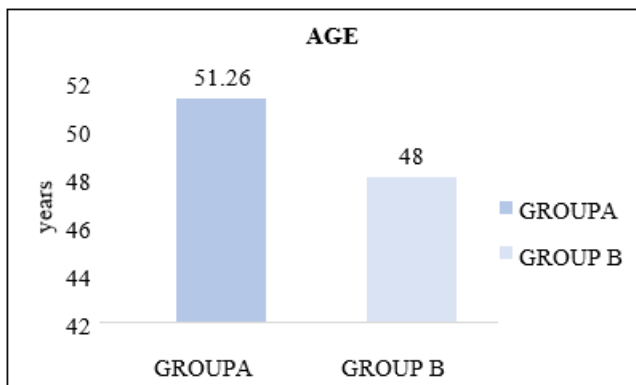
**Table 1:** Test of Normality (Shapiro wilk test)

Variable	Group A (n=15) (Mean + SD)	Value (Group A)	Group B (n=15) (Mean + SD)	Value (Group B)
Age (years)	51.26 ± 8.02	0.618	48.00 ± 8.44	0.395
Duration (months)	8.53 ± 3.66	0.003	9.13 ± 2.58	0.161
Monofilament (score)	3.53 ± 0.49	.063	3.65 ± 0.46	0.090
Distal Latency (ms) (Sensory)	3.32 ± 0.39	0.891	3.58 ± 0.39	0.070
Distal Latency (ms) (Motor)	4.70 ± 0.26	0.046	4.78 ± 0.25	0.258

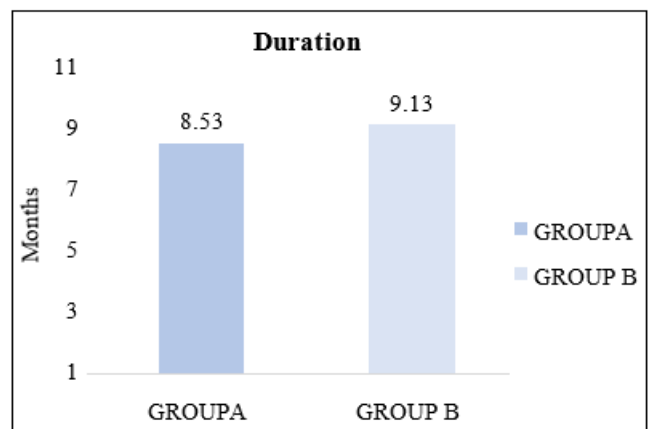


**Graph 1 (a):** Gender distribution in Group A

**Graph 1 (b):** Gender distribution in Group B



**Graph 2:** Mean Age(years) of participants in both groups



**Graph 3:** Mean Duration (months) in both group



**Table 5 (a):** Baseline characteristics under normal distribution (Independent T test)

Outcome Measure	Group A (n=15) (Mean $\pm$ SD)	Group B (n=15) (Mean $\pm$ SD)	T Value	P Value
Age (years)	51.26 $\pm$ 8.02	48.00 $\pm$ 8.44	1.086	0.287
Monofilament (score)	3.53 $\pm$ 0.49	3.65 $\pm$ 0.46	- 0.707	0.486
Distal sensory latency(ms)	3.32 $\pm$ 0.39	3.58 $\pm$ 0.39	- 1.795	0.083
Motor nerve conduction velocity(m/s)	55.27 $\pm$ 3.82	54.08 $\pm$ 2.37	1.023	0.315

**Table 5b:** Baseline characteristics under not normal distribution (Mann Whitney test)

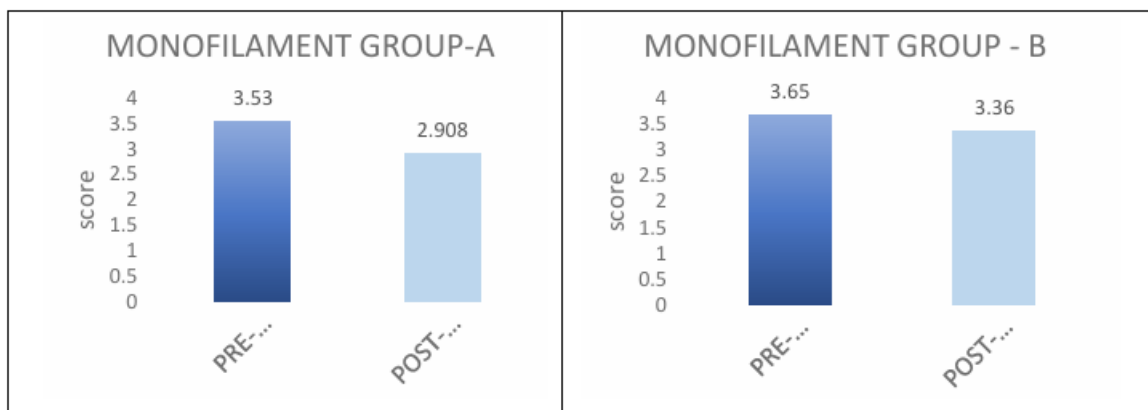
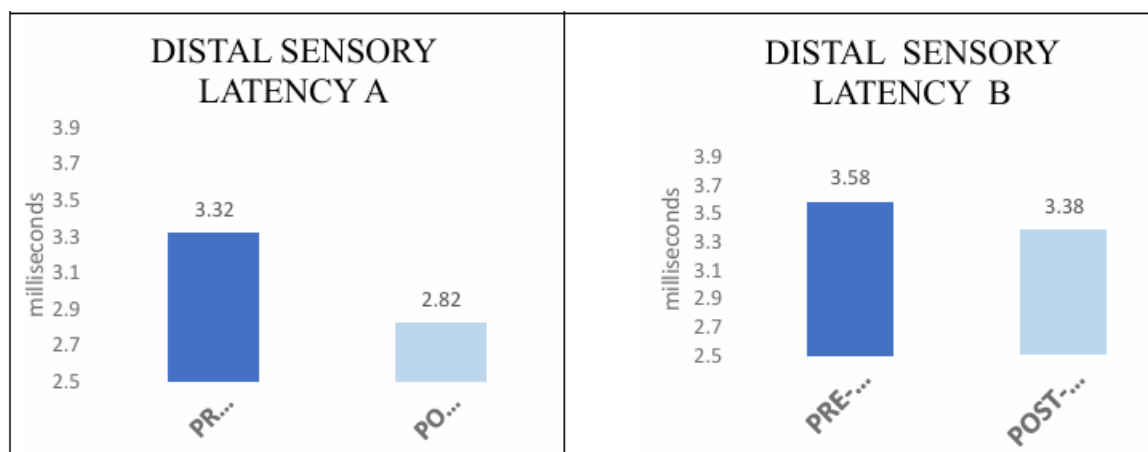
Outcome Measure	Group A (n=15) (Mean $\pm$ SD)	Group B (n=15) (Mean $\pm$ SD)	T Value	P Value
Distal Motor Latency (ms)	4.70 $\pm$ 0.26	4.78 $\pm$ 0.25	90.50	0.367
Duration (Months)	8.53 $\pm$ 3.66	9.13 $\pm$ 2.58	89.00	0.318

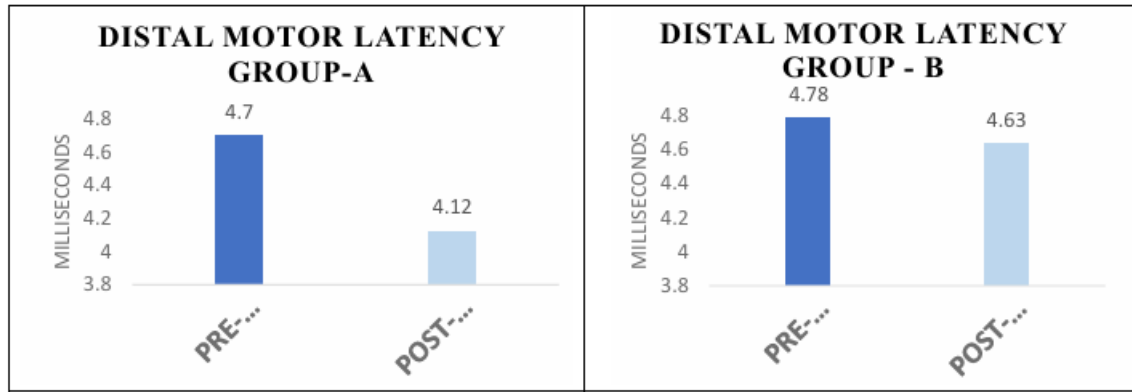
### 3. Results

All the p values of the baseline characters were **>0.05** which signifies that there was no statistically significant difference among the variables between two groups at the baseline.

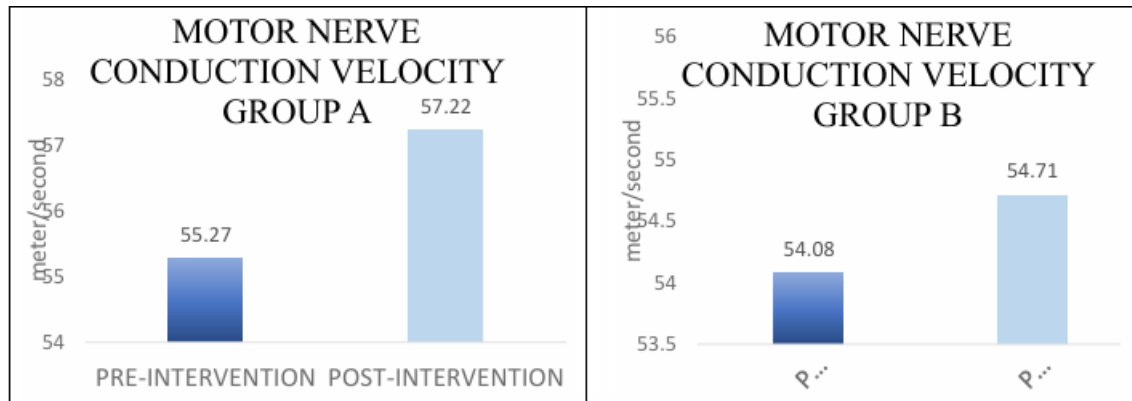
#### Within Group Analysis

**Paired T test** was used as data was normally distributed for monofilament, distal sensory latency and motor nerve conduction velocity. Wilcoxon test was used for distal motor latency as data was not normally distributed.

**Graph 4:** Mean of Monofilament(score) test Within Group A and Group B**Graph 5:** Mean of Distal Sensory Latency (ms) Within Group A and Group B



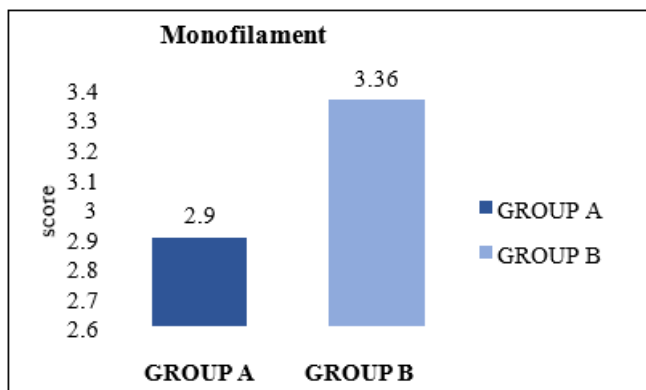
**Graph 6:** Mean of Distal Motor Latency (ms) Within Group A and Group B (Wilcoxon test)



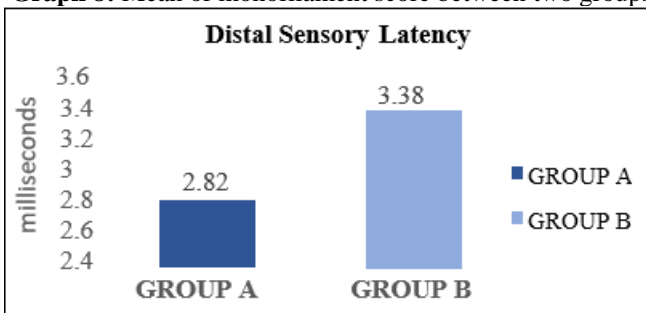
**Graph 7:** Mean of Motor Nerve Conduction Velocity (m/s) Within Group A and Group B

#### Between Analysis

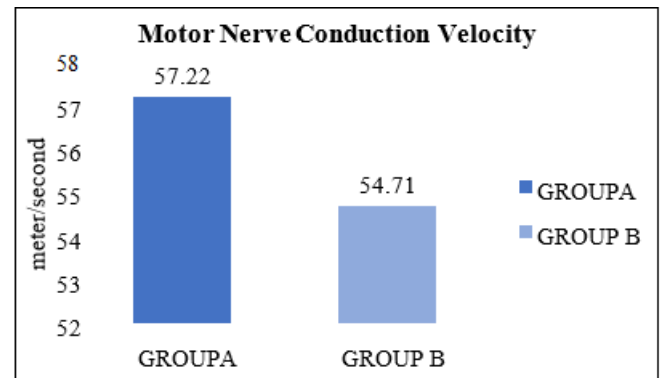
Between group analysis of difference in Monofilament, Distal Sensory Latency and Motor Nerve Conduction Velocity after 4 weeks of intervention was done using **Independent T test**, between group analysis of difference in Distal Motor Latency Velocity was done using **Mann Whitney test**



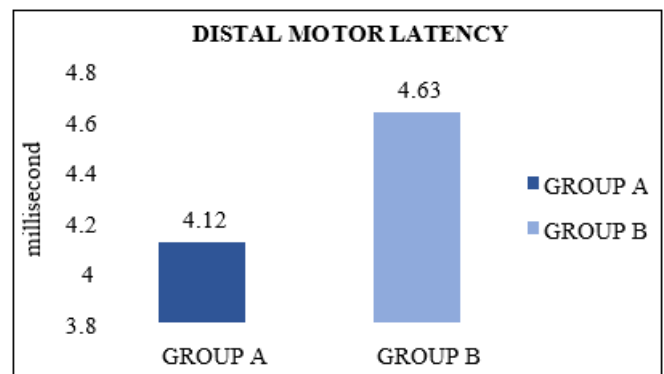
**Graph 8:** Mean of monofilament score between two groups



**Graph 9:** Mean of Distal Sensory Latency between two groups



**Graph 10:** Mean of Motor Nerve Conduction Velocity between two groups



**Graph 11:** Mean of Distal Motor Latency between two groups

**Table 6(a):** Statistical Analysis of Outcome Measure between two groups

Outcome Measure	Group A (Mean $\pm$ SD)	Group B (Mean $\pm$ SD)	T Value	P Value	Effect size Cohens (d) value	Significance
Monofilament (score)	2.90 $\pm$ 0.33	3.36 $\pm$ 0.44	-3.148	0.004	1.17	Large
Distal Sensory Latency (ms)	2.82 $\pm$ 0.37	3.38 $\pm$ 0.37	-4.107	0.000	1.48	Large
Motor Nerve Conduction Velocity (m/s)	57.22 $\pm$ 4.12	54.71 $\pm$ 2.25	2.070	0.048	0.47	Medium

**Table 7 (b):** Statistical Analysis of Distal Motor Latency between two groups

Outcome Measure	Group A (Mean $\pm$ SD)	Group B (Mean $\pm$ SD)	U Value	Z Value	P Value	Effect size (r) value	Significance
Distal Motor Latency (ms)	4.12 $\pm$ 0.51	4.63 $\pm$ 0.28	49.500	-2.614	0.009	0.47	Medium effect

## 4. Discussion

The Present Study was designed to study effects of Neurodynamic Technique on Paraesthesia and Nerve Conduction Velocity in Carpal tunnel Syndrome.

Total 30 patients with unilateral Carpal Tunnel Syndrome were included in this study according to the inclusion and exclusion criteria. After taking informed written consent, subjects were divided into two groups by chit method and given allocated intervention for 4 weeks. Group A received Neurodynamic technique along with Conventional treatment While Group B received Conventional treatment only. Pre and Post Assessment done by Monofilament, Distal sensory and motor latency and motor nerve conduction velocity of median nerve by Nerve Conduction Studies (NCS) were taken and analysis was done using Spss version 20.

At the end of Four weeks of treatment; patients in both groups showed improvement in Sensation (Monofilament) and Median Nerve Conduction Studies. The result showed a statistically significant difference for both the outcome measures between Group A and Group B. Also According to Cohen's d or r value, there is a statistically large effect size seen on Monofilament (SWMT) and Distal Sensory Latency While Medium effect on Distal Motor Latency and Motor Nerve Conduction Velocity in Group A (Interventional) compared to Group B (control).

In Present study the attempt was made to measure the effect of nerve mechanics by performing neurodynamic technique to affect the nerve physiology as measured by the latency and velocity of median nerve. As already mentioned by **Shacklock et al.** which shows the interconnection between nerve mechanics and physiology. Mechanical factors such as tension, compression, or traction of neural tissue influence physiological responses in intraneural blood flow, axonal transport, mechanosensitivity, and sympathetic evaluation<sup>(4)</sup>

During Within group Analysis of Group B (Control group) results showed Significant difference in post values of all the outcome measures. This might be due to biophysical effects of Ultrasound due to antiinflammatory effect that facilitate recovery from nerve compression<sup>(9)</sup> The micro massage effect of ultrasound occurs at cellular level attributed for reduction of oedema therefore helps to remove the unnecessary exudate hence reduce the danger of adhesion formation. Exercises that specifically target median nerve movement have been shown to increase nerve excursion without straining it hence, it could have facilitated patient's adherence and therefore led to improvement.<sup>(10)</sup>

There was also statistically significant group difference in Between group analysis of Monofilament, Distal Motor and sensory latency and motor nerve conduction velocity of two groups where improvement in Interventional group shows superiority than conventional group the reason for this is the neurodynamic technique mechanism which facilitates intra-neural blood flow indirectly fastens the conduction velocity and tissue health .This technique focuses on both neural as well as mechanical interface between median nerve and soft tissue , whereas Conventional treatment focus only on interface dysfunction and treating for same without mobilization of nerve .

Hence, the outcome measures of this study are supported by all scientific evidences.

## 5. Conclusion and Clinical Implication

In present study Group A (Interventional) showed more clinically as well as statistically significant effect than Group B(Conventional) It can be concluded that Neurodynamic technique is effective in improving paraesthesia and nerve conduction velocity in individuals with carpal tunnel syndrome .Neurodynamic technique focusing on neural as well mechanical interface (Slider as well opener) can improve sensory and motor function along with conventional treatment hence it is one of the important intervention to be considered in routine physiotherapy treatment protocol for carpal tunnel syndrome individuals.

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